Applying evolutionary principles to the obesity problem and other issues in public health

Simon Russell

A thesis submitted in partial fulfilment of the requirements of Liverpool John Moores University for the degree of Doctor of Philosophy

July 2017

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to Prof Harry Sumnall, Jim McVeigh and Dr Conan Leavey for their continued support and guidance during my PhD. Given the countless challenges I encountered over the last six years, I may not have completed this work without their patience and encouragement. I would like to thank Prof Mark Bellis, Prof Peter Wheeler, Prof Karen Hughes and Dr Penny Cook for giving me the opportunity to carry out this work and for their supervision. I would like to thank the participants of this research, particularly those who acted as primary and secondary seeds, and without whom this research would not have been possible. I would also like to thank Mark Whitfield for being a great boss and showing such understanding during the writing up of this work. Finally, I would like to thank my family and friends who have each contributed to this work in a variety of ways. In particular, Penny Russell for her help in proofing this thesis, Karen Critchley for checking the data tables and Emma FitzGerald for her spiritual guidance and companionship.

The publication given below is related to this thesis and would not have been possible without the research of this PhD:

- Russell, S.J., Hughes, K. and Bellis, M.A. (2016). Impact of childhood experience and adult well-being on eating preferences and behaviours. BMJ Open http://bmjopen.bmj.com/content/6/1/e007770.

ABSTRACT

Obesity is a complex condition that affects all age groups and socioeconomic strata and places significant burdens on health and social care systems in both developed and developing countries. Overeating and a lack of exercise, along with smoking and high alcohol use, are the most common causes of non-communicable diseases, which account for almost two-thirds of global deaths each year. This programme of PhD research aimed to better understand dietary and other health risk behaviours by considering the influence of evolutionary behavioural strategies, while controlling for other determinants of health risk behaviours, including childhood experience and socioeconomic variables. In the first study, young adults (n=393; aged 18-30 years) completed a bespoke self-report questionnaire and provided data on their developmental experiences and their socioeconomic environments, in addition to a range of behavioural choices and evolutionary strategies (e.g. reproductive behaviour). In the second study, a secondary analysis of the second iteration of the North West Mental Well-being Survey (NWMWBS) 2012/13 was undertaken to supplement findings from study 1. These studies were analysed using regression analysis and Latent Class Analysis. Across both studies, there was a clustering of risk behaviours. Adverse childhood experiences and lower socioeconomic status were found to be predictive of health risk behaviours, including unhealthy eating, binge drinking and smoking cigarettes. Various evolutionary behavioural strategies were found to be predictive of health risk behaviours. Reproductive strategy was found to be predictive of BMI; health offsetting was found to be predictive of risky eating behaviour and physical activity; investing behaviour was found to be predictive of BMI, general health risk taking, binge drinking, current daily smoking, and violence; altruism was found to be predictive of eating preference; trust was found to be predictive of general health risk taking, current daily smoking, and physical activity; cooperation was found to be predictive of current daily smoking; and, planning behaviour was found to be predictive of current daily smoking, and risky sexual practices. Overall, the research suggests that childhood experiences and socioeconomic inequality are key determinants of behavioural strategies, and that such strategies are likely to be adaptive.

CONTENTS

List of Tables

List of Figures

1. INTRODUCTION

1.1 Public health and non-communicable diseases

A founding principle of public health is that disease is a biological process arising from social conditions and that our success in promoting good health depends on manipulating the conditions in which people live (Rosner and Fried, 2010). There is an increasing influence of non-communicable diseases (NCDs), such as heart disease, type-2 diabetes, strokes and cancers, on morbidity and mortality (Martin and William, 2008); NCDs account for two-thirds of global deaths each year (WHO, 2017). Preventable NCDs (Jamison et al., 2006) are reaching epidemic proportions (Lopez et al., 2006) and are most commonly caused by overeating, smoking, lack of exercise and high alcohol use (Rosner and Fried, 2010; Daar et al., 2007). This research aims to add to the understanding of health risk and pathology-inducing behaviours by analysing strategic choices which underpin them, and interpreting these strategies using evolutionary principles. Various health risk behaviours are considered, including drinking alcohol and smoking cigarettes; however, a particular focus is given to eating behaviours, and other choices affecting imbalances between energy intake and expenditure, which lead to overweight and obesity.

1.2 The obesity problem

The World Health Organization (WHO) has described obesity as a complex condition that affects all age groups and socioeconomic strata and threatens to overwhelm both developed and developing countries (WHO, 2014). While obesity is a preventable health problem, in 2008 there were 1.5 billion adults (over 20 years of age) globally who were overweight (with a body mass index [BMI] of 25-29.9kg/m2) or obese (with a BMI of >=30 kg/m2). Of those obese, 200 million were men and 300 million were women (WHO, 2013). The prevalence of overweight and obesity in populations is increasing (Ebbeling, Pawlak and Ludwig, 2002) and trends project 65 million and 11 million more obese adults in the United States (US) and the United Kingdom (UK) respectively by 2030 (Wang et al., 2011). Currently, 65.0% of the world's population live in countries where more people are killed by being overweight or obese than by being underweight (WHO, 2013). In the US in 2010, two-thirds of adults (Flegal et al., 2010) and nearly one-third of children (Ogden et al., 2010) were overweight or obese. In the UK in 2012, 23.0% of adults were obese and 61.3% were either overweight or obese. Among children, 23.1% of four to five year-olds and 33.3% of 10 to 11 year-olds were overweight or obese (DoH, 2011).

The global obesity epidemic was described by the United States Surgeon General in 2002 as the "*greatest threat to public health today*" and was reported to "*kill more Americans every year than*

AIDS, all cancers, and accidents combined" (US Department of Health and Human Services, 2010). Obesity increases the risk of type-2 diabetes, cardiovascular diseases and several forms of cancer (Wang et al., 2011) and can also cause respiratory difficulties, chronic musculoskeletal problems, depression, relationship problems and infertility (FPH, 2010). Projected trends for the US and UK combined estimate an additional 6 to 8.5 million cases of diabetes, 5.7-7.3 million cases of heart disease and stroke and 492,000 to 669,000 cases of cancer by 2030 (Wang et al., 2011). The costs directly attributable to obesity are $61 billion per year in the US (Stein and Colditz, 2004) and £5.1 billion per year in the UK (DoH, 2011).

1.2 Rationale for this study

Since obesity is rapidly increasing in genetically stable populations, the epidemic can be primarily attributed to environmental factors (Ebbeling, Pawlak and Ludwig, 2002). While genes may increase the risk of weight gain, heredity may have less influence on the obesity epidemic than environmental factors (Ebbeling, Pawlak and Ludwig, 2002), including changes in the global food system, which is producing more processed, affordable and effectively marketed food than ever before (Gortmaker et al., 2011). In modern contexts, energy rich, highly palatable food and drink is plentifully available and the energy required to obtain this food and drink has been reduced (Prentice and Jebb, 2004). Behaviour such as overeating, excessive consumption of alcohol or physical inactivity causes overweight and obesity by creating a chronic energy imbalance between dietary intake and physical expenditure. The tendency for over-consumption is likely to have been of selective value to ancestral hominids living in seasonal environments with variable food availability (Neel, 1962; Ulijaszek, 2002) and, where the ability to obtain food was variable owing to ill health, ageing or injury. If physiological and psychological factors urge an individual to eat, weight regulation requires higher cognitive control (Ulijaszek, 2002).

Choices and behaviours relating to diet, exercise, drinking alcohol and smoking affect many aspects of health but particularly risk factors for NCDs. Research often focuses on particular health behaviours but multiple health behaviours can act synergistically (Ottevaere et al., 2011); for example, the choice to eat foods rich in sugar and fat, coupled with the choice to disengage from physical activity or exercise, is likely to lead to higher levels of surplus energy in the body than either of those choices in isolation. Cycles of harm can be created; for example, overweight or obesity leads to decreased physical activity, and subsequently, mental health conditions such as depression may be created or exacerbated. This in turn may lead to an increase in alcohol consumption, and a further reduction of physical activity, all of which greatly amplify the effects of any one of these issues in isolation.

In modern contexts, there are biological and physical determinants of dietary preferences and behaviours, which primarily relate to hunger, appetite, taste and access to different foods. There are also a variety of social and cultural determinants of dietary preferences and behaviours, including socioeconomic factors and cultural influences, such as beliefs and values (Taylor and Repetti, 1997). There are also plastic (changeable or adaptable) psychological determinants of diet choice, particularly relating to mood, stress and general temperament. These short and long term determinants interact and create complex pressures on individuals which shape and guide eating and other health behaviours.

Evolutionary theory predicts that an individual acts to optimise their behaviour in order to maximise their reproductive output and there are various heritable physical and behaviour traits which directly or indirectly contribute to reproductive output (Lewontin, 1968; Demetrius and Ziehe, 2007). For example, behaviour traits contribute to health and survival, which contribute directly to evolutionary fitness in terms of sexual selection and reproductive selection, and in terms of the ability to acquire resources and benefit from social success, both of which are directly associated with reproductive success (Rogers, 1990; Boorse, 1977). However, the relationship between health and survival, and reproductive success is complex; for example, senescence is directly detrimental to reproduction since natural selection becomes weaker at late ages and the acquisition of longevity incurs costs (Kirkwood and Rose, 1991). Modern environments in developed societies have created further complexities for humans; longer life expectancies, improvements in medicine (including fertility and infertility treatments) and an abundance of food have changed the environmental pressures which shape our behaviour. Hunter gatherers of the past sought to maximise their net rate of energy intake, which had a direct association with the reproductive success of the forager (Krebs, 1978). In modern developed societies, where there is an abundance of food, the consequence of maximising the net rate of energy intake would likely lead to overweight and obesity and associated pathology. This represents a conflict of evolutionary theories where a human would be expected to both maximise foraging success and maximise health, which contributes to evolutionary fitness during early adulthood.

The way humans evaluate and use information in behavioural decision making is the subject of different fields of evolutionary science, including human evolutionary psychology (Daly and Wilson, 1999). Evolutionary psychology works on the premise that the mind is comprised of psychological dispositions that were adaptive in ancestral environments but that our psychology and behaviour has not evolved as quickly as our environments have changed, that our brains cannot keep up with social and cultural change, and that we are now maladaptive in our mismatched surroundings. It is argued in this thesis that our behaviour is plastic and not independent of social and cultural change and, while psychological mechanisms which govern

behaviour are undoubtedly the products of ancestral environments, research that overlooks modern social factors as an integral part of the biological process is incomplete (Barrett, Dunbar and Lycett, 2002). There is also strong evidence that developments in civilisation have greatly accelerated human evolution and that many adaptive mutations, particularly relating to diet and nutrition since the advent of agriculture have created geographic and cultural diversity in the modern world (Cochran and Harpending, 2009). Throughout this thesis, evolutionary principles are applied to psychological mechanisms and behavioural strategies; however, the interpretations are not necessarily in keeping with the school of thought or discipline of 'evolutionary psychology'.

It is well established that environmental pressures influence human behaviour, which is often the result of trade-offs and can be interpreted in terms of adaptive strategies which vary between individuals (Winterhalder and Smith, 2000). For example, the amount an individual is willing to take risks, with health or money, is a trade-off between gaining short-term benefits while incurring long-term costs, and gaining long-term benefits while incurring short-term costs. The optimal or adaptive choices for any individual would be those which maximised net benefits (Day and Taylor, 1996). Communities or groups of individuals are often subject to similar environmental conditions and pressures and would be predicted to exhibit similar behaviours. If a group of individuals live in safe and secure environments they may be likely to make choices which yield benefits in the longer term; conversely an unsafe and insecure environment may be conducive to choices which maximise benefits in the short term since there is less chance that stable conditions will be maintained long term.

However, individuals in similar physical or socioeconomic environments do not always make similar choices (Taylor and Repetti, 1997). Developmental conditions, such as childhood experience, and/or variability in mental well-being, may also contribute to an individual's psychological mechanisms and therefore behavioural choices. For this reason the focus of many health prevention and promotion interventions has shifted from altering environments to attempting to change individual behaviours (Taylor and Repetti, 1997). In terms of obesity, this shift has produced limited success and has contributed to the creation of a culture of individual responsibility for good or bad health which can lead to damaging attitudes of discrediting illnesses (Becker, 1993).

Public health action is essential to address the obesity epidemic, yet policies and strategies to control or prevent obesity are required to account for the complex behavioural patterns and environmental determinants that have caused the problem (Gortmaker et al., 2011). Health programs are often more effective if the characteristics of the target group or individual are

considered and evidence suggests that effective programs which target health behaviours require a multifaceted approach (Spengler et al., 2012). An important facet of this approach may be recognising preferences and physiological mechanisms that may be adaptive given a set of circumstances but that lead to potential pathology. For various reasons (section 2.2.3) we retain innate preferences for calorie rich food, particularly containing sugar and fat (Aiello and Wheeler, 1995; Power and Schulkin, 2009), but there is variability between individuals in how these preferences are allowed to guide behaviour.

This research considers psychological mechanisms from an evolutionary perspective, while attempting to describe the environmental conditions in which they function. It is proposed that strategies and decision making, including those related to health behaviours, depend on adaptively relevant features of the current environment, whether perceived or actual. This research seeks to explore the idea that our behaviours, particularly relating to health, are adaptive in modern contexts, once the environmental conditions, particularly the socioeconomic circumstances, have been understood. Key objectives of this research are to identify what factors determine variation between individuals in terms of health behaviour strategies, and to identify to what extent individuals behave optimally in terms of their diet, health choices and reproductive output. The application of evolutionary principles to health behaviours is meaningful since domain-specific health decisions result in fitness benefits, and seemingly irrational decisions may demonstrate rationality at a deeper evolutionary level (Kenrick et al., 2009).

Interventions to prevent or treat overeating, inactivity and other health risk behaviours may be improved by understanding the formative causes of health behaviour strategies, whether developmental, or perceived/actual environmental conditions. While evolutionary principles have increasingly been applied to many independent disciplines of science (Hendry et al., 2010), the incorporation of evolutionary principles in public health requires a carefully considered integrated approach.

1.3 Applying evolutionary principles to public health

Behavioural strategies, which affect health risk behaviours, are shaped and influenced by environmental conditions (Bateson and Gluckman, 2011); to be effective, individually-targeted preventative health interventions may be required to understand formative environmental influences.

While some behavioural strategies may be plastic and change with current environmental conditions, others, particularly those which are formed during developmental periods, may persist

throughout adulthood (Pechtel and Pizzagalli, 2010). Developmental experiences during childhood and adolescence can have lasting neuro-behavioural consequences (Anda et al., 2005). Once adaptive strategies, such as maximising caloric intake (Danese and McEwen, 2012), may persist into adulthood despite environmental change and may have potentially detrimental consequences for an individual's health (Johnson, Spitzer and Williams, 2001). The influence of developmental environments illustrates the importance of preventative measures in reducing health risk behaviours. Interventions may seek to reduce insecurity and instability during childhood, foster healthy parent-child relationships and provide a stable setting for emotional development during adolescence.

Behavioural strategies are also shaped by subjective perceptions, such as current well-being, which may change depending on various distal and proximal factors (Chartier, Walker and Naimark, 2010; Bellis et al., 2013). The implication may be that choices relating to health can be improved by changing the way an individual feels and how an individual perceives their environment. In the context of this research, individuals whose health behaviours can be predicted by adult well-being could improve their health outcomes with secondary psychological treatments, such as counselling or cognitive behavioural therapy.

Behavioural strategies are also likely to be shaped by socioeconomic conditions; optimal or adaptive strategies are likely to vary between economic gradients or social conditions (Nettle, 2010). While socioeconomic variables are difficult to manipulate, they may be predictive of health risk behaviours, especially for particular demographic groups. Understanding the way an individual perceives their environment may also help in adjusting behaviours to promote healthier lifestyles, including healthier diets.

Evolutionary behavioural strategies themselves may be receptive to manipulation and intervention in order to improve the health outcomes they influence. The degree to which an individual takes health risks, offsets or invests for the good of their health may be adjusted by improving awareness of health behaviour and incentivising longer term gains. Interventions for individuals who are overweight, obese or suffering from other pathologies are likely to be improved by understanding the causes of behavioural strategies that underpin health risk behaviours.

There are a range of other independent variables, the manipulation of which could affect health outcomes and particularly overweight and obesity. These might include obesogenic environments, activity levels, alcohol consumption and food culture, including where and how food is bought and consumed (Ebbeling, Pawlak and Ludwig, 2002; Morland, Diez-Roux and Wing, 2006;

Kilpeläinen et al., 2011; Muraven, Collins and Neinhaus, 2002). Making changes to these independent variables are likely to affect health outcomes; the direction and extent of these influences is discussed in terms of existing evidence.

1.4 Research context

Evolutionary science and public health are extremely diverse and complex sciences. The challenge of this research is sufficiently narrowing the scope of the study to isolate specific relationships between adaptive strategies and health behaviours. There is a further challenge of estimating the variance in health risk behaviour that can be explained by adaptive strategies and contextualising the findings within the broader influences of sociodemographic variables. The identification of relationships between adaptive strategies and health risk behaviours may provide a foundation for further research. Public health responses relating to overweight and obesity require development and improvement. The advancement of knowledge of how evolutionary principles may guide health risk behaviours may be helpful in improving the effectiveness of current interventions and developing increasingly refined approaches.

1.5 Aims and objectives

1.5.1 Aims

- To improve our understanding of the obesity epidemic and other public health problems by applying an evolutionary interpretation. This interpretation is intended to add insight to, and provide a link between, existing known determinants of health risk behaviour, such as developmental experiences and socioeconomic conditions.
- To provide a foundation from which further research may inform and guide public health policies and preventative interventions relating to risky and pathological health behaviours.

1.5.2 Objectives

- To create a questionnaire tool for young adults to record demographics, developmental experiences, socioeconomic environments, a range of health behaviours (including eating behaviours and food choices, drinking alcohol, smoking cigarettes and physical activity) and a variety of behaviours which can be interpreted using evolutionary principles.
- To group theoretically similar variables to create internally consistent indices which represent health behaviours and evolutionary strategies.
- To explore the relationships between indices and demographics, developmental factors, subjective factors, socioeconomics and health behaviour outcomes.

- To create statistical models to demonstrate the independent relationships between demographics, developmental factors, subjective factors, socioeconomics, evolutionary strategies and health behaviours.
- To use a secondary data source to supplement analyses of study 1. Conduct similar explorations of relationships between demographic variables and health outcomes; and, create statistical models to demonstrate the independent relationships between demographics, developmental factors, subjective factors, socioeconomics and health behaviours.
- To use evolutionary strategies and health outcomes to identify behaviourally similar clusters of participants and describe the demographic and socioeconomic characteristics of each cluster. To create statistical models for each cluster to describe how predictive variables differ for each behaviourally distinct cluster.
- To use results to discuss the extent to which health behaviours may be guided by evolutionary strategies, how such strategies may be formed by environmental parameters and describe when adaptive strategies may become detrimental to health.
- To use results to suggest how public health measures, particularly preventative interventions and secondary treatments, could be improved to reduce the risks and harms of overweight, obesity and other health risk behaviours. This might include practical improvements to existing interventions or innovative approaches in the field of public health.
- To provide a platform and generate hypotheses for further research which applies an adaptive interpretation to health risk and pathology-inducing behaviour.

1.6 Hypotheses

The overall hypothesis of this study is that adaptive strategies affect health behaviours, particularly those relating to overweight and obesity. Testing this hypothesis is a priority since overweight and obesity is an increasing problem in terms of health and economic burdens in both the developed and developing world.

This methodology seeks to supplement the evidence that there are associations between health behaviours, such as overeating, and potential pathology, such as overweight and obesity, by comparing indicators for health behaviours with health outcomes among young adults. Similarly, the assumption that health risk behaviours are associated with one another will be tested; specifically that indicators for eating behaviour correlate with other health behaviours, such as drinking alcohol, smoking cigarettes, risky sexual practices and willingness to engage in violence.

Demographic variables, developmental variables (particularly childhood experience), socioeconomic measures and subjective factors (particularly adult well-being), will be explored in terms of their association with adaptive strategies as indicated by behavioural choices. Predictive effects of demographic, developmental, socioeconomic and subjective factors on evolutionary strategies (including reproductive strategy), health and financial risk taking, altruism, cooperation, offsetting and investing behaviours, will also be explored.

It is hypothesised that health behaviours, like other adaptive strategies, are trade-offs between benefits and costs over time, and the optimality of these trade-offs vary depending on environmental conditions. This will be tested by exploring the influence of environmental conditions on evolutionary strategies, and exploring the consequences of behavioural strategies on quantifiable health outcomes.

1.7 Research questions

The first seven research questions were developed from the findings of literature review (sections 2.5, 2.6 and 2.7); the relevance of these research questions to the key aims of the work is discussed in section 10.4. While there is established evidence for these questions, they were important to consider in the context of this work in order to explore links between behaviour and health outcomes, between different health risk behaviours and to provide context for the known determinants of health risk behaviour, particularly demographic, socioeconomic and developmental factors.

- Do health risk behaviours relating to dietary preferences manifest pathology among young adults, primarily as overweight and obesity?
- Are health risk behaviours associated with one another: Are unhealthy dietary preferences and behaviours associated with risky or harmful levels of alcohol use; daily smoking of cigarettes; risky sexual behaviour; violence; and low levels of physical activity?
- Do demographic variables influence health risk behaviours? Do males exhibit higher risk taking behaviour than females? Do younger adults exhibit higher risk taking behaviour than older adults?
- Do socioeconomic variables influence health risk behaviours? Do people of relatively lower socioeconomic status (lower income or unemployed) exhibit higher levels of health risk behaviour?
- Does childhood experience influence adult well-being? Do adverse childhood experiences lead to poorer states of adult well-being?
- Does childhood experience influence health risk behaviour? Do adverse childhood experiences lead to higher levels of health risk behaviour?
- Does adult well-being influence health risk behaviour? Do poorer states of adult well-being lead to higher levels of health risk behaviour?

While there is some evidence to indicate directionality for some of the questions below (section 2.8), they are presented as exploratory research questions, since evidence is either incomplete, contested or directionality is indirectly implied:

- Can evolutionary strategies be identified and quantified in contemporary contexts?
- Are evolutionary strategies adaptive in contemporary contexts or are they the remnants of once adaptive strategies derived from past environments?
- Are there strategic differences between age and gender groups?
- Are there strategic differences between socioeconomic groups, particularly relating to income and employment status?
- Do environmental conditions, particularly socioeconomic factors, affect evolutionary strategies? Specifically, are adverse environmental conditions conducive to strategies which maximise short term benefits while incurring long term costs?
- Do adverse childhood experiences and/or poor adult well-being affect evolutionary strategies? Similar to perceptions of environmental condition, are adverse childhood experiences/low adult well-being conducive to strategies which maximise short term benefits while incurring long term costs?

- To what extent does temporal perception determine evolutionary strategies and health behaviour?
- Do individuals who favour having children at a younger age also have a preference for having more offspring? If so, do individuals who prefer to have more children, at a younger age, exhibit short-term health strategies? Is reproductive strategy predictive of health risk behaviour?
- Are financial behavioural strategies associated with health risk behaviours, specifically in terms of risk taking, investment decision making and offsetting decision making? If so, do shorter term financial strategies predict shorter term health strategies?
- Are altruistic and cooperative tendencies associated with health risk behaviours? If so, do individuals who invest less socially also invest less in their health choices?
- Are reviewing and planning, and achievement striving associated with health risk behaviours? If so, do individuals who invest less time reviewing and planning, and achievement striving also invest less in terms of their health behaviour?
- If health behaviours are found to be associated with behavioural strategies, and are found to be predicted by demographics, developmental experiences, socioeconomics and subjective factors, to what extent can we predict individuals likely to exhibit health risk behaviour?

1.8 Limitations

A key limitation of this research is the lack of existing literature and evidence to guide an evolutionary interpretation of public health problems. A consequence is that many interpretations will be based on theoretical applications of evolutionary principles. Novel applications, especially those dealing with wide-reaching and complex principles, require attention to the potential caveats and confounding variables. The accurate representation of health outcomes and behavioural strategies is critical in this research and, where possible, will be justified with statistical measures. Where possible, relationships between behavioural strategies and health outcomes will be analysed independently after controlling for other predictive variables.

1.9 Structure of thesis

The thesis is structured as follows:

Chapter 1. Introduction: A brief overview of the topic; the rationale for the study; an introduction to the key concepts; an outline of the research context; the aims and objectives; and the hypotheses.

Chapter 2. Literature Review: An outline as to the importance of the subject; a justification of the research questions; the theoretical framework of the research; and, an evaluation and discussion of relevant evidence.

Chapter 3. Methodology: A detailed explanation of methods used for each component of the research; the rationale for choosing particular methods in relation to the research questions; and, an explanation of the procedures used, in terms of data collection, recording and analysis, which could allow for replication of research.

Chapters 4-9. Results: A detailed description of the data; analyses of eating behaviour and evolutionary strategies; analyses of health risk behaviours; analyses of activity and exercise; analyses of childhood experience and adult well-being; and, profiling analysis.

Chapter 10. Discussion and conclusions: An overview of important findings; a discussion of how results compared to initial hypotheses; a commentary of how this research relates to existing evidence; a discussion regarding the limitations of this study; and, a discussion regarding the implications for this research in terms of future research and healthcare policy. A discussion of the main strengths and weaknesses of this research is also provided.

2. LITERATURE REVIEW

2.1 Public health

"Public health is the science and art of preventing disease, prolonging life and promoting physical health and efficiency through…the development of the social machinery which will ensure to every individual in the community a standard of living adequate for the maintenance of health" (Winslow, 1920, p30). A founding principle of public health is that disease is a biological process arising from social conditions and that our success in promoting good health depends on manipulating the conditions in which people live (Rosner and Fried, 2010). While communicable diseases remain a real and, in some cases, expanding threat to public health (Rosner and Fried, 2010), there is an increasing influence of chronic illness, such as heart disease, type-2 diabetes, stroke and cancer, on morbidity and mortality (Martin and William, 2008), and cause two-thirds of deaths globally each year (WHO, 2017). Preventable non communicable diseases (NCDs; Jamison et al., 2006), are reaching epidemic proportions (Lopez et al., 2006) and are most commonly caused by common risk factors such as overeating, smoking, lack of exercise and high alcohol use (Rosner and Fried, 2010; Daar et al., 2007).

Despite the threat posed to health care systems, national and global actions to prevent NCDs have been inadequate and the challenge to public health systems to provide a scaled response in line with the burden of NCDs is great (Beaglehole and Yach, 2003). In order to address the issue, governments, agencies and civil society are required to acknowledge the risk factors and burdens of NCDs (Beaglehole and Yach, 2003). Three key areas which require address in order to reduce the burden of NCDs are improved diets, smoking cessation and reduced alcohol consumption (Barboza, 2003; WHO, 2001; McKee, Shkolnikov and Leon, 2001). In addition to raising awareness regarding the risk factors for NCDs, the key challenges faced in reducing the burden of NCDs are to: enhance economic, legal and environmental policies; modify risk factors; mitigate health impacts of poverty and urbanisation; and finally reorientate health systems (Daar et al., 2007). It is a principle aim of this research to assist and contribute to these complex challenges.

2.1.1 Overweight and obesity

Overweight and obesity are extremely complex conditions, with serious social and psychological elements, which affect all socioeconomic groups in both the developed and developing world (WHO, 2003). Simply stated, overweight and obesity is caused by a chronic imbalance between energy intake and expenditure (Jéquier, 2002). However, obesity is not a single disorder but a group of conditions each with a variety of causes; any influence of genetic predisposition on the aetiology of obesity is affected by environmental and behavioural variables (Jebb, 1997).

Bodyweight is influenced by a range of complex systems, including individual psychology, social psychology, individual activity, activity environment, food production, food consumption and physiology. An energy imbalance may be minor but could still lead to morbid obesity. An energy intake 5.0% higher than expenditure each day, which is small in itself, would lead to an increase of 5kg fat mass over a one year period; for this reason the aetiology of obesity in humans is particularly difficult to measure (Jéquier, 2002). Reduced activity and diets high in energy, saturated fat, salt and sugar and low in fruits and vegetables are the main causes of obesity and therefore NCDs such as cardiovascular diseases, type-2 diabetes, and non-infectious cancers (WHO, 2008; WCRF, 2007; Ezzati et al., 2004; AIHW, 2004; Wang et al., 2011).

2.1.2 Prevalence

In 2008, there were over 1.4 billion men and women worldwide who were overweight or obese (WHO, 2013). In 2012, two-thirds of adults in England and more than two-thirds of those in the US were overweight or obese (TIC, 2013; Ogden et al., 2014). Globally, obesity has nearly doubled since 1980 (WHO, 2013) and prevalence of overweight and obesity in populations continues to rise (Wang et al., 2011). The rate of overweight and obesity in children has increased 2.0 to 2.8-fold over 10 years in England and 2.3 to 3.3-fold over about 25 years in the US (Chinn and Rona, 2001; NCHS, 1999). Estimates suggest that by 2020 three of four people in the US and seven of 10 British people will be overweight or obese (Sassi, 2010). Rising prevalence of obesity will be concurrent with a rising health and economic burden which will adversely affect future populations (Swinburn et al., 2011).

2.1.3 Costs attributable to obesity

The cost to the UK economy of overweight and obesity was estimated to be £15.8 billion in 2007, including £4.2 billion in costs to the National Health Service (NHS; PHE, 2013). In 2003, in the US obesity-attributable medical expenditures were estimated to be between $61 billion and $75 billion (Stein and Colditz, 2004; Finkelstein, Fiebelkom and Wang, 2004); approximately 4-7% of total expenditure on healthcare (Finkelstein Fiebelkorn and Wang, 2003). Additionally obese patients, compared to normal-weight people, accrue 46.0% increased inpatient costs and 80.0% increased spending on prescription drugs (Finkelstein et al., 2009). Society also incurs considerable costs owing to loss of productivity, typically resulting from absenteeism, disability allowances and premature death (Trogdon et al., 2008).

2.1.4 Health risks and pathology

Obesity greatly increases the risk of NCDs (Wang et al., 2011). In 2008, 36 million people died from NCDs, representing 63.0% of the 57 million global deaths that year and that by 2030 such diseases are projected to claim the lives of 52 million people (UN, 2011). NCDs have been

reported to cause double the deaths that are caused by infectious diseases, maternal/perinatal conditions, and malnutrition combined, with 388 million people globally estimated to die from chronic diseases like type-2 diabetes, heart disease and related cancers in the next ten years (WHO, 2005). Life table analysis has demonstrated that overweight and obesity greatly decreases life expectancy; overweight 40 year old female and male non-smokers lost 3.3 and 3.1 years of life respectively and obese 40 year old female and male non-smokers lost 7.1 and 5.8 years of life respectively (Peeters et al., 2003).

Type-2 diabetes is caused by insulin insensitivity and a failure of the pancreas to produce insulin caused by excess bodyweight, exacerbated by overeating and inactivity (Royal College of Physicians, 2008). Among people with type-2 diabetes, the risk of cardio vascular disease is more than doubled and average life expectancy is reduced by seven years (RCP, 2008). Additionally, type-2 diabetes can cause health complications affecting the eyes, nervous system and kidneys (*ibid*). In the UK, coronary heart disease causes approximately 82,000 deaths each year, most commonly through heart attacks and failures; approximately one in five men and one in eight women die from the disease (NHS, 2012). In terms of cancer, every increase of $5kg/m^2$ in BMI raises a man's risk of oesophageal cancer by 52.0% and colon cancer by 24.0%. For women the same increase raises the risk of endometrial cancer by 59.0%, gall bladder cancer by 59.0%, and postmenopausal breast cancer by 12.0% (Renehan et al., 2008).

In addition to increasing a person's risk of developing NCDs, overweight and obesity can cause asthma, sleep apnoea and other respiratory difficulties, benign prostate hypertrophy, chronic and disabling musculoskeletal problems and infertility (Thorpe et al., 2004; Wang et al., 2008; Nichols et al., 2011; FPH, 2010; Winthrow and Alter, 2011). Among children, obesity causes hypertension, dyslipidaemia, chronic inflammation, increased blood clotting tendency, endothelial dysfunction and hyperinsulinaemia (Freedman et al., 1999; Ford et al., 2001; Ferguson et al., 1998; Tounian et al., 2001; Srinivasan, Myers and Berenson, 2002). The risk of developing more than one of these diseases (co-morbidity) also increases with increasing body weight (WHO, 2013).

There are also many psychological consequences of obesity, such as poor self-esteem, poor body dissatisfaction and depression (Wardle and Cooke, 2005). Obese children for example are often stereotyped as unhealthy, academically unsuccessful, socially inept, unhygienic and lazy (Hill and Silver, 1995); overweight children as young as five can also develop negative self-image (Davison and Birch, 2001).

2.1.5 Measuring obesity

Measuring obesity is difficult since the amount of fat in an individual's body, or adiposity, is an elusive characteristic to quantify (Lee and Kolonel, 1984). Fatty tissues also fluctuate greatly in different parts of the body (Dugdale and Griffiths, 1979). Body height and shape also varies and has been found to predict certain health risk factors. For example, in women four body types, as defined by ratios between hips, waist and chest, have been identified; android, gynacoid, thyroid and lymphatic (Liver doctor, 2014), and have been found to vary in terms of risks to certain health conditions (Zagami et al., 2013). Age, ethnic differences and the amount of fat that is stored viscerally compared to subcutaneously affect the test validity of BMI in measuring body fat; the self-reporting of height and weight also contains inaccuracies (Rothman, 2008; Wang et al., 1994; Janssen et al., 2014). The sensitivity and specificity of BMI have been demonstrated to be poor, particularly because the relationship between BMI and body fat is not linear (Rothman, 2008). However, BMI derived from body weight and height is the most commonly used surrogate measure for obesity; the Quetelet index W/H^2 is the most widely accepted (Lee and Kolonel, 1984).

2.2 Determinants and approaches to health risk behaviour

There is a particular focus in this research of behaviours which elevate the risk of overweight and obesity; however, health risk behaviours are also considered throughout in general terms and given here is an overview of their theoretical determinants and the key approaches to preventing them and promoting healthy lifestyles. While health is determined by many factors which interact in complex ways, four broad categories have been identified and presented; the contribution of an evolutionary approach to these factors is discussed in section 10.3.

2.2.1 Biological determinants

The heritability of obesity is discussed in section 2.3.1. The estimated influence of genetics on health, and the behaviour which shapes it, has changed over recent decades; where once human genes were reported to be the crucial determinant of illness, well-being and the behaviours affecting (Bortz, 2005), estimates now suggest that single genes account for less than 2.0% of ill health (Strohman, 1993). Longevity is also suggested to have relatively little to do with heredity; however, genetic variance can lead to altered metabolic pathways which mediate interactions with the environment and have impacts on health and senescence (Finch and Tanzi, 1997). Genes do not cause health risk behaviour but can be influential in complex ways; in some cases one gene may influence or predispose an individual to a range of behaviours, or a number of genes may interact with one another and predispose behaviours in specific or general ways (*ibid*). Identifying

individual genes which give rise to patterns of ill health is relatively rare; more common is genetic susceptibility to ill health as the consequence of multiple genes acting in combination (Institute of Medicine, 2006).

There is a broad and complex evidence base around the interactions between genes and the environment and their impacts on health but the relative contribution can be difficult to discern since family history often incorporates both shared genes and socioeconomic conditions. Individual physiology is a good example of this dual influence as it varies by both inherited genes and environmental conditions, particularly developmental conditions (in utero for example); the role of physiology in hunger, satiety and adiposity is discussed in section 2.3.4, while the influence of development in utero is discussed in section 2.6.1. Some specific health-related behavioural phenotypes have been found to have genetic associations (Cai et al., 2006). However, while physiological mechanisms, modulated by environmental conditions, have been found to guide elements of behaviour, physiology is also cyclically influenced by health behaviour; for example, a sedentary lifestyle may lead to a 'sedentary physiology' which can increase risk factors for non-communicable diseases (Tremblay et al., 2010). In general terms, the role of genes in influencing health risk behaviour is accepted to relatively minor compared to lifestyle and other environmental factors (Herskind et al., 1996). While it is important to be mindful of biological determinants of health, risk prevention and health promotion frameworks focus to a greater extent on psychological and environmental determinants of health.

2.2.2 Cognitive, psychological and behavioural determinants

In the context of eating, higher cognitive control of behaviour is discussed in section 2.4.5, while implicit cognition and delay discounting are discussed in section 2.7.6. Given here is an overview of the cognitive and psychological determinants of general health risk behaviour; behavioural factors are included as they are principally governed by psychological mechanisms and cognitive processes. While social factors are also linked to psychological mechanism, for clarity in this discussion social factors are grouped with economic and other environmental influences in section 2.2.3.

The mechanisms underlying cognition and behaviour are extremely complex and, to understand behaviour, an integrative approach is required which accounts for the function of behaviour while acknowledging the broad influencers of cognition. Neurobiology and psychological mechanisms are influenced by complex interactions between gene expression, developmental conditions and experiences, physiology, and physical and socioeconomic environments (Hassel et al., 2011). Multiple regions in the brain work in combination to govern behaviour; for example, the choice

to undertake a health risk behaviour such as smoking a cigarette would call upon an interaction between pleasure and emotional centres, including the amygdala, regulatory areas of mood most notably the hypothalamus, autonomic areas of the brain, including the anterior cingulate cortex, areas of conscious or higher though, including the pre frontal cortex, reward and expectation centres, including the nucleus accumbens and the orbitofrontal cortex, and areas involved with short and long term memory, primarily the limbic system (Nolte, 2002). The purpose here is not to map health decision making throughout the brain but to recognise that factors affecting any of these brain regions, either through developmental experiences, altered mood states and illness or injury would potentially have consequences for behaviour generally and those relating to health. The extent to which behaviour is the outcome of autonomic or conscious cognitive processes is much debated and may vary between individuals; for further discussion see section 10.4. However, evidence is clear that disruption to cognitive processes that result in psychological disorder affects health behaviour decision making; for example by creating mood disorders, depression, and inhibited social or emotional comprehension (Hassel et al., 2011).

As discussed in section 2.7.2, a prominent determinant of cognitive development is childhood experience. To the point of consensus, research suggests that adverse childhood experiences lead to developmental and biological disruptions which critically determine adult health behaviour more than any other factor (Shonkoff, Boyceand McEwen, 2009). Consequently, health promotion frameworks, including the prevention of health risk behaviours and the promotion of healthy lifestyles, require new frameworks which place childhood experiences as a central focus, primarily because adverse childhood experiences become biologically embedded and have enduring consequences (*ibid*). However, the adult brain continues to change and undergoes remodelling throughout adulthood (McEwan, 2000); therefore, health promotion policies and interventions which successfully foster positive childhood experiences and maintain healthy cognitive functioning through adulthood will have profound consequences for all aspects of health.

2.2.3 Socioeconomic determinants

Variation in health behaviour in relation to socioeconomic factors, particularly deprivation have been well established across various cultures and healthcare systems (Marmot, 2005). The socioeconomic determinants of health behaviour, particularly in relation to deprivation are discussed in section 2.6.1 and physical environmental factors are discussed in terms of eating behaviour and physical activity in section 2.4.2. An overview of socioeconomic determinants is given here as a key component of the public health approach to health risk behaviours; physical environments and socioeconomic conditions are considered jointly as they are fundamentally linked (Lovasi et al., 2009).

Access to education and therefore employment opportunities are crucial determinants of health and enable the ability to acquire resources and secure safe and stable housing; coupled with deprivation is the risk of discrimination and prejudice which can adversely affect health; social support or, conversely, social disorder and crime also affects health behaviour, as does public safety; finally, infrastructure including transportation and habitual segregation have also been found to be impactful on health behaviours and outcomes (Office of Disease Prevention and Health promotion, 2014). In terms of physical determinants of health, the built environment, particularly housing, schools and recreational settings, plays a role in health behaviour; proximity to worksites and exposure to harmful chemicals or hazards, in addition to aesthetic elements of the environment which also influence relevant behaviours (*ibid*).

The conditions in which people live, and the causes of such circumstances, have been the subject of increasing focus in health promotion and risk behaviour prevention programmes; particularly in terms of the fundamental drivers such as income, wealth and education (Braveman and Gottlieb, 2014). Despite complexities in the causal pathways between key socioeconomic determinants and health behaviours, which involve cognitive processing, there is broad consistency found, with few exceptions, of the association and predictability of health with income, wealth and education (*ibid*). It remains clear that in developed societies achieving sustainable improvements in population health will require a multi-agency approach, with careful attention given to the conditions in which people live and in which good health may thrive (Committee on Integrating Primary Care and Public Health, 2012).

2.2.4 Policymaking

Finally, policy making is a determinant of health behaviour; however, its influence is likely to act within the variance determined by childhood experience (and cognitive development) and socioeconomic factors (Shonkoff, Boyceand and McEwen, 2009; Nettle, 2010). However, policy at local and national levels can affect individual behaviours, whether through population wide health policy or informative ‘nudging’ to call on individual agency; discussed in more detail in section 10.5. Behavioural approaches in policy making have been identified as a potentially powerful way to improve population health but, to be effective, reliable evidence must be collated and policy makers are required to build behavioural components into policy making practice (Institute for Government, 2009). A feature of this work is to explore whether policy interventions which require a high level of individual agency are useful, given that other determinants, such as deprivation or adverse childhood experiences, could undermine such interventions.

Healthcare is also presented here as a broad outcome of health policy; however, health care is rarely preventative and while it is undoubtedly important in treating ill health and improving lives, the effects on health risk behaviour is likely to be limited (Adler and Stewart, 2010). Evidence also suggests that while a high level of care is important, access to healthcare may remain unequal and that faltering access may prevent individuals from preserving or improving their health (Gulliford et al. 2002).

While it is clear that laws and regulations have the potential to be key determinants of health behaviour and status, there remains a considerable gap between evidence and policy (Brownson, Chriqui and Stamatakis, 2009). To enact health behaviour change, reliable evidence is required to be delivered to policymakers in a timely fashion, and there needs to be the political will and economic investment to translate such evidence into policy and practice.

2.3 Human history

In order to contextualise an evolutionary approach in this research an overview of human history is provided here with the principle aim of providing insight into modern human physiology and general psychological predispositions. Non-domesticated animals do not carry excess fat unless it is adaptive; for example in those that hibernate or require thermal insulation, or those, typically rodents, that encounter large amounts of nutritious food which can be stored for a later time (Bøckman, 2011). Historically, humans would not have encountered the opportunity to become and remain overweight; neither would it have been adaptive to do so. Since the advent of agriculture, which greatly enhanced production, and industrialisation, which shifted populations from rural communities to towns and cities, humans have increased the amount of available food while becoming more sedentary. Such changes have caused a rapid increase in the number of overweight and obese people, which occurred at too fast a rate to represent genetic change at population level (Power and Schulkin, 2009). It has been argued that we will quickly adapt to our new conditions and those that can thrive on poor diets or those that can control their body weight when faced with an abundance of food will have more offspring and be more successful in evolutionary terms (Bøckman, 2011).

2.3.1 Hunter gatherers

From the evolution of modern humans 200,000 to 150,000 years ago (Oppenheimer, 2003), until the advent of agriculture in the Levant, approximately 10,000 years ago (Eshed, Gopherm and Hershkovitz, 2006), human populations lived exclusively as hunter gatherers, who tended to eat lean protein and high fibre diets (Speth, 1982). Food producing economies spread slowly through hunter gatherer populations with relatively few populations living as hunter gatherers in the present day. Hunter gatherers typically employed/employ optimal foraging strategies, predicted

by foraging models (Maynard Smith, 1978; Winterhalder, 1986a). While hunter gatherers spent considerable time resting and being sedentary, models predict that when foraging, foragers attempt to maximise their net acquisition rate of energy (Winterhalder, 1986b). Simple models of optimal foraging theories have undergone discussion and revision in line with the development of the empirical evidence base. For example, modern hunter gatherers have been found to exhibit variations in their foraging behaviour depending on the energetic and nutrient returns from various food types, the opportunity costs associated with the processing of various resources and the extent to which food may be shared between a group (Hill et al., 1987). Resource exploitation was not only important in terms of gaining energy but was also a key factor in deriving group size, territoriality, movement patterns and other aspects of social behaviour (Hill et al., 1987).

Until the advent of food storage techniques and later agriculture, hunter gathering humans did not evolve under conditions of high food availability and would have typically expended a lot of energy in obtaining food of which the energy and nutrient content would have been variable. Under conditions of constant high food availability, the once-adaptive strategy to maximise net acquisition rate of energy would lead to overweight and obesity.

2.3.2 Agriculture and industry

The advent of agriculture imposed new diets, diseases, societies and benefits to planning long-term, to which humans were poorly adapted (Cochran and Harpending, 2009); it also led to a vast population expansion which greatly increased the production of adaptive mutations (Hawks et al., 2007). Plants, such as wheat, barley, peas and lentils, and animals, primarily goats, were first domesticated in the Fertile Crescent of Southwest Asia. Agricultural practices spread around Europe and Asia over thousands of years by the geographic expansion of farmers and hunter-gatherers adopting farming techniques. Agriculture facilitated rapid population growth (farming produced 10-100 times more calories per acre than foraging), increased population density (which changed social structure from nomadic hunter gatherers to fixed communities) and brought about close associations with domesticated animals, all of which greatly increased pathogen loads and infectious diseases (Cochran and Harpending 2009). Evidence of this trend is found in human milk, which has changed in terms of anti-microbial function and contains the highest concentrations of immune-globulins, oligosaccharides and other antimicrobial molecules of all milks examined (Milligan, 2008).

Modernisation began with the industrial revolution which started in Great Britain at around 1800AD and spread around Western Europe and the United States. In addition to many innovations, such as steam power, the industrial revolution improved agricultural technology and greatly increased production of food, which allowed populations to break from the Malthusian

trap (Galor, 2005). The Malthusian trap is the term used to describe a condition before the industrial revolution where increases in productivity were matched by increases in populations; therefore individual resources remained stagnated (*ibid*). The industrial revolution led to substantial population growth, which has continued to the present day, particularly in expanding cities (Ashton, 1998). Since the industrial revolution, improvements in technology have led to greater food production and increasingly sedentary lifestyles.

Broadly speaking, humans have remained genetically stable; however, developments in civilisation over the last 10,000 years have led to a number of adaptive mutations relating to diet and nutrition, principally because the advent of agriculture and dairy farming presented novel conditions for humans who had been evolving as scavengers and hunter gatherers. Mutations and adaptations have created geographic and cultural diversity in modern humans. For example, there is a correlation between latitude and dietary fat processing; equatorial diets tend to be lean, high latitude diets tend to be fatty, at least on a seasonal basis. Inuits, for example, have lower blood pressure and circulating blood lipids than Europeans in order to process a diet high in fat (Young et al., 2007).

Distinctions in diet and environmental conditions have led to variation in genetic predispositions and physiology. Generally people from the Indian sub-continent have higher adiposity (and a greater propensity to store it centrally) at any particular BMI than Caucasians and sub-Saharan Africans (Yajnik, 2004). African American men have lower amounts of visceral fat that European American men and African American women have higher amounts of sub-cutaneous fat than women of other races (Hoffman et al., 2005). Generally Europeans have a greater ability to up-regulate fat oxidation than other racial groups; African American women have lower metabolic flexibility compared to white American women (Berk et al., 2006). Asian Americans weigh less, are shorter and have lower mean BMIs than European Americans (Park et al., 2001) but have a higher fat mass (especially visceral fat) for any given BMI (Araneta et al, 2002), which increases the risks of diabetes and other obesity-related diseases (Yajnik, 2004). Native Americans, Hispanics and African Americans appear to be more vulnerable to obesity and type-2 diabetes than European Americans (Abate and Chandalia, 2003) and people of Asian descent have higher risk of type-2 diabetes when consuming a western diet (Abate and Chandalia, 2003).

2.3.3 Adaptive biology

There have been several aspects of human biology that may have made us more susceptible to becoming overweight or obese. Generally, species within the genus *homo* evolved larger bodies and larger brains which may have selected for greater body fat stores (McHenry and Coffing, 2000; Power and Schulkin, 2009). The metabolic cost associated with larger brains may have

created a motivation to seek energy-rich, typically fatty foods, and enhanced cognitive abilities may have improved success at finding it (Aiello and Wheeler, 1995). Larger bodies allowed for more energy to be stored and it would have been adaptive to store energy obtained during periods of excess food availability since such opportunities would have been sporadic; weight gain would not have been sustained but used during periods of food scarcity (Power and Schulkin, 2009). Increasing body size would have allowed long periods of grazing on low-energy foods supplemented by consuming a large amount of high-energy foods, such as animal prey when the opportunity arose.

Larger brains may have posed developmental problems for humans; larger head size at birth would have required a wider pelvis which would have impeded locomotion. This trade-off led to humans giving birth as late as possible but still premature in terms of offspring development. Increases in maternal and neonatal fatness have been suggested to have adapted in response to selective pressures to produce offspring who required an extended period of postnatal brain growth (Kuzawa, 1998). Neonatal brain size has a directly proportional relationship to maternal body size; therefore maternal metabolic turnover is a limiting factor in encephalization since brain growth requires energy that must be supplied by the mother's body during gestation and lactation (Martin, 1996). Greater adiposity of human neonates, when compared to other mammals, is suggested to be at least partly explained by the enlarged human brain, which requires large reserves of energy to ensure obligatory needs are met should the flow of resources be interrupted (Kuzawa, 1998).

There is also evidence indicating that extra adiposity can confer advantages during illness which has been suggested to be particularly relevant after the advent of agriculture. This may also have been of particular importance for babies for whom fatness is useful for disease resistance since many diseases disrupt feeding and digestion (Kuzawa, 1998). There may also have been an adaptive advantage in producing fatter babies owing to the lower fertility of lean babies in later life (Catalano et al., 2007).

2.3.4 Homeostasis, allostasis and mismatch

Homeostasis is the term used to describe the physiological feedback processes required to regulate internal systems. Homeostatic processes resist perturbations around a set physiological point, which might relate to temperature, pH or blood glucose concentration (Schulkin, 2003; Power, 2004). Allostasis is the term used to describe the physiological process by which change occurs to improve viability, which creates new and temporary physiological set points (Sterling and Eyer, 1988). Homestasis and allostasis improve or defend viability by resisting or eliciting change using negative feedback or feed forward systems respectively. Should a short-term allostatic change

persist, a cost may be incurred which may be detrimental to health. As a physiological system becomes increasingly incongruent with its environment, the greater the cumulative costs incurred from the feed-forward responses, the greater the chance that such adaptive responses become insufficient or potentially maladaptive (Power and Schulkin, 2009). In the context of overweight and obesity the accumulation of excess adipose tissue is an adaptive response but if the change persists and becomes an allostatic load (McEwan, 1998) then the change can become maladaptive and pathological.

We continue to adapt to a changing world but the majority of our adaptations were shaped by evolutionary pressures from environments we no longer inhabit. We have increasingly learned to modify and change our environment, often to increase the availability and richness of food and decrease the effort required to obtain it (Prentice and Jebb, 2004). Many humans live in environments to which they are not matched and some anticipate that the degree of 'mismatch' will continue to increase (Sterling and Eyer, 1988). For many humans, energy rich food is widely available and is relatively inexpensive in relation to average income. Additionally, technology, infrastructure and a reduction in labour intensive work has reduced the number of calories humans typically expend (Gluckman and Hanson, 2006). For example, strong associations have been found between motor vehicle ownership and obesity in China (Bell et al., 2002). Humans have rapidly changed the environments in which they live but have suffered the consequences of becoming mismatched; most notably we are at risk of becoming overweight and obese. We were adapted for times of food famine but not food excess and once-adaptive metabolic and physiological adaptations pushed beyond their adaptive function have become pathological (Power and Schulkin, 2009).

2.3.5 Food and nutrition

Nutrients are derived from food and are essential for providing energy and facilitating growth and maintenance of the body. Macronutrients include carbohydrates, protein and fat, which are required to be consumed in relatively large amounts; micronutrients include vitamins and minerals and are required in smaller amounts (British Nutrition Foundation, 2013). Water and fibre are not considered as nutrients but are crucial for survival and good health. A varied and healthy diet should provide all the nutrients we require but general under-nutrition or nutrient deficiencies often lead to health problems and diseases. Obesity often develops from poor diet, particularly eating processed or fast foods and not eating fruit or vegetables; therefore obese people are often nutritionally deficient (NHS, 2012; Gillis and Gillis, 2005).

Crucial components of a nutritious diet are fruit and vegetables which, if consumed daily in sufficient amounts, could help prevent major diseases such as cardio-vascular diseases, certain

cancers, type-2 diabetes and depression (Harding et al., 2008; WHO, 2008). The Joint Food and Agriculture Organization (FAO) and World Health Organization (WHO) Expert Consultation on diet, nutrition and the prevention of chronic diseases recommended the intake of a minimum of 400g of fruit and vegetables per day (excluding potatoes and other starchy tubers) for the prevention of chronic diseases (WHO, 2008). Low fruit and vegetable intake is estimated to cause about 31.0% of ischaemic heart disease and 11.0% of strokes worldwide (WHO, 2002). In the UK, the mean consumption of fruit and vegetables is 328g per day (DoH, 2012) which is less than the European average of 386g per day (European Food Safety Authority, 2008) and less than the minimum consumption recommended by the FAO/WHO.

2.4 Causes of obesity

The causes of individual overweight and obesity are complex and multifactorial, encompassing genetic, epigenetic, physiological, nutritional, physical activity-related, psychological, neurobiological, sociological and environmental factors. Overweight and obesity at a population level is facilitated by technological, economic and cultural factors, which have led to increased food production and supply, increasingly energy rich foods and increasingly sedentary lifestyles. When considering obesity and related health risks, it is clear that simplistic or reductionist approaches are ineffective and that a more complete understanding of the causal factors is required in deriving or improving public health preventative interventions and treatments.

2.4.1 Heritability of obesity

Single gene defects account for a very small fraction of human obesity (Barsh, Farooqi and O'Rahilly, 2000) but underlying genetics that make us susceptible to obesity may be widespread since genetic polymorphisms that create predispositions to weight gain are likely to have been adaptive. Relatively few genes are protein producing but a great many are regulatory; predisposition to obesity has been reported to be caused by the interactions of up to 250 obesity-associated genes (Rankinen et al., 2002). Studies of twins (25,000 pairs) and biological and adoptive family members (50,000) reveal that the mean correlations of BMI are 0.74 for monozygotic/identical twins, 0.32 for dizygotic/fraternal twins, 0.25 for siblings, 0.19 for parent–offspring pairs, 0.06 for adoptive relatives and 0.12 for spouses (Maes, Neale and Eaves, 1997). Among young adults there are age and gender differences in the prevalence of overweight and obesity; in England people aged 25 to 34 years have been found to have higher prevalence of overweight and obesity than people aged 24 years and under (HSCIC, 2014) and males from both age groups had higher prevalence than females (Wang and Beydoun, 2007). While genetic factors play a role in susceptibility to weight gain, heredity may have less influence than is commonly believed; the obesity epidemic has rapidly developed over the last 40 years in genetically stable

populations, implying that the primary drivers must be environmental (Ebbeling, Pawlak and Ludwig, 2002).

Physical, social, political and economic environments are key influences in terms of what and how much we eat, in addition to how physically active we are (Qi and Cho, 2008). While further research is required on gene-environment influences on obesity, evidence suggests that lifestyle and health behaviour choices counteract predispositions to gain weight. For example, those who carry a common variant of an obesity promoting gene, and were active in their lifestyle, had a BMI equivalent to those who did not carry the gene, while those who carried the gene but were inactive had higher BMIs than inactive non-carriers of the gene (Andreasen, Stender-Petersen and Mogensen, 2008; Rampersaud et al, 2008). Other research suggests that obesity-promoting genes may increase the chance of weight gain but that such risks are attenuated by physical activity (Kilpeläinen et al., 2011). Understanding genetic contributions and determining predisposed risks to obesity is an important step in improving public health interventions but evidence suggests that health behaviours and choices and the environmental conditions which influence them are the critical causal factors driving the rapid increase in overweight and obesity (Harvard School of Public Health, 2014).

2.4.2 Obesogenic environments

Our direct environment influences nutrition and physical activity and therefore levels of overweight and obesity. Externality theory states that individuals may externally eat in response to food-related stimuli irrespective of internal hunger states (Schachter, Goldman and Gordon, 1968). Exposure to different foods as a child can influence adult eating preferences; additionally portion size affects how much children over the age of five choose to eat (Ebbeling, Pawlak and Ludwig, 2002; Rolls, Engell and Birch, 2000; Hollands et al., 2015). For adults, the strongest environmental influences identified to affect eating behaviours include the availability and cost of good quality food and the accessibility of fast food takeaways and restaurants. Good access to supermarkets has been found to be associated with lower rates of obesity and higher fruit and vegetable intake (Morland, Diez-Roux and Wing, 2006; Rose and Richards, 2004). Conversely, access to fast food and takeaways has been found to increase frequency of consumption, which is linked to obesity and weight gain (Cummins and Macintyre, 2006; Thompson, 2004); food from takeaway shops and restaurants has been found to contain 65.0% more energy than the average diet (Prentice and Jebb, 2003). However, the availability and quality of food often varies between socioeconomic areas (Reidpath et al., 2002); therefore, this evidence may be confounded by other variables such as deprivation.

Environmental structures influence physical activity, which is typically divided into transport and leisure activity. Factors which influence these forms of activities are distribution of parks and green spaces, actual and perceived safety, land use, population density, road use, local facilities and neighbourhood attractiveness (Foster et al., 2005). Models propose that increasing access to safe and attractive green space and increasing access to local facilities will increase levels of physical activity (Foster et al., 2005). More generally it has been suggested that supportive and integrated communities are more conducive to healthy eating and higher levels of physical activity (Jones et al., 2007). While there is evidence that the local environment affects eating behaviours and physical activity, the mechanisms are unclear; the influences are probably small and less important than actual and perceived sociodemographic variables (Jones et al., 2007). It may also be the case that environmental modification may affect people for whom exercise is already important rather than eliciting change in attitudes and behaviours among the sedentary or intermittently active (Jones et al., 2007).

2.4.3 Food production and eating habits

Since 1970, there have been substantial changes in food systems, namely an increased production and supply of energy dense foods, the distribution and transportation of which make them cheap, accessible and convenient (Kitchen et al., 2004; Brown, 1997; Paxton, 1994). The globalization of food markets has resulted in the introduction of mass-produced, low-cost foods to the domestic food supply of many countries. This change, along with advertising campaigns, may have a powerful effect on food choices and dietary patterns (Caballero, 2005). Diet content has increased in fats and carbohydrates derived from refined products (Ebbeling, Pawlak and Ludwig, 2002). Corporate retailers have increasingly taken control of the quality and choice of food available, which has created a change in consumer shopping habits (Marsden, Flynn and Harrison, 2000). This has led to increased consumption of high glycaemic index food, typically breads, ready-to-eat cereals, cakes and biscuits (Cavadini, Siega-Riz and Popkin, 2000). The increase in consumption of sugary drinks (including alcohol) has also contributed to overweight and obesity; research suggests that the energy intake for children who consume soft drinks was 10.0% higher on average than those who do not (Harnack, Stang and Story, 1999).

The change in food systems has contributed to changes in the culture of how food is bought and consumed. Since 1960 home cooking has substantially decreased (Mintz, 1996; Smith, Nq and Popkin, 2013) and the consumption of food outside of the home (where portion sizes are typically higher) has increased (Ebbeling, Pawlak and Ludwig, 2002). In addition to healthy eating patterns, television viewing has also been suggested to contribute to obesity, not only by reducing physical activity but by increasing caloric intake in children and adults (Robinson, 1998; Dumuid, et al., 2016; Jones et al., 2007; Wilkie et al., 2016). Research also suggests that the rise in food energy

supply is sufficient to explain the rise of obesity in the US over the last 40 years (Swinburn, Sacks and Ravussin, 2009). However, while food supply is undoubtedly a driver of weight gain in populations (Hall et al., 2009; Scarborough et al., 2011), frameworks for obesity determinants recognise layered levels where the physiology of energy balance is distally determined by environments and proximally by behaviour (Butland et al., 2007; Kumanyika et al., 2002); within any given environment, propensity and resilience towards obesity varies between individuals.

2.4.4 Physiology

Adipose tissue is not a passive organ but changes internal biological systems. Homeostatic feedback mechanisms are complex and controlled by a range of hormonal, cognitive and neural systems. Simplistically, hunger, satiety and adiposity are regulated and controlled by: adipose tissue, which releases leptin and other adipokines, and inflammatory cytokines; the pancreas, which releases insulin and pancreatic polypeptide; and gastrointestinal tract, which releases ghrelin (appetite regulating hormone) and other peptides (Kenny, 2011a). Hormonal regulators act on the hindbrain and hypothalamic regions of the brain to influence hunger and satiety; the brain reprioritises behaviour to consume or stop consuming food depending on whether signals imply a negative energy balance or satiation.

There is evidence that humans prefer and choose foods rich in fat, sugar and especially both combined; there are multiple physiological detectors for fat in food (Mattes, 2005), which increase its palatability in terms of texture, flavour and taste (Manabe, Matsumura and Fushiki, 2010). Eating high fat and sugar foods results in physiological and metabolic responses, such as increases in insulin and glucocorticoids, which stimulate pleasure-associated areas of the nucleus accumbens (Dallman et al., 2005). Homeostatic and reward systems are closely linked to cognitive learning in relation to the hedonic properties of particular foods, which elicit pleasure regions of the brain, most notably the mesoaccumbal dopamine system (Kenny, 2011b). Such elicitation, which is suggested to occur in the same region and in a similar manner to that found in drug users (Kenny, 2011a), is a powerful motivational force and can override homeostatic satiety signals. Meals which are highly desirable and palatable foods are often consumed more frequently and with greater portion sizes than less palatable foods (McCrory, Suen and Roberts, 2002). Whether food, particularly fats and sugars, can be ‘addictive’ in the same way as other substances has been the subject of much discussion (Corsica and Pelchat, 2010). The motivation to eat foods high in fat and sugar has been found to occur more during challenging or stressful circumstances, serving a less nutritional and more therapeutic function (Zellner et al., 2006). Whether people use internal satiety cues, internal pleasure cues or external cues to determine when to stop eating has found to vary with BMI (Wansink, Payne and Chandon, 2007).

Physiological regulatory systems can become imbalanced in overweight and obese people, leading to ineffective or inappropriate signalling. For example, high glycaemic foods increase postprandial blood sugar which affects appetite regulation (Ebbeling and Ludwig, 2001). Type-2 diabetes can be induced when insulin production in overweight or obese people becomes insufficient or ineffective in its action. Another example is found when obese people also produce a large amount of leptin but this does not produce the expected effect of reducing food intake and increasing energy expenditure, implying that we are resistant to the effects of endogenous leptin (Jéquier, 2002). Information molecules that regulate peripheral physiology in response to environmental challenges are also involved in changing the central states of the brain which can affect cognitive decision making and control. Physiology and metabolism are extremely complex and multidimensional and many molecules involved have been selected upon and have diverse functions in diverse tissues (Power and Schulkin, 2009). Crucially, overweight and obesity can cause the action of many information molecules and feedback systems to become imbalanced and ineffective, making weight loss and the return to a healthy equilibrium difficult to achieve.

2.4.5 Cognitive control

If humans have a preference for, and are rewarded when eating, energy-rich foods, which are cheap and widely available, it might be expected that all humans in such circumstances would become overweight or obese. However, rationally we understand the adverse effects on health and life expectancy of consuming such foods in high amounts and therefore use higher cognitive control to abstain or moderate our consumption (Philipson and Posner, 1999). Non-weight conscious individuals may choose to optimise their utility (in this instance, their lifespan) by maximising their caloric intake, perceived as a benefit, and reducing their energy expenditure, perceived as a cost; whereas weight-conscious individuals (i.e. mindful of detrimental health risks of overweight or obesity) may choose to optimise their utility by reducing their caloric intake and increasing their energy expenditure (Yaniv, Rosin and Tobol, 2009). There are likely to be gradients in rational weight conscious decision making, as evidenced by behaviour. For every individual there may be a rationally optimal weight, which may differ from a physiologically optimal weight; the larger the deviation between the two, the greater the risk of pathological consequences (Levy, 2002). While people are likely to have an objective of maximising their expected lifetime utility, psychological, environmental and socio-cultural factors can affect rational, non-additive eating and create a divergence from physiologically optimal body weights (Levy, 2002).

2.5 Treatment of obesity

There is a clear need for evidence-based public health action to address overweight and obesity and reduce the burden of associated harms. A multifaceted, multiagency approach is required to create effective strategies, preventative interventions and treatments via policy makers and associated agencies (Gortmaker et al., 2011). Governments are required to show leadership and a commitment to reducing obesity; public health policy makers must formulate evidence-based policies, including taxation and trade agreements; funding is required for targeted effective prevention initiatives; intelligence must be accumulated using monitoring systems to track trends for key information; health professionals and care givers need to be trained and empowered to deliver advice regarding nutrition and physical activity; and integrated, communicative partnerships are required between organisations and networks across localities and sectors (Gortmaker et al., 2011).

Empirical evidence that demonstrates effective treatments are limited and prevention efforts have rarely been sustained (Gortmaker et al., 2011); weight loss by any means has proved extremely difficult to achieve (Ebbeling, Pawlak and Ludwig, 2002). Current treatments and, to a lesser extent, preventative interventions, fail to adequately account for the causal factors that underlie pathology-inducing overeating and inactivity; a better understanding of adaptive behavioural strategies and shaping environmental conditions may improve public health action but may require wide-reaching and complex solutions. There is growing evidence of the effectiveness of specific treatments and interventions but even effective treatments in isolation are unlikely to reverse the obesity epidemic.

2.5.1 Secondary treatments

Secondary treatments which target overweight and obesity typically involve reducing caloric consumption and increasing activity levels. There is some evidence that programmes which reduce glycaemic load, replace trans-fats in foods with polyunsaturated fats, reduce salt intake and increase exercise can be effective in reducing obesity and related NCDs in adults (Thomas, Elliott and Baur, 2007; Shaw et al., 2006; Norris et al., 2005). Behavioural interventions have also been found to have varied success at encouraging weight loss in adults through dietary changes and promoting physical activity (Joseph et al., 2011; Gillison et al., 2015). Pharmacotherapy in the form of anti-obesity drugs have shown modest weight loss in some cases but have varying cardiovascular risks and adverse effects (Padwal et al., 2003). Traditional diet programmes that encourage dietary restraint have a history of failing to achieve sustained weight loss (Hill, Thompson and Wyatt, 2005; Heatherton, Herman and Polivy, 1991; Klesges et al., 1991). The ineffectiveness of weight loss treatment programs has led to recommendations that approaches

become more health-centred with less focus on weight loss and more focus on wider health, including mental well-being (Cogan and Ernsberger, 1999).

When non-intrusive treatments have failed, bariatric surgery is sometimes considered; The National Institute for Health and Care Excellence recommends that individuals with a BMI of over 35 who have recently been diagnosed with type-2 diabetes should be considered for a surgical procedure (NICE, 2014). While certain procedures have been found to produce substantial weight loss, the evidence of the safety of these procedures is unclear (Colquitt et al., 2009). Bariatric surgery also fails to address the root causes of overeating and may not necessarily lead to improvements in quality of life (Chandawarkar, 2006). For overweight and obese children, behavioural interventions and school or family based programmes with emphasis on physical activity have been evaluated for outcome and cost effectiveness with varying results (Gortmaker et al., 2011). As previously discussed, environmental conditions influence food consumption and physical activity but the nature of the effects are unclear; appropriate modifications to environments would be difficult to implement and there is very little evidence that such changes would be successful in changing behaviours.

2.5.2 Preventative interventions

Preventative interventions often focus on food and exercise education, lifestyle advice and making changes to the direct environment. Specific measures including an unhealthy food and beverage tax, front-of-pack 'traffic light' nutrition labelling and reducing the advertising of junk food have all been proposed or implemented but have been found to have limited impacts (Sacks, Rayner and Swinburn, 2009). Evidence reviews have been undertaken to analyse school programmes for children including healthy eating, physical activity, perceptions of body image, increased sessions for physical activity, improvements in nutritional quality of food, improvement of cultural practices (such as reducing the amount of time spent in front of television or computer screens) and health promotion strategies (Summerbell et al., 2005; Waters et al., 2011). While these have found strong evidence for beneficial effects, findings have been interpreted with caution and further work is suggested to be required to account for process and implementation factors, to record longer term outcomes and to identify potential harms and costs (*ibid*).

Childhood obesity prevention interventions are embedded within health, education and care systems and often focus on the improvement of lifestyle factors including dietary habits and sedentary time (Dumuid et al., 2016). However, a wider scope may be required if the causal factors of unhealthy behaviours are to be addressed, including developmental factors. Like all public health problems, obesity needs to be considered along with the other major issues that confront societies, such as deprivation, poverty, social inequality (Gortmaker et al., 2011) and

other factors contributing to subjective well-being. For example, childhood experiences shaped by community and familial safety and support can profoundly affect an individual's psychology, adult well-being and therefore decision making and health behaviour. Such effects are required to be understood, in connected with socioeconomic factors, in order to account the causal factors of health risk behaviours. Regardless of education and availability of nutritious food and healthy living promotions, choices relating to eating behaviour and physical activity are ultimately determined by psychological mechanisms. Preventative measures and secondary treatments which seek to modify behaviour may be superseded by such mechanisms, as determined by formative and current environmental conditions.

2.6 Ecological environments

The ecological environment is a key determinant of human behaviour and encompasses complex interactions between genetic, physiological and psychological systems and external social, cultural, demographic, technological, built and natural environmental pressures. Public health outcomes, such as overweight and obesity, are extremely complex since they are affected by every internal and external factor. The influences of genes and physiology have been discussed, as have the influences of the built environment; discussed here is the broad influences of socioeconomic factors on health risk behaviours.

2.6.1 Socioeconomics

Within economically developed countries, there are substantial differences in long-term health outcomes among people of different socioeconomic groups (Smith and Egger, 1993; Marmot, Kogevinas and Elston, 1987; Adler et al., 1993). Evidence indicates that these health inequalities are not reducing over time (Smith, Bartley and Blane, 1990; Singh and Siapush, 2006; Cristia, 2009). There are marked socioeconomic gradients in health behaviour (Nettle, 2010); people of lower socioeconomic groups have been found to have poorer diets, exercise less, smoke more, ignore health advice more and be less health conscious overall, than people from more affluent social groups (Qi, Phillips and Hopman, 2006; Relton, et al., 2005; Goldman and Smith, 2002; Pill, Peters and Robling, 1995; Lowry et al., 1996; Lantz et al., 1998; Lynch, Kaplan and Salonen, 1997; Lahelma et al., 2009; Wardle and Steptoe, 2003). Evidence suggests that health inequality does occur over the life course but that for some health issues, including obesity, the extent of inequality is greater among children and adolescents compared to young adults, implying a period of equalisation in early adulthood (Vallejo-Torres, et al., 2014). The prevalence and increase in rates of obesity are unequal and particular socioeconomic groups, ethnic groups and geographic regions are often disproportionately affected (Bundred, Kitchiner and Buchan, 2001; Strauss and Pollack, 2001; Ogden et al., 2010b). Prevalence in the US over the last 25 years has risen more

than twice as fast among minority groups compared with white groups, exacerbating pre-existing racial-ethnic disparities (Strauss and Pollack, 2001). The urban poor in developed countries might be partly vulnerable because of poor diet (James et al., 1997) and limited opportunity for physical activity (Gordon-Larsen, 2000). In 2007, the prevalence of obesity among children in the US was found to be 2.7 times lower among children with family income exceeding four times the poverty threshold; similarly nearly half of all children in low education and low income stratum were obese compared to 23.0% of children in high education and income stratum (Singh, Siahpush and Kogan 2010). Also in the US in 2007, children with parents with less than 12 years of education had 3.3 times more chance of being obese than children with parents who had a college degree (Singh, Siahpush and Kogan 2010). The greatest disparities in prevalence of childhood obesity and overweight were observed for parental education, household poverty status and race/ethnicity (Singh, Siahpush and Kogan 2010).

There are variations in consumption of fruit and vegetables between age groups, gender, education level, income, social classes and geographical regions (Johansson and Andersen, 1998; Ministry of Agriculture, Fisheries and Food, 1999; Thompson et al., 1999). Individuals with higher education, income and social status have been found to consume a greater amount of fruit and vegetables than those with lower education, income and social class (Johansson and Andersen, 1998; McClelland et al., 1998; Ministry of Agriculture, Fisheries and Food, 1999; Anderson and Morris, 2000). Age, gender and smoking status are also demographic characteristics or health behaviour associations that have been found to distinguish between low and high fruit and vegetable consumption (Thompson et al., 1999). The cost of food has been found to particularly influence food choices of those in lower socioeconomic groups, including students, the retired and the unemployed (Reicks et al., 1994; Lennernas et al., 1997; Johansson and Andersen, 1998).

While some gradients in health outcomes can be attributed to income disparity (healthy diets for example usually cost more than poor diets), socioeconomic gradients are found even where health behaviours are free (Nettle, 2010). Such gradients imply attitudinal, psychological, or in the context of this research, strategic differences. Individuals from lower socioeconomic groups have been reported to give greater importance to present over future benefits (Guthrie, Butler and Ward, 2009; Adams, 2009; Adams and White, 2009) and feel less empowered to control their health outcomes (Wardle and Steptoe, 2003). Individuals from lower socioeconomic groups may not be behaving sub-optimally or maladaptively but, given the circumstances of socioeconomic deprivation, their lower investment in health behaviour may be adaptive (Nettle, 2010). Taken to an extreme, it would not make sense for an individual to forego an immediate benefit, such as the pleasure derived from eating energy rich foods if they will not live long enough to incur the cost

(i.e. they will die from another cause before the detrimental effects of their adverse health behaviours have been expressed).

2.7 Developmental and subjective environments

2.7.1 In-utero

The in-utero environment is critical in determining permanent physiology and metabolism. During this period, genes may be regulated and expressed in different ways, some of which relates to the amount and distribution of adiposity (Gesta, Tseng and Kahn, 2008). Factors, such as maternal weight gain, BMI, nutrition and glucose regulation can influence gestational weight of babies and therefore the way that permanent physiology is directed. For example, risk of obesity appears to follow a U-shaped distribution with birth weight; both low and high gestation weight babies are more at risk of obesity and the associated health risks (Yajnik, 2004). Any discrepancy between foetal and adult nutritional experience may lead to a propensity for sustained weight gain. Environmental influence begins even before birth and nutritional advice for pregnant women may be an important component of preventative interventions.

2.7.2 Childhood experience

Neurobiological and psychological development continues throughout childhood and adolescence; cognitive maturity is not reached until an adult's third decade of life (Johnson, Blum and Giedd, 2009). Neurobiological pathways shape individual psychology, which determines behaviour including health choices. Childhood experience plays a key role in determining adult eating preferences, physical activity and therefore BMI. Children who suffer from neglect, abuse, stress and other adverse experiences are substantially more likely to suffer from childhood and adult obesity (Ebbeling, Dorota and Ludwig, 2002). Cumulative early psychological stress and behavioural problems have been found to be associated with childhood obesity and rapid weight gain during adolescence (Koch, Sepa and Ludvigsson, 2008; Mellbin and Vuille, 1989). The contribution of adverse childhoods in the creation of problem eating behaviours has been found to persist into adulthood (Johnson et al., 2002). Consequently, children from neglected backgrounds are at a greatly increased risk of obesity (a seven fold increase compared to harmonious backgrounds; Lissau and Sorensen, 1994), while adults who suffered childhood depression have higher BMI than healthy comparisons even after accounting for demographic and social class (Pine et al., 2001). Obese participants from diet programs, compared to healthy-weight adults, were also found to be significantly higher in the incidence of childhood sexual abuse and nonsexual childhood abuse (Gustafson and Sarwer, 2004; Felitti, 1993).

Physiologically, adverse childhood experiences have been associated with adaptive modifications in the nervous, endocrine and immune systems which integrate to maintain physiological stability through environmental changes (Danese and McEwen, 2012). Over activation of the nervous, endocrine and immune systems, which are integral to the regulation of emotions and stress, may characterise the underlying biological platform from which an increased vulnerability to subsequent stress, depression and anxiety may develop (Heim, 2001; Gustafson, 2004).

Childhood stressors are increasingly being shown to be linked to adaptive responses that have negative outcomes in modern society. These include impacts on the processes of brain development, emotional regulation, cognitive response, memory and learning (Anda et al., 2006) and autonomic, endocrine and immune systems (Heim and Nemeroff, 2001) that prepare organisms for short term survival in dangerous environments (e.g. heightened nervous and immunological activity and increased propensity for aggression). Availability of food is a primary determinant of quality and quantity of food eaten by humans (Mela, 1996) and a dominant driver of obesity (Swinburn, Sacks and Ravussin, 2009). Adverse childhood experiences often arise from unstable or insecure environments that are likely to coincide with inconsistent and unreliable food supplies; binge eating and attraction to high calorie foods may emerge as a response to this. Energy deficits can be a consequence of the absence of adequate food availability and a range of behavioural adaptations (Ulijaszek, 1996), such as caloric maximisation, may occur to defend the body against these deficits (Moore, 2000). The employment of such strategies during formative periods of development may persist into adulthood independent of mental well-being and current level of deprivation and with detrimental effects, including overweight or obesity.

As discussed above, in the presence of high food availability weight regulation requires higher cognitive control since psychological and behavioural factors urge an individual to eat (Ulijaszek, 2002). Those that suffer early life stress, such as abuse and neglect, may be inhibited in the development of higher order, complex cognitive and affective functions associated with brain regions which undergo protracted postnatal development (Pechtel and Pizzagalli, 2010). The inability to moderate consumption may also be in part explained by adaptive strategies that arise during childhood and persist into adulthood. Children from poor quality parenting environments are likely to have been at developmental disadvantage and so persistence of food storage may be a selective advantage. Public health approaches that seek to improve childhood experiences, most notably by supporting parent-child relationships, may be effective in reducing the development of health risk behaviours (Chartier, Walker and Naimark, 2009).

2.7.3 Subjective environments

Our perception is determined by the interaction of psychological platforms and life experiences. Ecological, particularly socioeconomic, and developmental conditions are key determinants of our life experiences, which strongly influence our psychological mechanisms and therefore our conscious and unconscious decision making, including health behaviour strategies. Once cognitive maturity is reached, psychological mechanisms become difficult to modify and may persist despite environmental or circumstantial change. Therefore subjective influences may cause the same environmental conditions to be perceived in different ways, leading to variation in behavioural strategies despite similar environmental circumstances. Adult well-being and psychological distress may be particularly important to public health, not only in terms of their intrinsic value, but in terms of their influence of health choices and behaviours. An example of food-related behaviours which persist despite situational change can be observed among individuals who have previously suffered extreme food deprivation; holocaust survivors for example report experiencing profound and long term changes in their attitudes towards food (Sindler, Wellman and Stier, 2004).

2.7.4 Adult well-being

Adult mental well-being is comprised of several aspects including self-acceptance, life purpose, relationships with others and personal growth. Well-being is determined by a combination of distal and proximal factors; social deprivation and childhood experience are key determinants of adult well-being and other health outcomes (Kiernan and Huerta, 2008; Anda et al., 2005; Chartier, Walker and Naimark, 2010; Bellis et al., 2013). Negative moods and emotional distress, such as depression, anxiety and stress, have been found to influence health behaviours and strategies, particularly relating to diet choice and physical activity (Felitti et al., 1998; Marsheb, 2006). Psychological stress in family environments has been reported to be a contributing factor to childhood obesity (Koch, Sepa and Ludvigsson, 2008). Some individuals respond to arousal states, such as fear or anxiety, with excessive eating, originally attributed to confusion between internal arousal states and hunger, often due to early learning experiences (Bruch, 1961). Individuals with binge eating disorder frequently suffer from psychopathology, including unhealthy restraint and psychological distress such as depression and stress (Polivy and Herman, 1993; Johnson, Spitzer and Williams, 2001). Obese people have been reported to be less responsive to internal stimuli and more responsive to salient environmental food cues (Schachter, Goldman and Gordon, 1968). A healthy diet positively impacts on short and long term mental health and plays an important role in the prevention of specific disorders, such as depression, Alzheimer's disease, schizophrenia and attention deficit hyperactivity disorder (Mental Health Foundation, 2014). Childhood and adult obesity can also create or exacerbate depression and low self-esteem, which can cause a cyclical effect between comfort eating and mental disorders (Wardle, 2005).

People dealing with loneliness or anger often eat even when they are not hungry (Wansink, Payne and Chandon, 2007) and there are physiological mechanisms associated with comfort eating which act to reduce stress. Glucocorticoids, which regulate glucose, can act to stimulate emotional regions of the brain, increase the salience of ingesting sucrose or fat and systematically increase abdominal fat deposits, which indicates that depressed people may comfort eat to reduce activity in the chronic stress-response network (Dallman et al., 2003). Improving adult well-being via interventions has been demonstrated to be successful to some extent in improving eating behaviours (Bacon et al., 2002). There is strong evidence to suggest that physical activity is effective in treating mild cases of clinical depression and generating moderate improvements in stress and anxiety (Fox, 1999); however, the incentive to undertake physical activity may be less in those suffering from such disorders.

2.7.5 Temporal perception

Our time perspective or temporal perception is a fundamental dimension of the construction of psychological time and is shaped by compartmentalising experiences into past, present and future frames (Zimbardo and Boyd, 1999). Temporal perceptions are formed and modified by personal experiences and environmental influences, and have important implications for emotional, cognitive systems (Carstensen, Isaacowitz and Charles, 1999) and therefore health behaviours and strategies. Constructions of past memories and anticipated future events frame an individual's representation of the present (Zimbardo and Boyd, 1999). There is variation in terms of how the present may be perceived depending on past experiences and anticipation of future events. Individuals may spend the majority of their time reviewing past events; the extent to which one does this may vary according to the costs and benefits attributed to events and experiences. The recall of these events may be accurate or with distortion and can range between nostalgic and positive or ruminative, traumatic, aversive and negative (Zimbardo and Boyd, 1999). Conversely, individuals may spend the majority of their time anticipating and expecting future events and experiences; similarly the costs and benefits of choices and events may be predicted. While influences of the past and the future shape our decision making we also respond to direct environmental or circumstantial stimuli, particularly salient elements (Zimbardo and Boyd, 1999).

Temporal perception is particularly relevant to health behavioural strategies where choices can be interpreted in terms of costs and benefits over time; often immediate benefits, such as pleasurable but unhealthy eating, incur costs at a later date, while eating healthily may be less enjoyable but may yield benefits at a future time (the wait in itself is a cost). Adverse experiences or environments may cause an individual to perceive the waiting cost for a future benefit to be higher (or less likely to happen at all) and the subjective value of the future outcome may become

more devalued than in an individual with positive past experiences and current environments. Such altered perception is likely to be evident in variation of health behaviours, where those who perceive the cost of waiting to be higher and the value of the future benefit to be lower may behave more impulsively and choose to receive immediate benefits and rewards (Wittmann and Paulus, 2008). While the literature on temporal perception and impulsivity is complex and occasionally unclear, it is logical that adverse experiences and environments change our perception of time, which has consequences for health cost-benefit decision making, particularly relating to food, alcohol and other substances.

2.7.6 Implicit cognition and delay discounting

Health behaviour is directed by impulsive influences and rational, conscious decision making, which can sometimes be conflicting (Carver, 2005). Pleasurable but risky health behaviours often incur future costs and self-control via higher cognition is required to resist temptations, such as unhealthy foods, cigarettes or risky sexual practices. Health-related treatments benefit by accounting for the psychological mechanisms which regulate the trade-off between reflective self-control and impulsive hedonic influences on behaviour. There have been many theories from the field of social psychology applied to health behaviour and an underlying assumption of many of them is that health behaviour responses are the result of cognitive appraisals of the expected benefits and costs of potential health threats; these decisions and resulting behaviours are reflective outcomes that require conscious reasoning (Hofmann, Friese and Wiers, 2008). The greater extent to which an individual employs consciousness and reflective decision making has been reported to correlate with lower risky health behaviours (Bogg and Roberts, 2004). Conversely, the greater extent an individual acts impulsively has been found to positively correlate with risky health behaviours (Grano et al., 2004). While innate factors may affect an individual's reflectiveness or impulsiveness, developmental experience and current environment are likely to be the key determinants. Impulsive drivers may be addressed by attempting to modify psychological mechanisms particularly relating to attentional biases and automatic affective reactions (Hofmann, Friese and Wiers, 2008).

Decision making with regard to immediate and delayed outcomes has been described by social psychology as delay of gratification (Mischel and Ebbesen, 1970), impulsivity (Ainslie, 1975), and time perspective (Zimbardo and Boyd, 1999). Cognitive psychology uses the term delay discounting (Kirby and Marakovic, 1996), which is the willingness to postpone an immediate reward in order to gain additional benefits in the future (Daugherty and Brase, 2009). The extent to which present rewards are preferred to future rewards depends on the length of the delay and the future value of the reward. Decision making relating to delay discounting has been found to be highly sensitive to situational manipulations (Mischel, Ebbesen and Zeiss, 1972); in the context

of this research, demographic factor in addition to family dynamics and marital status, and socioeconomic circumstances (including employment status, income or perceived community circumstances) are proposed to be key determinants of delay discounting. The choices relating to delay discounting can be discussed in terms of adaptive value; humans often trade-off between immediate and future benefits (Rosati et al., 2007) and have been found to account for future consequences when making temporal decisions (Frederick, Loewenstein and Donoghue, 2002). In relation to diet, it has been suggested that increasing tolerance for delayed food rewards may have evolved as a foraging adaptation and that variations in strategy were likely to be the result of variations in the environment (Rosati et al., 2007).

2.8 Evolutionary currencies

The key principles of natural selection are that individuals within a population have different physiologies and behaviours, or phenotypic variation; that different phenotypes have different rates of survival and reproductive success, or differential fitness; and that fitness is heritable through either genetic or cultural transmission (Lewontin, 1968). Darwinian fitness is the capacity to survive and reproduce; the property of which includes a variety of behavioural factors which are highly contingent on the environmental conditions that an organism experiences (Demetrius and Ziehe, 2007). Fitness is suggested to increase with each generation owing to natural selection but decrease owing to environmental change. Access to material resources, such as food and other currencies, is critical in assuring survival, fertility and attracting a mate (Cronk, 1991; Haddix, 2001; Irons, 1979).

Ecological, developmental and subjective environments build upon genetic predispositions to create the physiological and psychological systems that drive human behaviour, and for any set of environmental pressures there are optimal phenotypes. While there may be a temporal mismatch between phenotypes and environmental conditions (Hendry et al., 2010), behaviours are immediately changeable and one might expect behaviourally plastic organisms to function better in changing environments (Bateson and Gluckman, 2011). Humans demonstrate a high level of behavioural plasticity which enables modification of behaviour to be more successful in varied and changing domestic, socioeconomic and cultural environments. Unlike genetic transmission, there is heritable diversity in psychological measures and behaviour (Gangestad, 1997), which may be neutral variants amidst evolutionarily novel environments (Tooby and Cosmides, 1990) or a substantial prevalence of adaptive polymorphisms (Wilson, 1994).

Evolutionary theory would predict that humans optimise the apportioning of their resources to maximise fitness, typically by allocating energy between growth and survival, which may include investing in education for better income and security, and reproduction (Fieder and Huber, 2007).

However, the complexity and interchange between fitness affecting factors, such as income, wealth, health and reproduction has increased with contemporary living. When considering human evolutionary strategies, unlike plants or animals, the intentionality of trying to achieve a desired goal can confuse the adaptive significance of instinctive and unconscious behaviours (Daly and Wilson, 1999) but the relative influence of conscious goals and adaptive functions is much debated. In order to understand the complexity of the relationship, a better understanding is required of what constitutes evolutionary currencies and how the traditional understanding of reproduction as the measure of evolutionary success may need consideration.

The challenge of this research is to incorporate the established theoretical principles of evolutionary human behaviour and apply these principles to health behaviours within the diverse and complex environments of developed modern societies. Identifying established theoretical principles of evolutionary human behaviour can be problematic; the lack of clear definitions can lead to a range of interpretations of what is adaptive, whether genes are the only unit of selection or whether learned behaviour is also a legitimate unit of selection. This work is based upon the assumption that genetics and cultural learning have co-evolved over time and genes, physiological traits and psychologically driven behaviours are all legitimate units of selection with variable adaptive value for given environments.

The way humans evaluate and use information in behavioural decision making is the subject of different fields of evolutionary science, including human evolutionary psychology, evolutionary anthropology, human sociobiology and human behavioural ecology (Daly and Wilson, 1999). Evolutionary psychology attempts to bridge the gap between cognitive science and evolutionary biology in order to better understand human behaviour (Buss, 2009). However evolutionary psychology works on the premise that the mind is modular, with clear underlying computations, with an emphasis on psychological dispositions that were adaptive in an ancestral environment; modern skulls housing a Stone Age mind (Barrett, Dunbar & Lycett, 2002). It is argued that psychological mechanisms have not evolved quickly, while our environment has been subject to rapid changes, and consequently our psychology and behaviour is maladaptive in the environment to which we are now mismatched (Bolhuis, Brown, Richardson & Laland, 2011). The main criticism of evolutionary psychology is that it considers the individual to be independent of social and cultural influences and, while human behaviour and psychology are undoubtedly the products of our ancestral environments, research which overlooks culture as an integral part of the biological process is undoubtedly incomplete (Barrett, Dunbar and Lycett, 2002).

Among humans, unlike other species, ideas accumulate through generations until they are extremely complex; humans participate in cultural interactions until language has been learnt and

a variety of skills, some of them highly specialist, have been acquired (Tomasello, 1999). Cultural intelligence is a consequence of this learning, which enables the capability for humans to function in socially and culturally diverse settings using cultural judgement and decision making (Ang et al., 2007). High cultural intelligence enhances the ability to devise novel solutions, solve social problems, learn quickly and from experience, and learn from or deceive others (Tomasello, 1997), all of which have adaptive value. Adaptive value can therefore be ascribed to human behaviour derived from genetic, physiological, innate psychological and cultural influences.

2.8.1 Reproduction

Evolutionary success is traditionally measured by an organism's reproductive rate; for humans, the number of children and grandchildren that can be produced. Natural selection acts on humans, like any organism, to maximise their genetic representation of future generations, which includes helping relatives achieve the same objective as defined by the principles of kin selection (Hamilton, 1964). The concept of selection units is generally accepted to be genes (Dawkins, 1976) rather than individuals, populations or species. However, genes which produce designs that cause individuals to forsake individual reproductive success would not be adaptive nor have the opportunity to spread though populations (Lewontin, 1970). It has been argued that humans could potentially forego individual reproductive success to a greater degree than other organisms since much of our behaviour is based on learning and choices; the course of evolutionary selection is likely to have shaped learned behaviours and choices to maximise reproductive success (Turke, 1989). Individual goals derived from perceived cultural success have been found to correlate with reproductive success for various cultures, including modern Americans, and have been found to be consistent across cross-cultural samples (Essock-Vitale, 1984; Turke and Betzig, 1985). Reproductive decision making has become more complex in modern societies and is confounded by the effects of extended kin networks breaking down, a concentration of parental costs, the need to produce better-nurtured offspring and the transfer of inter-generational wealth (Turke, 1989); the fertility of women living in traditional societies has been reported to be more than twice as high as women living in contemporary societies (Campbell and Wood, 1987).

Life history theory predicts that reproductive strategy is determined by a trade-off between investment in somatic growth, or reproductive potential, and investment in reproductive effort (Stearns, 1992; Low, Simon and Anderson, 2002). It has therefore been argued that maximising reproduction negatively affects longevity (Lycett, Dunbar and Voland, 2000). There are a wide variety of environmental and ecological factors that affect these trade-offs in humans. Factors such as environmental condition, wealth and resource availability, childhood experience, family and community size and stability are cited key determinants (Daly and Wilson, 1988; Belsky, Steinberg and Draper, 1991; Lycett and Dunbar, 1999). A trade-off also exists between the

quantity and quality of offspring (Fieder and Huber, 2007). Since evolutionary success is said to be measured by the number of grandchildren rather than children, it may be worth having fewer offspring but better equipping them to maximise their reproductive output rather than maximising your own (Penn and Smith, 2007).

There are marked differences in reproductive strategies between males and females; men and women have evolved distinct mechanisms that underlie short and long term strategies arising from a variety of factors including sexual accessibility, commitment seeking, resource procurement, paternity certainty and parental investment (Buss and Schmitt, 1993). Reproductive senescence occurs substantially sooner in females, and males also have higher reproductive potential owing to reduced parental investment; such biological differences cause significant social distinctions (Laslett and Brenner, 1989). Different societies therefore are found to have biased gender ratios, where offspring differ in their ability to reproduce (Bereczkei and Dunbar, 1997), which may be explained by societal structure, cultural constructs or environmental pressures.

Modernisation has changed economic and political systems, which have driven cultural change and particularly the increase in education, the change in working patterns and gender roles (Inglehart and Baker, 2000). Occupation specialisation, increases in income and changing gender roles have led to changes in sexual norms and decreases in fertility. In the modern world there are evolutionary novel trade-offs; early reproduction is generally advantageous but relatively late births (waiting until older ages to have children) is more common now in economically developed societies than it was 20 years ago (Ventura et al., 2001). Modern women have been suggested to trade-off fertility against the opportunities to enhance their socioeconomic status, through education and career progression (Low, Simon and Anderson, 2002). Individuals who have attained higher levels of education have been found to delay reproduction (Fieder and Huber, 2007); socioeconomic advantages have been found to compensate for delayed births and lower lifetime fertility (Low, Simon and Anderson, 2002). Further evidence confirms the importance of material resources (Goodman and Koupil, 2009; Hopcroft, 2006; and Nettle and Pollet, 2008) and the training by which material resources may be acquired (Fieder and Huber, 2007) for successful reproduction. Individuals will redefine their cultural goals, which motivate behaviours and which, consciously or not, serve as proximate mechanisms to achieve ultimate fitness goals (Irons, 1979; Borgerhoff Mulder and Beheim, 2011). Reproductive success is difficult to quantify in the modern world without accounting for other currencies of success, such as wealth, health or abstract currencies, such as happiness.

2.8.2 Wealth

Money or wealth is the primary currency with which to procure resources in the modern world and has profound, if complicated, effects on reproduction, health and therefore evolutionary fitness. As a general evolutionary currency, wealth has been found to be as strong a predictor of long term fitness and immediate reproductive success. Thus, a desire to maximise wealth might serve the interests of long-term fitness as well as a desire for sex and offspring owing to the trade-off between transmitting genes to the next generation and transmitting wealth (Rogers, 1990). Generally, adverse environmental conditions, which often correlate with poverty, are associated with periods of rapid reproduction but among humans the evidence is not straightforward. If environments are so adverse that survival rates drop for parents and offspring, the optimal strategy for reproduction is to maximise the number of offspring and to begin reproduction at a younger age; such trends can be observed in past and present preindustrial societies (Mace, 2007). However, having more offspring does not always imply better reproductive success and, in preindustrial societies, positive associations have been found between male socioeconomic status and reproductive success, despite fewer offspring (Borgerhoff-Mulder, 1998). Gender differences have also been found between socioeconomic gradients in industrialised societies; higher status men have been found to have higher reproductive success while women of higher status have been found to have lower (Fieder and Huber, 2007; Mealey, 1985), which reinforces the evidence that women particularly face a trade-off between career choices to maximise wealth, and reproduction.

Counter intuitively, negative associations have been found in industrialised societies between socioeconomic status and reproduction (Wrong, 1980). Mathematical models would predict that in poor environments the optimal reproductive strategy is to maximise the wealth of a limited number of offspring but in a rich environment to maximise the number of offspring. However, in terms of derived evidence, positive associations between wealth and the number of offspring have been found only in the highest socioeconomic groups (Rogers, 1990). Some of the confounding evidence relating to wealth and reproduction may be explained by the influence of wealth perception rather than absolute quantity of wealth or resources. It has been suggested that individuals' perceptions of resources is the critical factor in reproductive decision making, at least in preindustrial societies, although the relationship between actual resources and perception of resources is unclear (Draper, 1989). Humans do not comply with simple animal models predicting a direct correlation between resources and reproductive output since sociocultural and developmental variables interject between an individual and their resources (Draper, 1989).

There are also elevated extrinsic health risks among individuals of lower socioeconomic groups, which cannot be altered by choices or behaviours (Nettle, 2010); for example, hazardous environmental levels of lead and air pollution (Bolte, Tamburlini and Kohlhuber, 2010; Crouse, Ross and Goldberg, 2009). Poorer socioeconomic groups are also associated with greatly increased chances of homicide and accidental death (Cubbin, LeClere and Smith, 2000). Coupled with avoidable health risks, greater exposure to unavoidable health risks engenders a disinvestment in health behaviour among people of lower socioeconomic groups (Nettle, 2010), which has negative consequences for morbidity and therefore survival and Darwinian fitness.

2.8.3 Health and eating

Throughout the animal kingdom, good health is a marker for genetic quality and biological fitness and can be signalled in a variety of ways. One example is the handicap principle (Zahavi, 1975), where costly traits which impede survival are displayed and the greater the trait, the greater the handicap and therefore the better the biological fitness. More common are honest signalling mechanisms where animals display favourable traits which may act as cues for the receiver, some signals may relate to parasite load while others may relate to physical size or strength (Bradbury, 1998). Humans also give a variety of signals to indicate their genetic quality as indicated by good health. Below average well-being, welfare or physical condition, such as height, strength, endurance, coordination, reflex or speed, have been suggested to be undesirable (Boorse, 1977). Facial symmetry and averageness is also a strong visual marker that an individual is able to maintain good health in the face of environmental challenges (Gangestad and Simpson, 2000). Evolution is suggested to favour healthy individuals owing to a range of direct and indirect benefits (Andersson, 1994) and often attractiveness judgements are synonymous with judgements of health (Grammer and Thornhill, 1994).

However, for modern humans, there is a contradiction between evolutionary and public health success. Public health is measured by longevity and evolution by reproductive output; an individual may be an evolutionary success but a public health failure, and vice-versa. Better health has been indirectly linked to increased progeny; the association may not be direct since an organism well adapted to one environment may not be well adapted to another; therefore health may be relative to a given environment (Boorse, 1977). However, whether good health is a ‘positive’, value laden concept, or a ‘value free’ statistical normality i.e. freedom from disease (any internal state that depresses a functional ability, including reproduction; Boorse, 1977), good health is desirable and valuable in terms of evolutionary fitness. Virtually all human choices and behaviours relate to energetic trade-offs which impact health, none more profoundly than behaviours relating to food consumption and physical activity. Acquiring the nutrients we need in optimal amounts is a key determinant of good health; however, the incentive to eat healthily

may be less for an individual or population who may be likely to die from another cause. This approach can be extended to all health related behaviours such as smoking or harmful alcohol use.

Evolutionary theory would predict that animals should maximise their net return of resources from feeding in order to maximise their size, minimize their development time and maximise their reproductive output; all of which are correlated with fitness (Calow, 1981; Townsend and Calow, 1981). Foraging among the Aché of eastern Paraguay, for example, was demonstrated to comply with optimal foraging models, i.e. foraging in such a way as to maximize net energy intake per unit time (Hawkes, Hill and O'Connell, 1982). Organisms that are relatively more adept and efficient at finding food can expect to improve their fitness and ultimately their reproductive success. Among modern hunter-gatherers, males who were more successful in hunting endeavours have been found to experience higher prestige and greater reproductive success (Alden-Smith, 2004). The vast majority of humans in the modern world do not need to forage or hunt and have a plentiful availability of food. It would be logical to assume that the application of optimal foraging strategies or caloric maximisation in modern societies would lead to overweight or obesity and the associated risks of pathology and poor health. The optimal strategies for good health, particularly in relation to the consumption of food, have changed as our environments have become modernised but optimal health may not always coincide with optimal reproduction. Whether genotypes or phenotypes that predispose or increase the likelihood of overweight or obesity are subject to the forces of natural selection is unclear since, despite posing pathological risks, the resulting morbidity or mortality which could inhibit reproduction often occurs after typical reproductive age. Therefore, while good health is undoubtedly a valued evolutionary currency, in some instances, behaviour which decreases health and increases the risk of pathology may be adaptive given developmental or environmental pressures.

The application of evolutionary principles to health behaviours may be meaningful since domain-specific health decisions result in fitness benefits and seemingly irrational decisions may demonstrate rationality at a deeper evolutionary level (Kenrick et al., 2009). Strategies and decision making, including those related to health behaviours, depend on adaptively relevant features of the current environment; delay discounting, risk aversion and investment of resources may vary depending on the fitness-relevant domain, in addition to individual differences, such as age and sex (Kenrick et al., 2009). Delay discounting is the reduction in the value of a reward with the increasing time until it is received, and has been found to predict eating breakfast, exercise frequency, tobacco, alcohol and drug use; better health is predicted by preferring larger, later rewards to smaller immediate rewards (Daugherty and Brase, 2009). Investing time in order to be healthy, like any delay discounting decision, is influenced by an individual's current situation; including socioeconomic environments, actual or perceived.

2.8.4 Happiness

Happiness, well-being, and self-esteem are closely associated (Baumeister et al., 2003) but are rarely considered as evolutionary currencies. Mental health, like physical health can be considered as either a positive value laden concept or a value free normality (the absence of disease or disorder). The most common disorders are stress, anxiety and depression, which have their own adaptive function but can become pathological, not only in terms of producing the associated conditions of fear and sadness (Nesse, 1999) but also in their much debated association with cardiovascular disease and cancer (Cohen, Janicki-Deverts and Miller, 2007). Good mental health is associated with physical health and therefore could have its own intrinsic adaptive function. Philosophically, happiness has been suggested to be the primary objective of life but it is more likely to have adaptive benefits, or be the result of other adaptive traits. For example, numerous studies have found happy individuals to be more successful in various aspects of life including marriage, income, work performance and health (Lyubomirsky, King and Diener, 2005). Whether happiness precedes success in various aspects of life or is a consequence of them is difficult to discern; there may be a cyclical or exacerbating relationship between happiness and various measures of success. Like behavioural strategies, happiness and well-being may often be shaped by environmental pressures and may persist even after conditions change. Whether happiness and well-being are positive concepts or just freedom from disorder, they are likely to have an adaptive value, in addition to being a by-product of adaptive behaviours and a causal determinant of behavioural strategies.

Compared with reproductive output, wealth or health, happiness is difficult to define as an evolutionary currency but undoubtedly has profound consequences for behavioural choices. Economists have argued that the value placed on social commodities, such as spending time with friends or a romantic partner, can be understood as utility, and the investment made in acquiring such utility are related to evolutionary goals (Kenrick et al., 2009). There is also a general assumption that fitness is directly related to this utility (Gandolfi, Gandolfi and Barash, 2002); however, this assumption fails to account for a range of evolutionary relevant factors, such as stage of life, or current socioeconomic or physical environment. There are a range of innate psychological mechanisms, and domain specific circumstances which create, sometimes competing, behavioural strategies; however, the general assumption that individuals are motivated to maximise this type of utility is well-evidenced (Kenrick et al., 2009).

2.9 Evolutionary behavioural strategies

As previously stated, natural selection acts when there is variation among traits, variation in reproductive success, a relationship between traits and reproductive success and an inheritability

of traits (Stearns and Koella, 2007). Human behaviour can be innate, determined by genetic predispositions, or learned. Evolutionary social science recognises that environmental pressures, in particular ecological (Laland and Brown, 2006), cultural (Henrich and McElreath, 2007) and material (Rogers, 1995) transmission, supplement genetic transmission in contributing to trait distributions (Borgerhoff Mulder and Beheim, 2011). Behavioural traits combine with morphology and physiology to create observable phenotypes, which vary between individuals and populations and are each suited to a greater or lesser degree to a given set of conditions or circumstances. Phenotypes, particularly those shaped by learned, and therefore more flexible, behaviours can change over time and with changing circumstances but may remain constant in the short term (Harley, 1981). Well-defined phenotypes that exist only in short terms can become evolutionary stable strategies (Maynard Smith, 1972). Mathematical modelling has demonstrated that evolutionary stable strategies may be achieved by non-genetic means. New circumstances can produce different learning which can create developmentally stable strategies (Dawkins, 1980), which can invade existing evolutionary stable strategies and yield relatively higher payoffs. Models typically employ game scenarios, which are often frequency dependent and function with a range of assumptions. In terms of health decision making for modern humans, there are likely to be a range of adaptive, optimal and stable strategies for any given set of environmental parameters.

Over evolutionary time the refinement of behavioural strategies such as self-control, forecasting, risk taking, trust, altruism, offsetting and investing, has been shaped by broad social pressures, including competition, group living, childrearing, sexual selection and mate choice. However, the precise procedure humans use to deal with particular conditions is not easily predicted from a general theory of evolution; there is a subtle relationship between humans and their environment which is the product of many evolutionary adjustments each with varying degrees of success (Slobodkin and Rapoport, 1974). Complexity also arises upon consideration of developmental environments, which may create subjective differences that affect strategies among individuals living in the same ecological and cultural environments. Behavioural strategies can be considered as units of selection with relatively different payoffs which vary according to environment pressures (e.g. socioeconomic conditions), subjective experiences (e.g. developmental conditions) and social learning as influenced by cultural conditions. Modelling of health behaviours can be particularly complex since certain behaviours that contain qualitatively different responses, such as eating and drinking, involve an assessment of the motivational state of the individual and the utility of the reward (McFarland, 1974; Brown and McFarland, 1979). Virtually all choices and decisions faced by modern humans are guided by individual frameworks which inform behavioural strategies, many of which have implications for health and Darwinian fitness. A principle aim of this research is to identify key evolutionary strategies and their selective pressures,

describe the behavioural outcomes and frame the consequences of such outcomes in the context of public health.

2.9.1 Risk taking

Risk taking is the potential to incur costs weighed against the potential to gain benefits; risk taking behaviour is undertaken when the likelihood of gaining benefits is perceived to outweigh the likelihood of incurring costs. Risk taking behaviour can be applied to the evolutionary currencies of reproduction, wealth and health. As discussed, an individual may choose to delay reproduction in order to increase wealth and stability but incurs the risks of decreasing fertility. In terms of health or financial risks, evidence suggests there is a general association with gender and age, with older people and females being more risk-averse (Byrnes, Miller and Schafer, 1999; Tymula et al., 2013). However, evidence suggests that risk taking discrepancies between the genders is narrowing, potentially with the reduction of distinct gender roles in modern society (Byrnes, Miller and Schafer, 1999). Contrary evidence also suggests that older people may be more likely to make risky financial investments (Wang and Hanna, 1997). Historically, risk taking behaviour has been reported to be of evolutionary significance for hunter gatherers, especially hunting males, who risk their health and survival by hunting dangerous animals but can reap high benefits in terms of acquiring energy rich food and increasing desirability among potential mates (Bliege Bird, Smith and Bird, 2001). There is a trade-off for the risk taker in terms of potential costs and benefits but also for potential mates, which leads to optimal strategies and sexual selection; a potential mate may desire the strength and coordination of a good hunter, and the resources they may acquire, but a risk taker who incurs high costs, typically injury or death, becomes highly unattractive (Wilke et al., 2006). Status competition among young males in the modern world is suggested to be a driver of risk taking behaviour both in terms of extreme risk taking behaviour, such as gang violence, and lower level risk taking such as daredevilry and gambling (Wilson and Daly, 1985).

Every individual makes life choices relating to health, wealth and therefore reproduction which involve trade-offs between anticipated rewards and risks. It is likely that the optimal or adaptive risk taking strategies would vary according to environmental context but that cognitive processes involved in such decision making are shaped by personal experiences and development. There are a range of emotional and psychological mechanisms involved in this decision making such as impulsive sensation seeking, sociality, anger and disgust (Zuckerman and Kuhlman, 2000; Fessler et al., 2003). Health risk taking, such as substance use or risky sexual practices, can be attributed to sensation seeking, impulsivity and aggression which have been found to be moderately to strongly heritable as well as learned; gambling and risky driving have been found to be more peripheral to heritability than health risk taking (Zuckerman and Kuhlman, 2000). Differences in

risk taking between males and females have been suggested to vary with trait variation, such as impulsivity (Zuckerman and Kuhlman, 2000).

Eating unhealthy foods, smoking, drinking, using other substances or having risky sexual encounters, have immediate benefits, typically by stimulating, exciting or activating pleasure centres in the brain. However these behaviours often incur costs, typically health costs which may result in long term pathology, morbidity and mortality. Behavioural strategies which govern the extent to which an individual may be inclined to increase payoffs (usually in the short term) but increase the risks (usually in the long term) are likely to be primarily determined by past and present environmental conditions. Health risk behaviours, such as substance use, unsafe sex and injury prone behaviours have been found to cluster together (Senf and Price, 1994), implying the willingness to take different health risks is governed by a general behavioural strategy. Current socioeconomic status has been found to be strongly associated with health risk behaviours (Petridou et al., 1997). Lower socioeconomic status often coincides with poorer environmental conditions, which is likely to affect temporal perception, often by decreasing the perceived value of a future outcome; in which case, strategies that provide benefits in the short term are more likely to be employed. As discussed, poorer environmental conditions are also likely to pose greater threats through either direct or indirect threats to morbidity and mortality. Individuals respond to mortality cues from poor environments (resource scarce compared to resource rich) by taking greater health and financial risks (Griskevicius et al., 2011). Research has suggested that subjects from poor environments have been found to seek immediate rewards when feeling threatened whereas subjects from predictable and safe environments responded to the same cues by becoming more cautious (Griskevicius et al., 2011). Poor or adverse environments are likely to engender a 'live fast and die young' psychology where an individual feels compelled to immediately obtain what they can since the future is less certain that secure and stable environments (*ibid*).

Unlike risky health behaviours, financial risk taking can be empirically measured; health risks and pathologies are probabilities rather than numerical values. Where accurate values can be assigned to costs and payoffs, it can be predicted that an individual would always act to maximise their utility based on the value of the payoff, the probability of winning and the probability of not winning. However individuals' behaviour deviates and varies considerably from predictive models of value maximisation (Wärneryd, 1996). For example individuals frequently pay more than the expected value of insurance and gambling, such as in lotteries, hence the profitability of insurance and gambling companies. Despite the probability, in each case the utility is distorted; the potential of loss of not having insurance can be financially ruinous and the potential gain of a lottery can be an extremely high payoff (Wärneryd, 1996). Predictive models do not account for

the variance arising from subjective experience or current level of wealth. Social disadvantage and poverty has been found to be strongly associated with buying insurance and gambling. For example, in the UK half of the poorest households do not have home contents insurance compared to one in five for those with average income and one in ten for the richest households (The Poverty Site, 2009). Poorer neighbourhoods in the US and the UK have been found to be more likely to have gambling problems compared to neighbourhoods with low poverty levels, even after controlling for age, gender and race (Barnes et al., 2013; Wardle et al. 2011). These behavioural strategies may have low probabilities of success but may be optimal. Poorer people have less to lose and would be less likely to fear the consequences of needing insurance but not having it; similarly poorer people may be more likely to take financial risks in the hope of making disproportionate, if unlikely, gains. Richer people conversely have more to lose and are more likely to invest in insurance. Similarly richer people may be less likely to take financial risks since the value of the unlikely payoff is relatively less. From a public health perspective, the most effective way to encourage less risky behaviours may be to highlight the predictability of the future rather than simply providing health promotion advice.

2.9.2 Altruism

Altruism is defined as a behavioural act that benefits others who are not closely related at the expense of the actor (O'Gorman, Wilson and Miller, 2005); whereas helping close relatives can be explained by kin selection theory (Hamilton, 1964). Altruism often takes the form of helping others but can also relate to punishing a cheating individual, the process of which incurs an expense but benefits others. The psychological mechanisms which govern these forms of altruistic behaviour are suggested to vary (O'Gorman, Wilson and Miller, 2005). Whether altruism acts for the good of a species, 'trait group' or population or whether altruism acts only for the good of the individual has been much discussed (Maynard-Smith, 1998). Altruism can be defined as reciprocal, hedonic or true altruism (where the ultimate desire is to help another), which is suggested to be the only form of truly selfless altruism. Altruism almost certainly evolved through reciprocation and would have become adaptive at a time when hominid species lived in small, mutually dependent and stable social groups (Lee and DeVore, 1968).

Typical altruistic behaviour would incur a small cost to the giver and a large benefit to the receiver and might include helping during times of danger, sharing food, helping the sick or wounded, helping the very young or old, sharing implements and sharing knowledge (Trivers, 1971). Altruistic punishing is likely to have evolved in response to subtle and gross cheating where an individual attempts to reciprocate less than a benefit received or fails to reciprocate at all (Trivers, 1971). Altruism has also been suggested to be a form of costly signalling (McAndrew, 2002). The psychological mechanisms and emotions that regulate altruistic helping and punishing involve

aspects of friendship, dislike, moralistic aggression, gratitude, sympathy, trust, suspicion, trustworthiness, guilt and dishonesty (Trivers, 1971). As a behavioural strategy the extent to which a person behaves altruistically is determined by developmental and environmental, particularly socioeconomic, variables. Developmentally, whether within family or social networks, if reciprocation does not follow altruistic behaviour an individual may become distrustful and therefore less likely to behave altruistically in the future. In terms of wider social groups, the likelihood for future interactions is particularly important in determining altruistic behaviour (reciprocation cannot occur in one off interactions; Axelrod and Hamilton, 1981), it would be reasonable to predict that as community size increases, the likelihood of behaving altruistically would decrease since the likelihood of future interactions would be reduced.

Behaving altruistically has particular relevance to health and is associated with greater physical health, well-being and longevity (Post, 2005). While there may be health benefits to individuals and communities that behave altruistically, there is a trade-off whereby investing too much in helping behaviours can become overwhelming and expensive, which provides a stressful burden and negates any advantages gained in physical and mental health (*ibid*). Whether altruistic behaviour significantly impacts on health or is a consequence of other determinants, such as well-being or developmental environments, is unclear. However as a behavioural strategy with payoffs and costs it is reasonable to assume there would be an optimal or adaptive amount for an individual to behave altruistically for a given set of environmental parameters.

2.9.3 Cooperation and community

Cooperation, like altruism, provides a benefit to another individual or group but does not require reciprocation since it also yields direct or indirect fitness benefits to the actor (West, Griffin and Gardner, 2007). The apportioning of public goods is a key feature of human society and groups, or populations, who employ cooperative strategies are more likely to be more successful than groups who are selfish and uncooperative (Killingback, Bieri and Flatt, 2006). The paradox of cooperation is that individuals can benefit by acting selfishly in a cooperative society, as demonstrated by the famous example of the tragedy of the commons[1] (Hardin, 1968). A shared resource may be optimally sustainable if every individual takes a fair share; however, if an individual takes more than their fair share it yields a big benefit for that individual and a cost which is shared among the rest of the group or population. However humans have a concept of fairness and are willing to make sacrifices in order to punish greed. An example of the tragedy of the commons in the modern age is where resources overlap political boundaries, where rights are

[1] The theory of the tragedy of the commons (Hardin, 1968) states that the rational individuals, behaving to each's self-interest, would result in detrimental consequences for the group, specifically in terms of depleting resources.

incomplete and access to a given resource is open, such as fisheries (Benjamin, 2001). Other natural food resources can be interpreted as a communal resource and may be depleted more rapidly than is sustainable owing to the tragedy of the commons.

Individual eating behaviours are influenced by communal food sources and the immediate social context. Groups of individuals sharing a food resource have been found to consume more than individuals eating alone via a process called social facilitation (de Castro et al., 1990); some evidence suggests that subjects who eat with others consume up to 60.0% more than when subjects eat alone (Redd and de Castro, 1992). Similar findings have also been reported for children aged between two and six years (Lumeng and Hillman, 1992). While these findings vary with the types and amounts of food available and level of adiposity, the general trend highlights a change in behavioural strategy owing to immediate social context. Psychological factors such as arousal and attention are suggested to influence social facilitation, in addition to social values, which are likely to be shaped by current environmental and social factors (Guerin and Innes, 1984).

Cooperation is indirectly relevant to health through the improved productivity, community engagement and health outcomes that a cooperative society may elicit, and directly in terms of cooperative health behaviours, an example of which may be engaging in safe sexual practices such as wearing a condom (Kashima, Gallois and McCamis, 1993). As a behavioural strategy, developmental environments and current community structure and engagement are likely to be key determinants of cooperative or cheating strategies. It would be reasonable to predict that small, well-integrated communities and supportive, trusting and nurturing developmental environments would be likely to select for higher levels of cooperative behaviour. Conversely, insecure developmental environments and large communities, where individuals and family units operate in relative isolation, may be likely to select for more selfish and cheating strategies. It would also be logical to predict that cooperative rather than selfish behaviours would be associated with reduced caloric consumption based on evidence and models of communal resources. Attitudes towards cooperation are likely to affect, rather than directly define, health behaviours and in the context of this research cooperativeness may be a useful indicator of peer trust and societal values.

2.9.4 Offsetting

In context of this study, the term offsetting is used to describe a type of delayed gratification or the foregoing of an immediate benefit with the expectation that the payoff will be higher in the future. Variation in an individual's ability to delay gratification has been demonstrated among children; those who delay immediate gratification and persist in goal-directed behaviour for the sake of later outcomes have been found to develop into more cognitively and socially competent

adolescents and adults (Mischel, Shoda and Rodriguez, 1989). There are often benefits to employing cognitive control and delaying gratification; children who were better at delaying gratification also achieved higher scores in school, completed college at better rates and coped better with frustration and stress as adults (Mischel, Shoda and Rodriguez, 1989). Factors that may influence our behaviour strategy or ability to wait for a larger payoff are similar to those that determine our impulsiveness, such as developmental environments and therefore the ability to trust. Trust that the future reward will be forthcoming refers to an interdependent relationship based on social expectations and cooperation (Robinson, 1996) and tends to be shaped by past experiences which become mechanised in our cognitive decision making (Delgado et al., 2005). Detrimental childhood environments have been found to be strongly associated with high levels of impulsivity and an inability to delay gratification; it may be more difficult for an individual to wait for a reward if they are not sure it will materialise (Michaelson et al., 2013). The role of self-control, sensitivity to immediate rewards and the perceived cost of time waiting are also key determinants of offsetting strategies (Benzion, Rapoport and Yagil, 1989)

More impulsive individuals, who are suggested to have less self-control, have been found to be more likely to suffer the adverse consequences of substance use and obesity (Michaelson et al., 2013; Casey et al., 2011). Food, like other substances, can be immediately gratifying but often incurs long term costs in terms of health risks and pathology; the payoff for delaying such gratification is good health. While good health does not require social trust, individuals may perceive the costs of waiting to be high and therefore the immediate payoff to be more desirable. An individual may also be unable to trust that they would live long enough to incur a cost to their health and that other risks would supersede the costs resulting from the behaviour. Individuals willing to offset may forego immediate payoffs or benefits, such as pleasurable food, often containing fat and sugar, with the expectation of bigger payoffs in the future; in the case of healthy eating, the main benefits would include avoidance of overweight and obesity and the associated health risks.

2.9.5 Investing

Investing behaviour is spending an amount of time, energy or money, a form of a cost, in the immediate term with the expectation of yielding a higher return or payoff at a later time. Personal decisions to invest in health are suggested to depend on factors including stage of life, current state of health, the current level of wealth, the perceived cost of the investment and the likely return on the investment (Grossman, 1972). Individuals aim to optimise behavioural strategies in order to maximise returns or future payoffs by appraising their personal circumstances and the environmental conditions. Investments in health behaviour follow similar appraisals. Personal investment theory (Maehr and Braskamp, 1986) explores the determinants of investment

behaviours in terms of the complex interactions between personal characteristics and specific situations or contexts. Of particular relevance to investment decision making processes are: the personal incentives and motivations of an individual which drive behaviour; the sense of self which defines an individual's competence, social identity and confidence to achieve success; and the characteristics of a given context, which define the terms of the opportunity (Duda and Tappe, 1988). Each component is interrelated and affected by formative environments, for example subjective variation would affect an individual's motivation, sense of self and perception of a given environment.

Individuals constantly make investment decisions which can be related to health. Decisions can be direct, such as paying for private healthcare or investing in health insurance, or indirect, such as investing in expensive but healthy foods, or investing time and energy in physical activity. Healthcare is provided free at the point of delivery in the UK but personal medical insurance is available for those who want faster access to healthcare services (King and Mossialos, 2005). The decision to invest in private health insurance is affected by education, income and age (King and Mossialos, 2005) with better educated, higher earners and older individuals more likely to invest. Those with a better education are often higher earners and are likely to have more disposable income to invest; they may also be more likely to prioritise individual over collective responsibility (King and Mossialos, 2005). Older individuals are likely to perceive the cost of waiting for healthcare to be higher and therefore more willing to invest for quicker access to healthcare services.

Indirect healthcare investment decisions are also likely to be strongly affected by socioeconomic conditions in addition to the subjective consequences of developmental environments. Investing in healthier food incurs a higher financial cost in the short term (Rao et al., 2014) but the investment yields a long term benefit of improved health and potentially a longer life. Similarly, investing in physical activity or exercise incurs a short term cost of time and energy but also yields a long term benefit of improved health. Similar to direct health investments, it would be reasonable to predict that individuals with better education, higher incomes and generally favourable socioeconomic environments would be more able and willing to invest in health-promoting behaviours. As with other behavioural strategies, individuals from positive developmental environments, and therefore with better well-being and self-worth, may also perceive waiting costs for future benefits to be less than those from relatively adverse environments and therefore be more likely to invest short term costs for future benefits. Evidence supports this prediction; socioeconomic and psychological factors such as well-being are associated with better diets and increased physical activity (Nettle, 2010; Marsheb, 2006). As an adaptive strategy, variation in health behaviour investment is likely to be determined more by

subjective and current environmental variables than genetic predispositions. While optimal behaviour is likely to vary according to an individual's current environment, psychological mechanisms shaped by developmental experiences may persist despite changes in environmental circumstances.

2.9.6 Reflective decision making

Reflective or impulsive decision making is associated with health risk behaviours (Bogg and Roberts, 2004). Reflective decision making in the context of this research is the extent to which an individual reviews past experiences and uses such information to guide decisions and choices. While the psychological drivers of reflective and impulsive decision making have been discussed, the consequences for health risk behaviours will be considered here in more detail. Impulsive and pleasurable behaviours are often associated with health risks and potential long term pathologies. Overriding impulsive behaviour requires self-control, which has been suggested to be a finite resource which may be depleted but restored across time; subjects have been found to drink more alcohol, eat more unhealthy foods and engage in less-restrained sexual behaviour after engaging in prior self-control tasks (Muraven, Collins and Neinhaus, 2002; Vohs and Heatherton, 2000; Gailliot and Baumeister, 2006). The implications are that individuals from environments that present frequent opportunities for risky health behaviours, such as a ready availability of unhealthy foods, alcoholic drinks, cigarettes or other substances, may find it difficult to maintain self-regulation in order to inhibit impulsive behaviour. Impulsive decision making can be specific; for example when a general motivation such as hunger meets specific environmental stimuli, or it can be a trait, which may drive an individual to act on a variety of stimuli in an impulsive manner (Hofmann, Friese and Wiers, 2008). The degree to which an individual will act impulsively may also depend on a hedonic component or the incentive value that is placed on a particular outcome. While individuals may have genetic predispositions which affect reflective decision making, reflective and impulsive decisions are often the result of interactions between environmental cues and long term memory, which is created and reinforced by past experiences and behaviours resulting from various stimuli (Hofmann, Friese and Wiers, 2008). For example, repeated experiences with a pleasurable food or substances, and the behaviours that accompany its consumption, become associated clusters in an individual's long term memory. Internal or external triggers can prepare an individual to respond to environmental stimuli in accordance with prior learning experiences, which may elicit an impulsive drive to consume that food or substance (Seibt, Häfner and Deutsch, 2007).

Reflective mechanisms, which involve reviewing past experiences and projecting possible consequences, serve to override the potentially harmful effects of cumulative impulsive behaviours. Reflective learning is an internal processing of experiences and their consequences

and can change conceptual perspectives and therefore the way we perceive future stimuli (Boyd and Fales, 1983). Regular decisions or choices to override unwanted behaviours may become behavioural schema (Strack and Deutsch, 2004), which respond to particular cues in certain ways. However, situation changes may divert cognitive resources and prevent reflective decision making from overriding impulsive behaviours (Seibt, Häfner and Deutsch, 2007). It has been suggested that reflective processes lead to better choices since outcome behaviours are closely related to reasoned preferences (Paternoster and Pogarsky, 2009). However it may be argued that impulsive behaviours are adaptive in environments where immediate payoffs are worth more than potential benefits in the future, but adverse developmental environments are likely to interfere with cognitive mechanisms, such as those which override impulsivity.

While individuals vary in the extent to which reflective processes are used in health behaviour decision making, past experiences, the processing of such experiences and current environmental stimuli remain key determinants of behavioural choices. It would be reasonable to predict that individuals from less nurturing environments would be less likely to successfully employ and sustain reflective and self-controlled behaviours. Repeated experiences and their psychological effects shape learning and memory, which interact with current environmental stimuli to create mechanisms for behaviour. However self-control may be depleted when faced with frequent and pleasurable stimuli. Therefore, individuals from environments with frequent hedonic opportunities, such as pleasurable foods, alcohol, cigarettes or other substances, may be less likely to maintain self-control. Harm reduction or health promotion in relation to risky behaviours may be more successful if tempting but harmful environmental stimuli can be reduced or avoided. Individual decision making may also be improved with reinforcement of self-control strategies which override impulsivity for health risk behaviour.

2.9.7 Achieving

Status and income correlate with individual fitness (Hopcroft, 2006) but the investment of time and finances in attempting to achieve such success may be costly. Ambition to achieve has been described as a constructive characteristic (Hogan and Schroeder, 1981) and may be the result of internalised goals and aspirations which promote social progress, or fitness (Hansson et al., 1983). Ambitious individuals tend to be well-adjusted, socially active and open to new experiences (Hansson et al., 1983). While moderate correlations of achievement striving have been found with impulsivity (Glass, 1977); the drive to achieve is often considered as a relatively unique characteristic. Achievement striving depends on intrinsic motivations, such as fear of failure and sense of purpose, which are created or compounded by environmental influences. An individual's cultural surroundings, as shaped by family, peer networks and wider society, are likely to influence expectations and aspirations. Cultures that are heavily meritocratic are likely to exert

higher pressures to succeed than cultures in which individuals inherit a sense of belonging and purpose. The extent to which an individual strives to enhance their status and income may also vary according to the likelihood of achieving their goal, which may be determined by social opportunities or perceptions of them. As a behavioural strategy the drive to succeed and achieve varies between individuals but is strongly affected by developmental and current social environments.

It may seem beneficial to employ a strategy of high achievement striving but time and money are not the only costs which may be incurred. Stress and anxiety are associated with highly striving individuals, which may, in part, explain the association with coronary heart disease and cardiac mortality among the most driven individuals (Hansson et al., 1983). Working hard for a future goal requires investment and patience, and is affected by the described processes of implicit cognition. Individuals who have less cognitive stability and reflective thinking may be more likely to engage in self-defeating behaviours. Current or perceived adverse environmental opportunities are also likely to reduce the inclination to achievement strive as the current costs may not be offset by payoffs in the future. In terms of health behaviours it would be reasonable to predict that individuals who are motivated to achieve long term goals through reflective planning would be less inclined to consume pleasurable foods for short term gains. Some evidence supports this theory whereby ambitious individuals have been found to consume higher levels of vegetables; however, this may be a product of lifestyle and income differences (Appleton et al., 2007).

2.10 Summary

The rising prevalence of overweight and obesity is costly in human and financial terms, and public health organisations face complex challenges if the current trend is to be stabilised and reversed. The causes of overweight and obesity are multifactorial and encompass genetic, physiological, nutritional, physical activity-related, psychological and environmental factors. The focus of this research is to better understand how health risk behaviours and strategies, particularly relating to diet and activity, may be adaptive given the influence of developmental, perceived and actual environmental conditions. Preventative interventions and treatments are unlikely to be effective in isolation and an evolutionary interpretation of the behavioural strategies which increase the risks of overweight and obesity, or other health risk pathologies, may be useful in informing public health policy makers.

3. METHODOLOGY

3.1 Introduction

The main aim of this research was to explore how demographic, developmental, socioeconomic and subjective variables shape evolutionary behavioural strategies, whether conscious or unconscious, and examine how such strategies guide health risk behaviours, particularly overeating.

To meet the aims and objectives, a questionnaire tool was designed in order to collect information relating to individuals, their experiences and their environments, in addition to a range of behavioural choices and strategies. This was a cross-sectional sample and as this was exploratory research, was not intended to be representative of the general population of North West England or the UK. Associations and predictive models derived from the data would describe relationships between evolutionary behavioural strategies and public health outcomes in the sample within the context of environmental conditions. These relationships would not be used to reflect or describe the general population and would stand independent from potential demographic or regional variations.

Participants were recruited via convenience sampling for preparatory work to evaluate questionnaire design with respect to participant engagement and completion time, and to identify potentially confusing, sensitive, or challenging questions. The main study was undertaken using chain referral sampling in order to efficiently and economically capture data across different social strata. Data for test, pilot and main studies were undertaken using paper questionnaires, which were returned to the researcher via pre-paid envelopes. Paper surveys were used rather than an online survey since, despite a decreasing differential of coverage, access to the internet remains unequal (Hohwü et al., 2013). Sample size was not formally calculated as this was exploratory work (Jones, Carley and Harrison, 2004). Response rates are also reported to be lower in Web-based questionnaires (Kongsved et al., 2007) and, since this was a relatively long and thought-provoking questionnaire, respondents in Web-based questionnaires may be more likely to skip difficult items (Hohwü et al., 2013).

Secondary analysis of the second iteration of the North West Mental Well-being Survey (NWMWBS) 2012/13 was then undertaken. This was a large household survey undertaken in the North West of England, it was used to supplement findings from study 1. Study 2 included a number of data items relevant to the research questions and contained a large sample population who met the inclusion parameters of this research. The NWMWBS was conducted in the North West region of England, the population of which was 7,056,000 in 2011 (ONS, 2011). An original

question from the primary study, a consistent indicator for eating preference, was also incorporated into the NWMWBS, which provided the opportunity to further explore key research questions.

3.2 Study 1

3.2.1 Questionnaire design

A systematic approach to the literature review was undertaken in order to evaluate existing evidence and to contextualise this research within the fields of public health and evolutionary science. The questionnaire tool was mostly comprised of bespoke researcher-derived questions, written to examine specific research questions and based upon the evidence described in the literature review. For most questions, there were no existing validated tools which adequately measured the specific outcomes required by the research questions or that would generate suitable data for planned analyses. One standardised scale was used to determine adult mental well-being; the short Warwick-Edinburgh Mental Well-being Scale (SWEMWBS) an abbreviated version of the WEMWBS. SWEMWBS has been validated for use on adults. The scale shows high correlations with other mental health and well-being scales and lower correlations with overall health scales, the distribution of data was near normal (without ceiling effects), and test-retest reliability at one week is high (0.83; Tennant et al., 2007; Stewart-Brown et al., 2009).

Since there are substantial differences in long-term health outcomes among people of different socioeconomic groups (Smith and Egger, 1993, Marmot, Kogevinas and Elston, 1987; Adler et al., 1993), demographic and socioeconomic questions were included. Questions related to health and evolutionary behavioural strategies were identified through the literature review (Section 2.8). Some questions were written to examine choices which could be directly related to evolutionary principles, such as how many children participants had or wanted. Other questions related to behavioural strategies and were designed to categorise participants on the basis of actual behaviours or preferences. Since health behaviours can involve qualitatively different responses and varying degrees of intrinsic and extrinsic motivation, the questionnaire tool sought to assess participants' motivational states (McFarland, 1974; Brown and McFarland, 1979) by presenting theoretically opposing options, some of which focussed on immediate pleasure rewards while others focussed on long term health goals.

The bespoke, researcher-derived questions were subject to theoretical and methodological considerations; there were various psychometric challenges within this research given the breadth and complexity of the research aims. A logical and structured approach was used through this process, which used established frameworks and strategies to ensure the reliability and validity of this newly developed questionnaire tool. Data items were required to operationalise key issues contained within the research questions while remaining accessible and relevant to the target demographic of young adults (Rattray and Jones, 2007). This was particularly important since the generation of data was via self-complete paper questionnaires; there was not extensive guidance or researcher support for participation. However, there was a succinct introduction to the questionnaire which gave clear instructions and offered an amount of guidance if participants were unsure of how to answer questions. Questions were written using clear language and phrasing, with italicised emphasis where required and with additional instructions within questions if the response required was not immediately obvious. The sequencing was designed to be logical to reduce potentially biased responses; potentially emotive questions were placed between the middle and end of the questionnaire. The formatting was considered with the view to preventing boredom and retaining engagement.

There were various issues of measurement considered since the questionnaire sought to record familial, demographic, and socioeconomic items in addition to various health factors and a range of behavioural variables. The questionnaire also required classification questions, such as age and gender, attitudinal questions, such as participants' perceptions or beliefs, and behavioural questions, such as health risk behaviours. Recording a range of content and combining these question types required a varied approach within the questionnaire. While it was not ideal in terms of ease of engagement or completion rates, it was deemed necessary to generate data appropriate to meet the requirements of the research questions.

The majority of data items were various types of closed questions; responses were restricted in order that they were relevant and directly relatable to research questions. Closed questions also allow for efficient analyses and are the preferred format for paper surveys (Kitchenham and Pfleeger, 2002). A limited number of open free text questions were used to record numeric choice responses.

Nominal and ordinal questions were used to classify participants, the response options for these questions were mutually exclusive in order that participants provided only one answer. Nominal data items are appropriate for conspicuous groups (Brady and Kaplan, 2000), and were utilised for questions relating to demography, ethnicity, sexuality, education, employment status and a developmental question (which parent/s, if any, participants grew up with until the age of 16). An ordinal question was used for income where categories were ranked from lowest to highest. An

ordinal scale (1-10) was used to classify participants past, current and predicted future happiness, where responses could be ordered between a range of categories but where the distance between categories was not assumed (Agresti, 2002). The scale was comprised of an even number meaning participants were required to commit to a direction as there was no neutral option. A ten point scale was deemed to be appropriate for this question as they have been found to yield higher validity when relating to measures such as states of mind, including satisfaction ratings (Coelho and Esteves, 2007).

Open numeric response questions were used for a range of questions including number of siblings/children, preferred number children/grandchildren, age of family members, and frequency of behaviour questions. These ranged from behaviours undertaken in a 24 hour period to the last 12 months and there were a range of valid responses. Questions were carefully worded so participants were aware of the units required for each question (e.g. hours, days, years, occasions, portions). Numeric response questions were used where there were a large number of possible responses and providing categorical options would have disproportionately lengthened the questionnaire. These allowed for continuous and categorical data analyses (Section 3.2.5). These questions were deemed appropriate as they allowed a large amount of data to be recorded in concise page space. In some cases they were the only practical way to record data; for example, participants were asked how long they felt they could maintain their current standard of life, for which legitimate responses could have ranged between one month and 50 years or more. Self-reported height and weight were also recorded using open numeric response questions.

Five point Likert scales were used where there were sets of related questions and the strength/intensity of attitudes and opinions were deemed to be important and could be assumed to be ordinal (Bowling, 1997). These were adopted to provide a precise reading within a range of responses where a rank order could be assigned without an assumed equal value of interval (Jamieson, 2004); for this reason, median values were reported for such ordinal data rather than the mean. The optimal number of points to use on a scale has long been debated and evidence is conflicting. There is a general consensus that scales with more than three points are conducive to obtaining the most and best quality information (Preston and Colman, 2000), and some research suggests that scales of seven points maximise information obtained (Green and Rao, 1970). However a range of research suggests that reliability is generally independent of the number of response categories and that consistent test-retest reliability and constant inter-rater reliability were found using scales of three, five, seven or nine points (Bendig, 1954; Brown, Wilding, & Coulter, 1991). Consistent with the SWEMBS five point scales were used. Likert scale questions were used to rate various elements of childhood experience, perceived importance of factors affecting the choice to have children, adult well-being, and the pleasure derived from various

eating and lifestyle behaviours.

Reduced response rates and undesirable effects on data quality, including poor completion, are known to occur when questionnaires are excessively long and time consuming (Drolet and Morrison, 2001). Since this questionnaire tool required a large number of data items there was a necessity to record information in a concise amount of page space. Research has found that for some measures, binary questions, when compared with longer scale questions, do not decrease the validity of the data generated (Grassi et al., 2007). Reliability has also been found to be maintained with binary questions compared to multiple choice or Likert scale data items (Dolnicar, Grün and Leisch, 2011). Additionally, participant reported binary data items to be simpler (ibid) and equally pleasant compared to a longer questions (Dolnicar and Grün, 2007).

In the context of this work closed format binary choice questions were designed to reduce complex decisions into simple choices. Participants may not have felt strongly about one or more of these questions but were encouraged to choose the response which they agreed with the most or would do more often. This was useful in relation to the research questions since they enabled strategic choices to be identified; intermediate values were not deemed to be useful when considering evolutionary behavioural strategies in particular. Binary choice questions were used for strategic choices relating to eating, physical activity, reproduction, financial and health risk taking, offsetting, investing, cooperation, altruism, and achievement striving.

Closed format (single answer) multiple response questions are a well-established, reliable method for capturing high quality information across many disciplines of science; while various formats exist the importance of well worded questions with clear objectives is well documented (Moss, 2001). These questions were written to be intuitive with a view to yielding clear data which met the objectives of the work. Response options were comprehensive to avoid bias and mutually exclusive to elicit single answer responses. Multiple choice questions were used where limited responses were appropriate but where there were necessary options or intermediate response categories, compared to binary outcomes. Multiple response data items provided several options, typically three or four, to categorise participant perceptions, choices and behaviours. This type of data item was used for questions relating to perceptions of health, diet choice, health risk behaviour, hypothetical health opinions, and family history and disease.

This questionnaire tool comprised a range of constructs and answer formats, and while this would lead to a variety of data types and analytical challenges, each question type was considered in terms of the appropriateness to the data generation and the relevance to the research questions. The questionnaire was presented according to question type:

1. Free text questions (short text spaces) were provided for estimates of time (months or years), height and weight, year of birth for participants' siblings, current age or age of death for parents/grandparents, and frequency of behaviour questions for various lifestyle topics (number of occasions per day, month or year).

2. Five point Likert scales were used to determine childhood experiences, the importance of various factors when deciding how many children to have, the SWEMWBS, and pleasure derived from various activities. A ten point scale was used to measure past, current and predicted future happiness for specified age groups.

3. Binary choice questions were used for actual or hypothetical behaviours relating to diet, exercise, sexual health, financial and economic issues, family history, and various social issues. Binary choice questions were scored 0 and 1.

4. Multiple choice questions were used to mprovide further detail relating to participant motivations, for example, what factors would incentivise participants to make healthier lifestyle choices.

The content of the questionnaire is given here by question theme (see appendix 1 for full questionnaire).

1. Socio-demographics

Among young adults there are age and gender differences in terms of the prevalence of overweight and obesity. In terms of age, in England people aged 25 to 34 years have been found to have higher prevalence of overweight and obesity compared to people aged 24 years and under (HSCIC, 2014). In the US, in terms of gender, men have been found to have higher prevalence of overweight or obesity than women, but prevalence was found to be increasing at a greater rate in women (Wang and Beydoun, 2007). Differences in the UK and the US have also been found among ethnic groups; for example, in England, white men were found to have the highest mean BMI and Asian men had the lowest and among women, Black women were found to have the highest mean BMI and White women the lowest (HSCIC, 2014). Within economically developed countries, there are differences in long-term health outcomes among people of different socioeconomic groups (Smith and Egger, 1993), and social and economic environments are also a key influence in terms of what and how much we eat (Qi and Cho, 2008). People in lower socioeconomic groups have been found to have poorer diets, exercise less, smoke more, ignore

health advice more and be less health conscious overall, than people from more affluent social groups (Qi, Phillips and Hopman, 2006; Relton, et al., 2005; Goldman and Smith, 2002; Pill, Peters and Robling, 1995; Lowry et al., 1996; Lantz et al., 1998; Lynch, Kaplan and Salonen, 1997; Lahelma et al., 2009; Wardle and Steptoe, 2003).

In response to this evidence, a range of demographic questions were included in the questionnaire tool, including:

- Participant age - categorical (18-24; 25-30).
- Participant gender - categorical (male; female).
- Self-identified ethnicity - categorical (White; Arab or Middle Eastern; Asian or Asian British; Black or Black British; Chinese; Other - free text).
- Self-identified sexuality - categorical (heterosexual; homosexual; bisexual).
- Education level - categorical (none; primary school; secondary school; university).

There is an established relationship between socioeconomic status and health outcomes; however, this research sought to explore the behavioural strategies which underpin health behaviours. Self-perceived wealth may differ from actual wealth depending on relative wealth of peers or socioeconomic group, therefore perceived wealth or financial security may influence health behaviours and outcomes. To explore this relationship a financial security and stability index was created using a combination of demographic variables and multiple choice questions which indicated participants' actual and perceived current socioeconomic situation. The index was calculated using composite Z-scores (Clark-Carter, 2014; Nardo et al., 2005) where lower scores represented insecurity and instability (unemployed, low income, unsure of maintaining current standard of living, unpredictable lifestyle and poor financial position) and higher scores represented security and stability (employed, high income, sure of maintaining current standard of living, predictable lifestyle and good financial position). The questions which comprised the index were:

- Employment status - categorical (employed full-time; employed part-time; unemployed; student; retired).
- Total household weekly income - categorical (0-£200; £200-£300; £300-£400; £400-£500; £500-£700; £700+).
- General perceived financial position – multiple choice (I usually have the money for what I need; I usually find it difficult to make ends meet; I have some good times and some bad times).

- Estimate of maintenance of current standard of living – free text (number months or years).
- Life stability – binary choice (I have a good idea what my life will be like in 12 months' time; I am not really sure what my life will be like in 12 months' time).
- Life predictability – binary choice (most days in my life I know more or less what I will be doing; most days are unpredictable).

2. Family and social

Research suggests that the number of siblings an individual has can influence quality of diet (Blane, Davey and Hart, 1999) and mortality risk from non-communicable diseases (Hart and Davey Smith, 2002). Positive associations have also been found between increasing numbers of siblings and inclination to smoke cigarettes and increased consumption of alcohol (Hart and Davey Smith, 2002). Sibship size and birth order has also been found to influence personality traits and psychology strategies (Jefferson, Herbst and McCrae, 1998); birth order has also been found to be associated with evolutionary emotions; firstborns for example have been reported to exhibit lower levels of jealousy than middle and lastborn children (Buunk, 1997). Under conditions of insufficient resources, younger children are fed better than older; however among small sibships firstborns are generally favoured (Ernst and Angst, 1983). Cognitive and social development is also mediated by parental behaviours, which may vary between single parent and nuclear families; patterns of family interaction also change dramatically following parental divorce (Hetherington, Cox and Cox, 1979). Children who suffer from neglect, abuse, stress and other adverse experiences are substantially more likely to suffer from childhood and adult obesity (Ebbeling, Dorota and Ludwig, 2002). Questions relating to sibship were included in the questionnaire tool, the number of parents participants grew up with and the age or age of death of parents and grandparents was also included to gauge familial support.

In addition to socioeconomic group and family dynamics, there is a wealth of reliable evidence which indicates that higher levels of perceived social support are linked with improved health outcomes (Uchino, 2006), which may be physical (Berkman et al., 2000), related to infectious diseases (Lee and Rotheram-Borus, 2001) or related to non-communicable diseases, such as cardiovascular diseases (risk factors for which typically include a range of health risk behaviours; Brummett et al., 2001). More supportive and integrated communities have been found to be more conducive to healthy eating and higher levels of physical activity (Jones et al., 2007). The questionnaire tool included questions relating to participants' perceived number of friends and social time.

- Number of siblings participants' have/had and what year the oldest/youngest was born – free text (number and year of birth of oldest/youngest siblings).
- Family members participants grew up with until the age of 16 – categorical (both parents; father only; mother only; neither).
- Current age (or age of death) of parents/grandparents – free text (current age or age of death of mother, father, maternal grandmother and grandfather, paternal grandmother and grandfather).
- Frequency of socialising with close family members/friends – free text (number of days in a typical month).
- How pleasurable participants found aspects of their relationship - five point Likert-scale questions (socialising with friends [not including family], seeing close family [mother, father, sister, brother], playing with your children [if you have any], quality time with your current partner [when you have one]).
- Participants' family health – two multiple choice question (there is a history of cancer/heart disease on my father's side of the family; there is a history of cancer/heart disease on my mother's side of the family; there is a history of cancer/heart disease on my father's and mother's side of the family; I am not aware of any family history of cancer/heart disease on either my mother's or father's side).

3. Adult well-being and happiness

Well-being is determined by a combination of distal and proximal factors including social deprivation and childhood experiences (Kiernan and Huerta, 2008; Anda et al., 2005; Chartier, Walker and Naimark, 2010; Bellis et al., 2013). Negative moods and emotional distress, such as depression, anxiety and stress, have been found to influence health behaviours and strategies, particularly relating to diet choice and physical activity (Felitti et al., 1998; Marsheb, 2006). Adult well-being and happiness was measured in the questionnaire tool using multiple indicators

- The standardised SWEMWBS – five point Likert scale seven aspects of well-being (I've been feeling optimistic about the future; I've been feeling useful; I've been feeling relaxed; I've been dealing with problems well; I've been thinking clearly; I've been feeling close to other people; I've been able to make up my own mind about things).
- Current typical happiness – free text number of days in a typical week participants (felt they had overall enjoyed the day).

- Past, current and predicted future happiness - ten point Likert scale for nine age ranges including current age (0<=10, 10<=20, 20<=30, 30<=40, 40<=50, 50<=60, 60<=70, 70<=80, 80 and above).

4. Childhood experience

Childhood experience plays a key role in determining adult eating preferences and physical activity. Early psychological stress and behavioural problems have been found to be associated with childhood obesity and rapid weight gain during adolescence (Koch, Sepa and Ludvigsson, 2008; Mellbin and Vuille, 1989). The contribution of adverse childhoods in the creation of problem eating behaviours has been found to persist into adulthood (Johnson et al., 2002).

- Self-assessed childhood experience was measured for six factors – five point Likert scale (my childhood was happy, my childhood was loving, my childhood was violent, my childhood was poor [little money], my childhood was lonely, my childhood was strict).

From the six factors, a childhood experience index was created to represent how positively or adversely participants perceived their childhoods. The index excluded whether childhoods were poor, since this cannot be directly related to adverse or positive experiences, but included a question relating to past happiness between the ages of 0<=10. The index was calculated using composite Z-scores (Nardo et al., 2005) where lower scores represented adverse childhoods (unsafe, unhappy, not loving, violent and lonely) and higher scores represented positive childhoods (safe, happy, loving, non-violent and not lonely).

5. Temporal perception

Temporal perceptions are formed and modified by personal experiences and environmental influences, and have important implications for emotional, cognitive systems (Carstensen, Isaacowitz and Charles, 1999) and therefore health behaviours and strategies. Questions were included to indicate variation between participants in terms of the emphasis of their thinking, whether emphasis was placed on reviewing past experiences, anticipating future events, or thinking in terms of the present moment. Original temporal perception questions included:

- Temporal perception - Multiple choice (most of the time I am thinking about what is going to happen in the future; most of the time I am thinking about what has happened in the past; most of the time I am thinking about the here and now; most of the time I am day dreaming).

- Temporal perception - Multiple choice (when my mind wanders from the present it tends to be about working through things I need to do; when my mind wanders from the present it tends to be about re-living things I have done; when my mind wanders from the present it is usually not really connected to my past or future).

6. Lifestyle

While there are socioeconomic gradients in health behaviours and outcomes (Nettle, 2010), those employed in occupations which demand long working hours have been found to be at risk of inactivity (Kirk and Rhodes, 2011). The relationship between occupational status and physical activity is complex; however, a range of lifestyle behaviour questions were included in the questionnaire tool in order to better understand how active participants were in pursuing leisure activities. Long working hours can also undermine family welfare (Jacobs and Gerson, 2001); therefore, questions were included to gauge how much time participants spent with their immediate family.

Since evolutionary fitness is primarily the capacity to survive and reproduce, questions relating to sex were included as indirect indicators of reproductive strategy. Risk taking behaviour can be applied to the evolutionary currencies of reproduction, wealth and health. Typically risk taking behaviour has been reported to be of evolutionary significance, especially for males, in terms of acquiring energy rich food and increasing desirability among potential mates (Bliege-Bird, Smith and Bird, 2001). The questionnaire sought to gauge one form of risk taking behaviour by including questions relating to willingness to engage in violent fights. Altruistic behaviour also evolved as a strategy from trade-offs between current costs and future benefits. Altruism depends on trust between the giver and receiver, and one question relating to potential levels of trust was included regarding travel abroad; research indicates that breadth of foreign travel is robustly related to generalised trust (Cao, Galinsky and Maddux, 2013).

- Frequency of lifestyle behaviours – free text (number of days on a typical week participants attended classes or courses, shopped for pleasure, played with their children [if they had them]).
- Frequency of lifestyle behaviours – free text (number of sexual occasions per month participants perceive a healthy sex life to comprise).
- Frequency of lifestyle behaviours – free text (number of occasions per year participants travelled abroad, engaged in a violent fight with someone).

- Duration of lifestyle behaviours – free text (how long in hours per day participants spent in bed, watching TV, talking to their current partner [if they had one], reading for pleasure).
- Pleasure engaging in various activities - five point Likert scale (studying on a course or night class, having time to themselves, watching TV, reading for pleasure, having sex).

7. BMI

There are various factors which affect the test validity of BMI, including self-reporting of height and weight (Rothman, 2008; Wang et al., 1994; Janssen et al., 2014), and the relationship between BMI and body fat is not linear (Rothman, 2008). However BMI derived from body weight and height is the most commonly used surrogate measure for obesity (Lee and Kolonel, 1984), therefore height and weight questions were included on the questionnaire, from which an estimate of BMI could be calculated.

- Height and weight - free text (number feet and inches or metres and centimetres, stone and pounds or kilograms).

8. Food preferences and behaviours

Humans prefer and choose foods rich in fat and sugar (Mattes, 2005), and these foods stimulate pleasure associated areas of the nucleus accumbens (Dallman et al., 2005). Rationally we understand the adverse effects on health and life expectancy of consuming such foods in high amounts and therefore use higher cognitive control to abstain or moderate our consumption (Philipson and Posner, 1999). Obesity often develops from eating processed or fast foods and not eating fruit or vegetables (NHS, 2012; Gillis and Gillis, 2005). Fruit and vegetables, consumed daily in sufficient amounts, help prevent major diseases such as cardio-vascular diseases, certain cancers, type-2 diabetes and depression (Harding et al., 2008; WHO, 2008). Questions were included which sought to identify whether participants primarily ate according to what tasted good and gave them pleasure or according to what they believed was best for their current and future health; questions were also included relating to diet composition.

The number of meals prepared and consumed at home has changed in recent years with more meals being consumed in restaurants, fast food outlets and from takeaway orders (Nicklas, Baranowski, Cullen et al., 2001). Frequency of eating in restaurants and of fast food meals has been positively associated with fatness and energy intake respectively (McCrory, Fuss, McCallum et al., 1999; Jeffery and French, 1998), eating out generally has also been associated with total

energy intake and poorer-quality diets (Clemens, Slawson and Klesges, 1999). Eating out is also associated with bigger portions, and larger portions have been found to increase food intake by both lean and obese adults (Edelman, Engell, Bronstein, et al., 1986). Questions relating to eating home prepared meals were included in addition to questions relating to meal patterns since individuals who eat breakfast regularly have been found to have a more adequate micronutrient intake and better dietary quality than those who do not (Siega-Riz, Popkin and Carson, 1998). The evidence around snacking is unclear; while snacking between meals has not been found to influence weight loss (Bertéus-Forslund, Klingström, Hagberg, et al., 2006), energy dense snacks have also been found to promote obesity (Drewnowski, 2009). Since 'nibbling' and 'grazing' are associated with leanness (Nicklas, Baranowski, Cullen et al., 2001), it is implied that it is the nutritional value of snacks rather than the quantity that influences body weight. Finally, portion size has been found to influence body fat and how much people choose to eat (Rolls, Engell and Birch, 2000).

- Frequency of eating behaviours – free text (occasions during a typical 24 hours participants ate snacks other than at meal times).
- Frequency of eating behaviours – free text (number of days during a typical week participants ate breakfast, ate midday meal, ate an evening meal, ate a ready meal).
- Frequency of eating behaviours – free text (number of days during a typical month participants ate at a restaurant).
- Pleasure taken from eating various foods - five point Likert-scale (home cooked meal, fresh vegetables, fresh fruit, takeaways, eating out at a restaurant, eating chocolate or cakes or snacks).
- Food preference - Binary choice (I am careful with what I eat; I eat anything I want).
- Food preference – Binary choice (I prefer foods that are good for my health; I prefer foods that make me feel good when I eat them).
- Food preference - Binary choice (I prefer a big meal that leaves me feeling full; I prefer a smaller meal that has high-quality ingredients).
- Satiation – Binary choice (I like to feel full; I do not like to feel full).
- Satiation - Binary choice (at meal times usually I eat all the food on my plate; at meal times I often leave some food on my plate).

An index was created to indicate to what extent participants ate foods that they found pleasurable rather than foods which were good for their long term health. Included in this index were variables which indicated the extent to which participants prepared and cooked food at home rather eating takeaway food or eating out in pubs or restaurants, and variables which indicated eating for health

as a primary motivation, and eating until satiation. The index was calculated using composite Z-scores (Nardo et al., 2005) where lower scores represented eating for pleasure (i.e. eating pleasurable and unhealthy foods, eating when not hungry and eating to or beyond the point of satiation), and higher scores represented eating for health (consumption of healthy and good quality foods and only eating when hungry). The questions which comprised the index were:

- Frequency of eating behaviours – free text (number of days during a typical week participants ate a home prepared dinner).
- Frequency of eating behaviours – free text (number of days during a typical week participants ate chips).
- Frequency of eating behaviours – free text (number of days during a typical month participants ate a takeaway for their evening meal).
- Frequency of eating behaviours – free text (number of portions of vegetables consumed during a typical 24 hours).
- Frequency of eating behaviours – free text (number of days during a typical week participants ate at least one piece of fruit).
- Food preference - Binary choice (I prefer foods that are good for my long term health; I prefer foods that make me feel good when I eat them).
- Food preference - Binary choice (I am careful to eat foods that do not make me put on weight; I do not really think about my weight when choosing my food).

9. Physical activity

A lack of exercise is cited as a common causal factor for the current increase in non-communicable diseases (Rosner and Fried, 2010; Daar et al., 2007). Physical activity is directly related to energy expenditure and caloric balance, for this reason various questions related to physical activity and exercise were included in the questionnaire.

- Duration of sedentary time – free text (number of hours in a typical 24 hour day participants spent standing or moving about).
- Activity preference - Binary choice (to go up two floors in a building I would usually take the lift; to go up two floors I would usually take the stairs).

An activity index was created to indicate how active participants were and included questions relating to their current level of exercise, pleasure taken from exercise and motivations for exercise. The index was calculated using composite Z-scores (Nardo et al., 2005) where lower

scores represented physical inactivity and higher scores which represented physical activity. The questions which comprised the index were:

- Frequency of exercise – free text (number of days during a typical week participants played sport or exercised).
- Frequency of walking – free text (number of days during a typical week participants walked without sitting down for at least a mile or twenty minutes).
- Pleasure taken from physical activity - five point Likert-scale (physical exercise).
- Exercise and health - Binary choice (if I watch my diet I can stay healthy without exercising; exercising is an essential part of staying healthy).
- Motivation for exercise – Multiple choice (I already exercise 30 minutes a day; I would take 30 minutes exercise a day if it extended my life by 5 years; I would take 30 minutes exercise a day if made me look 5 years younger; In reality none of these would make me do 30 minutes exercise a day).
- Exercise perception – Multiple choice (I think I exercise about an average amount for someone my age and sex; I think I exercise more than the average for someone my age and sex; I think I exercise less than the average for someone my age and sex).

10. Health perceptions

Poor diet, smoking and inactivity have all been linked to NCDs. Research indicates that while high proportions of smokers and inactive people recognised their behaviour to be harmful, a much lower proportion of obese people recognised the harms associated their lifestyle (Silagy, Muir, Coulter, et al., 1993). While the desire to change behaviour rose with increasing risk factors for smokers and obese people, there was an inverse relationship among inactive people between risk factors and attempts to increase exercise (Silagy, Muir, Coulter, et al., 1993). Perception of risk may guide behaviour before harms have been incurred and increasing risk perceptions have been found to reduce the probability of smoking (Viscusi, 2006). Several questions were included that sought to explore health risk perceptions within the context of behaviour strategies.

- Perceptions of health risks of being obese – free text (number of years participants believed an obese person would live compared to a non-obese person).
- Perceptions of health risks of smoking – free text (number of years participants believed a non-smoker would live compared to a smoker).

- Perceptions of health risks of inactivity – free text (number of years participants believed a person who doesn't exercise would live compared to a person who exercises for 30 minutes a day).

11. Drinking alcohol

Drinking alcohol is a health risk for a range of diseases including cardiovascular diseases, and has been found to be associated with impulsive and hedonic behaviour (Muraven, Collins and Neinhaus, 2002). The relationship between alcohol and obesity is complex but there are associations, which are influenced by patterns and levels of drinking (PHE, 2012). In the UK, 10.0% of all calories consumed are from alcohol (Bates, Lennox and Swan, 2009) and additional caloric intake rises substantially when alcohol is consumed (Dennis, Flack and Davy, 2009). Various alcohol-related questions were included on the questionnaire, as a measure of health risk behaviour strategy.

- Pleasure taken from drinking alcohol - five point Likert-scale (having an alcohol drink).
- Reasons for drinking alcohol – Multiple choice (I drink alcohol to help me unwind; I drink alcohol to be social; I never drink alcohol).
- Motivation for reducing alcohol consumption - Multiple choice (I do not drink alcohol; I would reduce the amount I drink if it extended my life; I would reduce the amount I drink each week if it made me look younger; nothing would make me reduce the amount I drink).
- Health risk perceptions of drinking alcohol – Multiple choice (drinking two alcoholic drinks a day would have no effect on how long I live; drinking two alcoholic drinks a day would probably make my life longer; drinking two alcoholic drinks a day would make my life a little shorter).

12. Smoking cigarettes

Like alcohol, smoking cigarettes is also associated with NCDs, and is disproportionately harmful in those who are overweight or obese; smoking increases insulin resistance and is associated with central fat gathering (Chiolero, Faeh, Paccaud, 2008). Overweight and obese smokers face a synergy of harm which greatly increases the risk of cardiovascular disease. Smoking represents a health risk behaviour which was important to incorporate into the questionnaire tool.

- Pleasure taken from smoking - five point Likert-scale (how pleasurable you find smoking a cigarette).
- Motivation for reducing cigarette smoking - Multiple choice (I don't smoke; I would stop smoking if it extended my life; I would stop smoking if it made me look younger; nothing would make me stop smoking).

13. Sexual health

General risk taking behaviour is associated with irregular or no contraceptive use among adolescents; low academic skills and educational aspirations are also predictors of risk-taking sexual behaviour (Luster and Small, 1994). Sexual risk taking can led to sexually transmitted diseases and unwanted pregnancy; questions are included here to build a profile of participants' sexual health risk taking.

- Use of condoms - Binary choice (using a condom makes me feel safer, using a condom makes sex less enjoyable).

14. Health risk taking combined

A health risk taking index was created, combining questions relating to unhealthy eating, drinking alcohol, smoking cigarettes and risky sexual practices, to give an overall indicator for health risk behaviours. The index was calculated using composite Z-scores (Nardo et al., 2005) where lower scores represented health risk averse behaviour (healthy diet, low alcohol consumption, not smoking, safe sexual practices) and higher scores represented health risk taking behaviour (unhealthy diet, high alcohol consumption, smoking, unsafe sexual practice). The questions included in the index were:

- Consumption of energy dense food – Multiple choice (I like the taste of thick butter on bread and put lots on; I like the taste of thick butter on bread but spread it thinly; I do not like the taste of thick butter on bread).
- Consumption of energy dense food – Multiple choice (I like to eat chips and eat them regularly; I like to eat chips but try to eat them as little as possible; I do not like chips and do not eat them; I do not like to eat chips but will eat them if someone gives them to me).
- Frequency of drinking – free text (number of days during a typical week participants consumed at least one alcoholic drink).

- Frequency of getting drunk – free text (number of occasions during the last 12 months participants had been drunk).
- Heavy episodic use of alcohol - Likert scale (number of days a month participants had five or more alcoholic drinks).
- Daily smoking – free text (number of cigarettes smoked on a typical day).
- Sex without contraception – Binary choice (when not planning a baby unprotected sex is sometimes worth the risk; unprotected sex is something you should do only when you want to conceive).

15. Financial risk taking

Problem gambling has been found to increase the risk of stress-related disorders, such as hypertension and cardiovascular disease (Fong, 2005). Like other risk taking behaviour (Bliege Bird, Smith and Bird, 2001), gambling is higher among males (Moore and Ohtsuk, 1997) and is also related to impulsivity (Fong, 2005). Questions were designed to represent gambling behaviour at a range of stakes and odds in order that participants would reach at point at which the risk exceeded the benefit of the potential payoff. The odds were all favourable mathematically, either in terms of the chances of winning (e.g. five in six chance of winning), or where the odds were even (50/50 chance), in terms of a greater payoff compared to the stake (e.g. stake £10 and win £30). Questions were designed so that it would make sense for virtually everybody to agree to the first gamble since the stakes were low and the payoff was higher than the stake, but only the most risk taking would accept the final gamble in which participants risked losing everything they owned, despite a good chance of winning.

To explore the relationship between health risk taking and financial risk taking, and both forms of risk taking to health behaviours and outcomes, a financial risk taking index was created. The index included actual gambling behaviour and hypothetical betting choices. The index was calculated using composite Z-scores (Nardo et al., 2005) where lower scores represented financially risk averse behaviour (unwilling to gamble or bet) and higher scores represented financially risk taking behaviour (willing to gamble or bet). The questions included in the index were:

- Low stakes gambling, bet £10 to win £30 on the toss of coin – Categorical (yes; no).
- Medium stakes gambling, bet £100 to win £500 on the toss of a coin – Categorical (yes; no).

- Medium stakes gambling, bet £100 on the roll of a six-sided dice (you pick one number) to win £3000 – Categorical (yes; no).
- High stakes gambling, bet £1000 on the roll of a six-sided dice (you pick one number) to win £30,000 - Categorical (yes; no).
- Would you be prepared to bet: Everything you own (including your car, house and savings) on the roll of six sided dice and if you win, you double everything You win if the numbers 1, 2, 3, 4 or 5 come up but lose if number 6 comes up - Categorical (yes; no).

16. Direct evolutionary

Reproductive strategy is determined by a trade-off between investment in somatic growth, or reproductive potential, and investment in reproductive effort (Stearns, 1992; Low, Simon and Anderson, 2002). Investments in health and wealth contribute to reproductive potential but the balance of the trade-off is determined by complex factors including environmental conditions, resource availability, childhood experience, family and community size and stability (Daly and Wilson, 1988; Belsky, Steinberg and Draper, 1991; Lycett and Dunbar, 1999). Modern economic and political systems have driven cultural change and particularly have increased education and changed working patterns (Inglehart and Baker, 2000). Enhancing socioeconomic status and reproductive potential, results in delaying reproduction and investing more in fewer offspring later in life. Increasing socioeconomic status also results in improved health outcomes; it could be theorised that short term reproductive strategies would coincide with short term financial strategies and disinvestments in health behaviours. To explore these complex relationships the questionnaire tool recorded direct and indirect evolutionary measures; direct evolutionary questions, primarily sought to understand reproductive strategies and priorities.

- The importance of various factors when deciding how many children to have - Five-point Likert scale (size of home, cost of raising/educating children, effects of child bearing on you or your partner's appearance, effects of child bearing on your partner's health, having enough time to do what you want to do, difficulties fitting in paid work or your career, uncertainty about future income and security, your age, your partner's views, having enough time for each child).

An index for reproductive strategy was created using direct and indirect indicators of how many children participants wanted. Included in this index was the age at which participants perceived to be ideal to begin having children. The index was calculated using composite Z-scores (Nardo et al., 2005) where lower scores represented reproducing at a younger age and having many

children and higher scores represented reproducing at an older age and having fewer children. The questions included in the index were:

- How many children participants wanted – free text (number of children).
- How many grandchildren participants wanted – free text (number of grandchildren).
- What ideal age participants thought women should be to have children – free text (age).
- What ideal age participants thought men should be to have children – free text (age).
- Reproductive preference - Binary choice (it's best to leave having children until later in life; it is best to have children early in life).

17. Indirect evolutionary

Over time behavioural strategies such as self-control, forecasting, risk taking, trust, altruism, offsetting and investing, have been shaped by social pressures, including competition, group living, childrearing, sexual selection and mate choice. However, there is a subtle relationship between humans and their environment which is the product of many evolutionary adjustments each with varying degrees of success (Slobodkin and Rapoport, 1974). Questions were presented using every-day behavioural choices to indicate conscious or unconscious choices which contribute, directly or indirectly to evolutionary fitness, as informed by evidence in the literature. Questions were related to direct reproductive output, use of energy or expenditure and survival ability, which included health choices. Some of the broad categories described below contain overlap; for example, much behaviour can be interpreted in terms of energy expenditure and therefore survival ability or fitness.

i. Altruism

Altruistic behaviour incurs a cost to the giver and a benefit to the receiver and might include helping during times of danger, sharing food, helping the sick or wounded, helping the young or old, sharing implements and sharing knowledge (Trivers, 1971). Behaving altruistically has particular relevance to health and is associated with greater physical health, well-being and longevity (Post, 2005). While there may be health benefits to individuals and communities that behave altruistically, there is a trade-off whereby investing too much in helping behaviours can become expensive, and negate any advantages gained in physical and mental health (Post, 2005). Questions relating to altruism included:

- Helping others at night - Binary choice (if I saw someone lying on the pavement in the night-time I would see if they were okay; I would avoid them).
- Helping others during daytime – Binary choice (if I saw someone lying on the pavement in the day-time I would see if they were okay; I would avoid them).
- Helping someone else's child despite risking your own life - Binary choice (I would donate a kidney to save someone else's child even if it meant risking my life; I would not).
- Giving your life to save your own child– Binary choice (I would sacrifice my life to save a child of mine; I am not sure if I would be able to sacrifice my life to save a child of mine).
- Helping someone despite risking your own health – Binary choice (I am generally good with people who are ill; I avoid people who are ill).
- Being honest with information - Binary choice (I think being honest is always the best thing to do; I think in the real world you sometimes have to be dishonest).

An index was calculated using composite Z-scores (Nardo et al., 2005) but the scale was not found to have a satisfactory level of internal consistency and was omitted from logistical modelling.

ii. Cooperation and trust

Cooperation, like altruism, provides a benefit to another individual or group but does not require reciprocation since it also yields direct or indirect fitness benefits to the actor (West, Griffin and Gardner, 2007). The apportioning of public goods is a key feature of human society and groups or populations who employ cooperative strategies are likely to be more successful than groups who are selfish and uncooperative (Killingback, Bieri and Flatt, 2006). Cooperation and trust have been grouped since mutual trust is a crucial factor in engendering collective action (Putnam, 1995). The paradox of cooperation is that individuals can benefit by acting selfishly in a cooperative society. Cooperation is indirectly relevant to health through the improved productivity, community engagement and health outcomes that a cooperative society may elicit, and directly in terms of cooperative health behaviours, an example of which may be engaging in safe sexual practices such as wearing a condom (Kashima, Gallois and McCamis, 1993). Questions relating to cooperation and trust were:

- Trusting the general public - Binary choice (most people you meet in life can be trusted; most people you meet in life cannot be trusted).

- Cooperation in society – Binary choice (in life it is every man for himself; in life we are all in it together).
- Community closeness during development - Binary choice (I grew up in a community where everyone knew each other; I grew up in a community where people kept themselves to themselves).
- Familial support – Binary choice (I can rely on my family for support; I cannot rely on my family for any support).
- Friendship support – Binary choice (I can rely on my friends for support; I cannot rely on my friends for support).

An index for cooperation and trust was created from the above questions by calculating a Z-score but the scale was not found to have a satisfactory level of internal consistency and was omitted from regression modelling.

iii. Health offsetting

Evidence suggests that those who delay immediate gratification and persist in goal-directed behaviour for the sake of later outcomes have been found to develop into more cognitively and socially competent adults (Mischel, Shoda and Rodriguez, 1989). Linked to impulsivity, determinants of offsetting behaviour can be environmental, such as the socioeconomic environment, or experiential, such as childhood experiences and adult well-being. Obese people have been found to have high levels of impulsivity and offset less than lean individuals. Foregoing immediate payoffs or benefits, such as pleasure derived from fatty or sweet foods, is likely to lead to bigger payoffs in the future, mainly the avoidance of overweight and obesity and the associated health risks.

The index was calculated using composite Z-scores (Nardo et al., 2005) where lower scores represented not offsetting (acquiring immediate benefits with future costs) and higher scores represented offsetting (foregoing immediate benefits with immediate costs). The questions in the offsetting index were:[2]

- Food preference - Binary choice (I prefer foods that are good for my long term health; I prefer foods that make me feel good when I eat them).

[2] Two questions were duplicated from the eating for health index; these scales were not used together for any analyses.

- Food preference - Binary choice (I am careful to eat foods that do not make me put on weight; I do not really think about my weight when choosing my food).
- Preference for length or quality of life - Binary choice (length of life is more important to me; quality of life is more important to me).
- Preference for length or quality of life – Binary choice (I would rather die at age 70 years after having been healthy; I would rather die at age 85 having had health problems from the age of 55).

iv. Investing

Rather than foregoing an immediate benefit, investing behaviour typically involves spending an amount of time, energy or money, a form of a cost, in the immediate term with the expectation of yielding a benefit in the future. Similar to offsetting behaviour, investment decisions are determined by environmental and experiential factors. Many investments relate to financial decisions, such as investing money and time in education or investing in a pension, in both cases the anticipated future returns are higher than the initial investment. In terms of health, decisions can be direct, such as paying for private healthcare or investing in health insurance, or indirect, such as investing in healthy foods which are more expensive, or investing time and energy in physical activity, both of which deliver a payoff of good health at a later time. Questions relating to investing behaviour included:

- Investing spare money – Binary choice (I tend to save extra money; I tend to spend extra money).
- Investing in education – Binary choice (years of low income studying at university is worthwhile; years of low income studying at university is not worthwhile).
- Investing in good quality food – Binary choice (I would be happy to pay more for locally produced food; I buy food based on value for money).
- Investing in insurance – Binary choice (Investing in insurance for your house, car or travel is usually a good use of money; investing in insurance is usually a waste of money).
- Investing for older age – Multiple choice (I am investing in a pension/putting money aside for older age; I would like to invest in a pension/putting money aside for older age but cannot afford to; I do not think it is worth putting money aside for old age; I do not think much about older age).

An index was calculated using composite Z-scores (Nardo et al., 2005) but the scale was not found to have a satisfactory level of internal consistency and was omitted from logistical modelling.

v. Reviewing and Planning

Reviewing past behaviour and planning future behaviour is determined by impulsive and reflective decision making. Reviewing and planning behaviour are grouped in this index since they are products of the reflective system, where behaviour is a consequence of a decision process (Strack and Deutsch, 2004). Behaviours which incur health risks, such as drinking alcohol, smoking cigarettes and eating unhealthy foods, are undertaken more readily by impulsive rather than reflective decisions makers. Reflective learning is an internal processing of experiences and their consequences and can change conceptual perspectives and therefore the way we perceive future stimuli (Boyd and Fales, 1983). Past and present experiential factors may shape long term strategies; immediate environments also determine impulsive and reflective decisions. Overriding impulsive behaviour requires self-control and subjects have been found to drink more alcohol, eat more unhealthy foods and engage in less-restrained sexual behaviour after engaging in prior self-control tasks (Muraven, Collins and Neinhaus, 2002; Vohs and Heatherton, 2000; Gailliot and Baumeister, 2006). Therefore environments that present frequent opportunities for risky health behaviours, such as a ready availability of unhealthy foods, may create difficult circumstances to maintain self-regulation which inhibits impulsive behaviour. Questions relating to reviewing and planning behaviour were:

- Reviewing experiences – Binary choice (I routinely review my experiences; I tend to not dwell on what has happened).
- Impulsivity – Binary choice (I am usually quite an impulsive person; I am usually quite calculated in my decisions).
- Planning for the future – Binary choice (I am always planning for the future; I tend to wait and see how things develop).
- Planning for retirement – Binary choice (I have plans for when I retire; I have not really thought that far ahead).

An index was calculated using composite Z-scores (Nardo et al., 2005) but the scale was not found to have a satisfactory level of internal consistency and was omitted from logistical modelling.

vi. Achieving and striving

Ambition to achieve has been described as a constructive characteristic (Hogan and Schroeder, 1981) and may be the result of internalised goals and aspirations which promote social progress, or fitness (Hansson et al., 1983). The extent to which an individual strives to enhance their status and income may be determined by social opportunities or perceptions of them. As a behavioural

strategy, the drive to succeed and achieve varies between individuals but is strongly affected by developmental and current socioeconomic environments. In terms of health behaviours it would be reasonable to predict that the motivation to achieve long term career or financial goals would be associated with the motivation to live a long and healthy life. However, stress and anxiety are associated with highly striving individuals, which can be highly detrimental to health (Hansson et al., 1983). To explore this potential association several questions related to achievement striving were included on the questionnaire.

An index was calculated using composite Z-scores (Nardo et al., 2005) where lower scores represented being disinclined to achieve or strive (content, unsure of ambitions) and higher scores which represented being inclined to achieve and strive (aspirational and sure of ambitions). The questions in the reviewing and planning index were:

- Reality compared to expectation – Binary choice (so far in life I am doing roughly what I expected; I never imagined I would be where I am now).
- Reality compared to desires – Multiple choice (so far I have had the life I always wanted; so far my life has been nothing like the one I wanted; I have never really known what type of life I wanted).
- Reality compared to childhood expectation – Multiple choice (as an adult, I am doing what I thought I would when I was at school; as an adult I am doing something completely different from what I thought when I was at school; when I was at school I never had any idea what I would do when I was an adult).

3.2.2 Test and pilot study

Questionnaires were tested with twelve departmental colleagues from Liverpool John Moores University (LJMU). Discussions were undertaken with participants during the completion of the test questionnaires. This feedback process led to minor changes in the structure and language of the questionnaire tool. Data from testing were not included in final analyses.

A pilot study was subsequently undertaken using convenience sampling to further evaluate the questionnaire in terms of participant engagement, completion time, and to identify potentially sensitive or problematic questions. Participants were approached and recruited via personal and professional contacts, mostly via staff from LJMU. A student group from Manchester Metropolitan University (MMU) were also invited to participate while completing field work of a related nature. The sample comprised males and females, a range of age groups (including participants aged 31 years and over) and a variety of social groups (including students,

professionals, unemployed people, parents and grandparents). Participants were fully informed about the research, were given a formal information sheet and were required to indicate consent prior to completing the questionnaire. LJMU staff were invited to anonymously deposit the questionnaire in a returns box and students from MMU were invited to return completed questionnaires in sealed envelopes to their programme leader who delivered the questionnaires to the researcher. All other participants were provided with pre-paid envelopes to return completed questionnaires by post directly to the researcher.

Approximately 300 questionnaires were distributed and 143 (47.7%) were returned. Participants reported that the questionnaire took between 20-40 minutes. Based on participant comments and feedback, several questions that were poorly understood were removed; deletions also assisted in reducing the completion time. No formatting changes were made to remaining questions and no additional questions were added into the questionnaire for the main study; therefore, data from the pilot study were included in final analyses.

Following analyses of pilot study data, it was decided that the main study would focus on participants aged 18 to 30. This was due to subjective and statistically significant differences in behavioural strategies across age groups. For example, older participants were found to be significantly more risk averse, more likely to invest their money for the future and more likely to prioritise health choices. While such findings were interesting, the objective of the study was to compare differences in evolutionary strategies between changing environments, and not between age groups. The study demographic was restricted to control for this effect and 51 participants aged 31 years or older were excluded from the final analyses.

3.2.3 Data collection

Data for the main study was collected via a chain referral sampling technique. Chain referral sampling is a general term for a class of sampling methods developed from snowball sampling (Coleman, 1958). Chain referral sampling begins with a convenience sample of subjects which serve as ‘seeds’, from which wave-1 subjects (or primary seeds) are recruited; wave-1 seeds recruit wave-2 subjects (or secondary seeds), for as many repetitions as required (Heckathorn, 2011). Chain-referral sampling was developed and is often used to allay the privacy concerns of stigmatised groups, such as injecting drug users or people living with HIV (McCreesh et al., 2013). This sample was not intended to be representative and sought to recruit adults between the ages of 18-30; and so chain referral was considered to be a good data collection methodology owing to its recruitment efficiency (Malekinejad et al., 2008; Lansky et al., 2007). Chain-referral sampling has the potential to rapidly recruit a high number of participants and previous research has indicated that chain-referral sampling can be successfully used to collect reliable public health

data, and has been reported to generate a good sample without analytical adjustments (Platt, Wall, Rhodes, et al., 2006; Malekinejad et al., 2008; WHO, 2013). However, other research indicates chain-referral sampling can incur biases which may be problematic to resolve (McCreesh et al., 2013). Biases in chain-referral sampling may accrue since not everyone in an identified population has an equal chance of selection and recruitment (Atkinson and Flint, 2001). Selection is subject to the choices of the primary and secondary seeds and samples are likely to be biased towards cohesion within social networks (Griffiths et al., 1993).

The sample from study 1 was compared to study 2 (the NWMWBS); however, this research did not aim for the sample to be representative or generalisable to wider populations. Instead, this research focussed on exploring the relative associations between environments, behaviours and health outcomes. For example, whether individuals from relatively more adverse environmental conditions, within defined socioeconomic parameters, are more likely to employ strategies which increase short term benefits while incurring long term costs, compared to individuals in relatively better environmental conditions. If this model was found to be significant, it could be hypothesised and tested among populations with different socioeconomic parameters; changes to the strength of the model and the parameters which affect such changes would be the subject of further work. Owing to the exploratory nature of this study and the emphasis on identifying relationships between variables rather than empirically testing a representative sample, chain referral sampling was judged to be an appropriate way to recruit participants for this study. There was also limited funding for this research and chain referral represented a viable method of capturing a large sample within available resources (Atkinson and Flint, 2001).

Ten primary seeds were initially selected and a further two were later selected as the sample total was below the minimum target. Each primary seed was invited to select 10 secondary seeds, who were each invited to recruit ten participants. A total of 1,200 questionnaires were distributed; 10 bundles each containing 10 questionnaires, 10 participant information sheets and 10 pre-paid envelopes were given to each primary seed. Each primary seed also received specific written instructions for distribution of questionnaires to secondary seeds. Secondary seeds each received 10 questionnaires, 10 participant information sheets and 10 pre-paid envelopes, along with specific instructions for their distribution to participants. Each participant received one questionnaire, one participant information sheet and one addressed, pre-paid envelope. Each participant was requested to check a box at the beginning of the survey to indicate they had read and understood the information sheet and gave consent to participate.[3]

[3] See appendices for instructions and participant information sheets.

The 12 primary seeds were known to the researcher but secondary seeds and participants remained anonymous. Each bundle of 10 questionnaires was given a specific code therefore each questionnaire received by the researcher could be attributed to a primary and secondary seed. Primary seeds were requested to assign and note the specific code given to each secondary seed. Participants were also asked 'Please tell us how well you know the person who gave you this questionnaire? (very well, quite well or not very well)' in order to understand the extent of dispersal from the researcher, primary and secondary seeds. Of participants 23.7% said very well, 29.0% said quite well and 47.3% said not very well.

In terms of incentives, a £10 'Love to Shop' high street shopping voucher was given to each primary seed and a £5 voucher to each secondary seed via the primary seed; other participants were not incentivised. Further vouchers were given to primary seeds for the reception of five or more questionnaires from any given code within their batch (one £5 voucher for every five questionnaires received). Suitable incentives have been found to reduce the biases of chain referral samples, such as voluntarism and masking, and have been demonstrated to produce samples that are independent of the initial subjects from which sampling begins (Heckathorn, 1997). In this case, compliance was encouraged using a form of group-mediated social control or secondary incentives, whereby seeds were rewarded for participation they elicited from a peer in order to encourage an amplified influence throughout social groups (Heckathorn, 1997). A total of 305 questionnaires were received, 25.1% of the total distributed; including the 91 participants from the pilot study, the total sample of adults between the ages of 18 and 30 was 396.

3.2.4 Data inputting and cleaning

Data were inputted and cleaned using IBM SPSS Statistics (v20.0). To ensure accurate and consistent data, inputting was checked after every half page of each questionnaire during data entry. Errors were first detected manually and then using basic analyses, such a frequency tests of categorical data. Each questionnaire was given a unique code during inputting and a subsample (1-%) was retrospectively checked to audit the accuracy of data entry. For non-categorical data, outliers were first searched for manually by arranging the data in ascending order; identified outliers were then excluded and marked as missing data. Exclusion was justified if a data point was found to be more or less than twice the interquartile range. For example, outliers for the question 'what do you think is the best age for: Women to start having children?' the median value was 28, the lower quartile value was 25 and the upper quartile value was 30. The difference between lower and upper quartile values was five (twice the difference was 10), therefore values below 15 (25-10) and above 40 (30+10) were excluded. A total of three responses were deleted for all questions as a result of this analysis; responses from those participants were still included in other analyses. Certain variables were not subject to these analyses; for example, the question

‘how many months or years from now do you feel sure you can at least maintain your current standard of living?’ has valid answers which range from one month to 60 years.

Unusual response patterns, such as consistently picking the first option or alternating between options, were also manually identified during inputting and marked as missing data; two participants were excluded from all analyses as a result of this identification. Internal checks were completed to check responses were not contradictory for a given participant. These analyses were undertaken to ensure similar questions were answered consistently, such as whether participants smoked cigarettes or drank alcohol; one record was deleted as a result of this process (the total usable sample was 393). Frequency of missing values was not systemic and could not be predicted from demographics or participant occupation. However, higher frequencies of missing values were found among the binary choice compared to other questions. This may indicate a difficulty among some participants in interpreting some of the binary choice questions; the trend may also have resulted from waning concentration owing to the overall length of the questionnaires and the relative thinking time associated with the binary choice questions.

3.2.5 Analyses

Preliminary analyses were conducted to understand and describe the data. Subsequent analyses were used to identify variables and indicators with the highest test validity. Identified associations were then considered in various models in order to control for the effects of demographics and confounding variables and to gain insight into the direction and extent of predictive environmental conditions and behavioural strategies. Derived models described how environmental conditions may shape evolutionary strategies and how such strategies may predict specific public health outcomes. The associations identified between environmental conditions or behavioural strategies and public health outcomes were interpreted in terms of the adaptive pressures which may underpin them. Analyses were undertaken using IBM SPSS Statistics 20.0+.

To improve the usefulness of data, response categories were sometimes combined or dichotomised, for example, for use in bionomial logistic regressions. Justification and theoretical reasoning for categorisations are provided below; the limitations of data categorisations are discussed in section 10.7.4. Missing data items were excluded for categorical and closed choice questions, for this reason numbers presented here and throughout do not always equal the total sample of participants. For continuous data and indices, missing values were replaced with the mean.

1. Demographic categorisations

Ethnicity was dichotomised into non-white (n=50, 12.7%) and white (n=343, 87.3%). Black and minority ethnic (BME) is a commonly used term to describe people of 'non-white' descent. While this grouping is frequently utilised, it is accepted that the sub groups within BME are not homogenous; equally the sub groups within the 'white' grouping are also likely to be diverse. While the variable of ethnicity was not central to the research questions, the potential limitations of these groupings were acknowledged.

Employment was dichotomised into employed full time (n=253, 64.4%) and not employed full time (n=140, 35.6%). Employment status was categorised in this way in order that participants with a stable income, the key element of behavioural decision making, were grouped.

Education was dichotomised into university educated (n=309, 79.0%) and non-university educated (n=82, 21.0%). Education was grouped in this way as schooling is free until the age of 18, while university education requires considerable time and investment; in reference to the research objectives, grouping those able and willing to invest in their education compared to those unable or unwilling was the most useful categorisation for analyses.

Total weekly household income was dichotomised into high, £700 or more per week, (n=144, 38.2%), and low, less than £200 per week to between £500 and £700 per month (n=233, 61.8%). Total weekly income was dichotomised in this way to group the relatively highest earners and the average and lowest earners; the mean household income in 2014 was £568 per week (HMRC, 2015).

2. Family categorisations

Parents lived with until the age of 16 was dichotomised into participants who grew up with both parents until the age of 16 (n=331, 84.2%) and participants who grew up with one or no parents until the age of 16 (n=62, 15.8%). Groups were determined in this way as single or no parent families may be expected to have endured potentially destabilising conditions compared to children who lived with both parents until the age of 16. While there is complex literature around the nature and extent of potential consequences of divorce, bereavement or being from a single or no parent family, these broad categorisations were deemed acceptable in terms of the developmental experience and the relevance to the research question.

3. Well-being categorisations

For adult well-being, an overall score for the SWEMWBS was calculated by summing participant scores for the seven items, low scores were based on one standard deviation below the mean (n=393, mean=26.04, STD 5.25).

4. BMI, weight and fitness categorisations

BMI values were grouped according to the standard categories of underweight (<18.5), normal weight (18.5-24.99), overweight (25-29.99) and obese (>30), which were considered as ordinal groups; for some analyses, the binary groups of overweight and obese (n=59, 18.4%) and underweight and normal weight (n=262, 81.6%) were used. Owing to potential issues of sensitivity, height and weight were optional questions and there were missing data for 72 participants.

Self-reported weight as a child was dichotomised into healthy weight or skinny as a child (n=336, 88.4%), and overweight as a child (n=44, 11.6%). For both BMI and reported childhood weight, grouping overweight and obesity together was deemed the most meaningful categorisation in terms of the relevance to the research questions.

Self-perceived fitness and healthiness was categorised as fit and healthy (n=181, 48.5%) and not fit and healthy (including fit but unhealthy, unfit but healthy and unfit and unhealthy, n=201, 51.5%). While fitness and healthiness are not synonymous terms, being unfit, unhealthy or both represents long term health risk, and for the purposes of the research objectives, these participants were grouped together.

5. Health behaviour categories

Daily consumption of fruit and vegetable portions was dichotomised as high (three or more portions per day) and low (two or less portions per day). While recommended daily limits are of 400g or five portions per day (WHO, 2008), the UK mean consumption is less (328g). In order to be best relate to the research question, the potentially highest risk participants were grouped together (those consuming the equivalent of 160g or less); it was hypothesised that the highest risk health behaviours would be predicted by strategic choice.

Frequency of weekly alcohol consumption was categorised as none or low (drinking two or less occasions per week; n=272, 70.8%) and high (drinking on more than two occasions per week, n=112, 29.2%).

For binge drinking of alcohol, participants were categorised as none (zero occasions participants drank more than 5 drinks in a single episode in typical month, n=72, 18.8%), low (one to four occasions, n=211, 55.2%), high (five to eight occasions, n=59, 15.4%) and very high (nine or more occasions, n=40, 10.2%). Binge drinking was dichotomised as high (drank five or more drinks on five or more occasions during the last month) and low (drank five or more drinks on fewer than five occasions during the last month). Similar to daily fruit and vegetable portions, there are recommended daily limits which could have been used to group participants; however, data suggests that a large proportion of people in the UK exceed these limits, a substantial proportion of which are young adults (ONS, 2015). Grouping the highest risk participants was considered the best method for identifying variations in behavioural strategies and meeting the objectives of the research.

Smoking categories were daily smokers (n=92, 24.2%) non-daily smokers (n=288, 75.8%). Ex-smokers and non-daily smokers were grouped with non-smokers as they had chosen to stop or limit the amount they smoked cigarettes, which typically represents health investment behaviour. The distinction in groups here was to identify health risk takers and compare them to participants who were averse to health risk behaviours or invested in healthy behaviour.

Violence categories were derived from the frequency of violent fights participants reported from the previous 12 months: participants who reported at least one violent fight (n=50, 13.3%) and participants who reported no violent fights (n=327, 86.7%). Participants who had engaged in one fight or more were grouped for the purposes of analyses as they represented individuals willing to engage with violence as a risk behaviour; categorising in this was meaningful in terms of the behavioural strategies relating to risk.

6. Indices for behavioural strategies

Indices were created to indicate behavioural strategies for which single items may have been subject to inconsistent or questionable construct validity. Single item measures may be less valid or reliable than multi-item alternatives and creating indices from groups of variables allows for a degree of testing of construct validity and internal consistency reliability (Nunally and Bernstein, 1994). To represent participants eating behaviour, activity levels, childhood experience, financial security, temporal perception and identified evolutionary strategies, collections of theoretically

similar variables were grouped to create indices. For each index, variables were grouped according to their theoretical relationship but the association and direction of the grouped variables were required to be statistically similar. All variables were required to correlate in the same direction and to have a correlation coefficient of greater than 0.2. Where required, variables were given inverse values to ensure a consistent direction of correlation; for example, the childhood experience index values for increasingly unhappy or violent childhoods were inverted to correlate with increasingly happy, safe or loving childhoods. Where possible, indices were subject to internal checks to ensure construct validity and internal consistency reliability between data (as described in section 3.2.4). Each index combined between four and nine theoretically similar variables; composite Z-scores were created for each variable and indices were calculated by summing the Z-scores for each variable and calculating the mean. For a given participant, if less than 50.0% of data were missing for an index, pro-rata replacement was used to populate the data with the sample mean. Participants with 50.0% or more of missing data were excluded from analyses.

The indices were tested for internal consistency reliability to estimate the proportion of variability attributable to the score and the proportion attributable to error. Cronbach's alpha was calculated to test the internal consistency reliability of each composite Z-score; variables which did not meet these criteria were removed from the scale. The overall score for Cronbach's alpha was required to be higher than 0.500 for each index to be included in analyses; less than this score was deemed statistically unacceptable and internally inconsistent (Gliem and Gliem, 2003). Cronbach's alpha scores based on standardised items are reported for each index. Several indices had 'acceptable' or 'good' levels of internal consistency, in some cases poor or questionable but acceptable levels were found; these scales were included in analyses. Their inclusion was justified since indices were not being used constructively or predictively but as general indicators of behavioural strategies, and as such were deemed to have a satisfactory level of test validity. High/low scores for each index were calculated using one standard deviation above or below the mean. Given below are the indices used throughout analyses:

Financial security and stability index

The financial security and stability index was comprised of 393 participants, the range of scores was between -2.51 and 7.58, the mean was 0.00 and the SD was 3.23. Using the composite Z-scores, Cronbach's alpha score was 0.672 for this index, which was acceptable.

Adult well-being index

The adult well-being index, taken from WEMWBS scores, was comprised of 388 participants, the range of scores was between 1.60 and 5.00, the mean was 3.77 and the SD was 0.62. Cronbach's alpha was not calculated for this index since it is calculated from a standardised, validated set of questions.

Childhood experience index

The childhood experience index was comprised of 393 participants, the range of scores was between -14.80 and 3.09, the mean was 0.00 and the SD was 3.80. Using the composite Z-scores, Crombach's alpha score was 0.804 for this index, which was a good level of internal consistency.

Eating preference for pleasurable or healthy foods

The eating for pleasure or health index was comprised of 393 participants, the range of scores was between –12.33 and 9.46, the mean was 0.00 and the SD was 3.45. Using the composite Z-scores, Crombach's alpha score was 0.622 for this index, which was acceptable.

Physical activity index

The physical activity index was comprised of 393 participants, the range of scores was between –8.72 and 8.86, the mean was 0.00 and the SD was 3.48. Using the composite Z-scores, Crombach's alpha score was 0.769 for this index, which was acceptable.

The health risk taking index

The health risk taking index was comprised of 393 participants, the range of scores was between -6.66 and 14.14, the mean was 0.00 and the SD was 3.46. Using the composite Z-scores, Crombach's alpha score was 0.620 for this index, which was acceptable.

Financial risk taking

The financial risk taking index was comprised of 393 participants, the range of scores was between -2.51 and 7.58, the mean was 0.00 and the SD was 3.02. Using the composite Z-scores, Crombach's alpha score was 0.741 for this index, which was acceptable.

Reproductive strategy index

The reproductive strategy index was comprised of 393 participants, the range of scores was between -7.14 and 15.11, the mean was 0.00 and the SD was 2.75. Using the composite Z-scores, Crombach's alpha score was 0.644 for this index, which was acceptable.

Health offsetting index

The health offsetting index was comprised of 393 participants, the range of scores was between -2.40 and 5.72, the mean was 0.00 and the SD was 2.09. Using the composite Z-scores, Crombach's alpha score was 0.511 for this index, which was acceptable.

Achieving and striving index

The achievement and striving index was comprised of 393 participants, the range of scores was between -3.12 and 2.36, the mean was 0.00 and the SD was 1.80. Using the composite Z-scores, Crombach's alpha score was 0.586 for this index, which was acceptable.

7. Other behavioural strategy questions

Indices for investing, reviewing, planning, cooperation, trust and altruism behaviours were omitted from statistical modelling but were used for some descriptive analyses or cross-tabulations. For some analyses:

i. Investment behaviour was measured using the single items: Which statement do you agree with: I am investing in a pension/putting money aside for older age or I would like to invest in a pension/putting money aside for older age but cannot afford to; and, which statement do you agree with: I do not think it is worth putting money aside for old age or I do not think much about older age.

ii. Reviewing behaviour was measured using the single item: Which statement do you agree with: I routinely review my experiences or I tend to not dwell on what has happened.

iii. Planning behaviour was measured using the single items: Which statement do you agree with: I am always planning for the future or I tend to wait and see how things

develop; and, I have made plans for retirement or I have not thought that far ahead.

iv. Cooperation behaviour was measured using the single item: Which statement do you agree with: In life it is generally every man/woman for themselves or we are all in life together.

v. Trust behaviour was measured using the single item: Which statement do you agree with: Most people you meet in life can be trusted or most people you meet in life cannot be trusted.

vi. Altruism behaviour was measured using the single item: Which statement do you agree with: I would donate a kidney to save someone else's child even if it meant risking my life or I would not donate a kidney to save someone else's child.

Indices were dichotomised or divided into groups based on one standard deviation above or below the mean (0.00 for composite Z-scores):

i.	Security and Stability Index:	N=393, mean=0.00, STD 3.23
ii.	Adult well-being	N=388, mean=3.77, STD 0.62
iii.	Childhood Experience Index:	N=393, mean=0.00, STD 3.79
iv.	Eating for Pleasure or Health Index:	N=393, mean =0.00, STD 3.44
v.	Physical activity Index:	N=393, mean=0.00, STD 3.47
vi.	Health Risk Taking Index:	N=393, mean=0.00, STD 3.45
vii.	Financial Risk Taking Index:	N=393, mean=0.00, STD 3.02
viii.	Reproduction Index:	N=393, mean=0.00, STD 2.75
ix.	Offsetting Index:	N=393, mean=0.00, STD 2.09
x.	Achieving and Striving Index:	N=393, mean=0.00, STD 1.80

5. Statistical procedures

Correlations and associations were identified between indices, or individual variables and various outcomes. The Kolmogorov-Smirnov test and the Shapiro-Wilk test were used to test data for normality; normally distributed or parametric associations were measured and tested for statistical significance using the Pearson Product-Moment Correlation test and not normally distributed or non-parametric associations were tested using the Spearman Rank Correlation Coefficient. A less-conservative modified Bonferroni adjustment was applied to p-values where three or more

measures were used in analyses (Jaccard and Wan, 1996). Holm's sequential Bonferroni adjustment was used to protect against both over-claiming and under-claiming the number of significant differences between values (Holm, 1979).

Cross-tabulations were used to analyse bivariate frequency distributions; the Chi-Square statistical test ($\chi 2$) was used to determine statistical significance. For the primary study, cross tabulations were run of totals available for each sub heading e.g. trust/cooperation; where multiple variables were grouped under one sub-heading, missing data for any included question were omitted from analyses.

Where indices did not have good internal consistency, Principle Component Analysis (PCA) was used to identify the strongest single predictive indicator for a given behaviour (e.g. altruistic tendencies). An oblique rotation was applied since the factors were deemed to be related. This analysis provided the statistical justification for the inclusion or omission of variables for certain analyses. The Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy were used to determine the strength of the concept (KMO scores >0.9 were classed as very good, scores >0.8 were classed as good and scores >0.7 were classed as reasonable). PCA allowed variables to be ordered in terms of their strength and provided statistical justification for predictive independent variables included in regression models.

Backwards conditional logistic regression models were used to identify the predictive utility of independent variables for each dependent variable. Related variables, as indicated by correlation and PCA analyses, were selected for various models but only significant variables were reported. Significance of regression models was derived using the ANOVA Test; 95% confidence intervals (0.05%) and Odds Ratios (OR) were also reported.

Latent profile analysis (LPA) was used to identify unobservable clusters or groups of respondents that were homogenous in their responses to sets of questionnaire items, and who are substantively different from individuals in other groups (Bakk, Tekle and Vermunt, 2013). Latent Gold 5.0 software was employed (Vermunt and Magidson, 2013) using model based posterior membership estimated by maximum likelihood methods, where class size differs between groups using a random-effects approach. Latent Gold uses the Expectation Maximization algorithm for processing missing data. To investigate the relationship between class membership and external variables, a three-step modelling method was used. Step three modelling resolves the biases of an unadjusted system, where downward estimates and classification errors may occur, by adjusting step-three analysis procedures based on corrections according to estimates of classification errors (Bakk, Tekle and Vermunt, 2013). Step one involved estimating the latent profile model of

interest using developmental or behavioural strategies, which were significantly associated to one or more outcome variable. Up to 10 clusters were run for each model and the number of classes for each model was determined primarily using the Bayesian Information Criterion Index (BIC), where the lowest BIC number indicated the model of best fit. Entropy R^2 values were also considered, which indicate how well class membership can be predicted based on the observed variables; the closer this value is to 1 the better the predictions (Vermunt and Magidson, 2013). High entropy values are over 0.80, medium between 0.60 and 0.80, and low between 0.40 and 0.60 (Clark and Muthén, 2009). Step two assigns individuals to latent profiles using their posterior class membership probabilities. Step three explores the association between the assigned class memberships and external variables. Step three was used for proximal or concomitant variables, sociodemographic covariates which predict profile membership, and distal outcomes, dependent health variables predicted by profile membership (Lanza, Tan and Bray, 2013). Proximal or concomitant variable analysis yields multivariate analysis where variables were entered into a logistic regression for the latent profiles, and distal outcome analysis yields a bivariate analysis for each dependent variable, similar to crosstabs for categorical data and ANOVA for continuous data (Vermunt and Magidson, 2013). Maximum Likelihood (ML) adjustment was used (Vermunt, 2010), with modal classification, where individuals were assigned to the class with the largest posterior membership probability. All missing values were included and outputs were presented dummy first for step three analysis.

3.3 Study 2

To supplement Study 1, a secondary analysis of the North West Mental Well-Being Survey (NWMWBS) 2012/13 was undertaken. The NWMWBS was conducted in the North West region of England, the population of which was 7,056,000 in 2011 (ONS, 2011). An original question (section 3.3.1 ci) from the primary study was incorporated into the NWMWBS in order to maintain a consistent indicator for the specific health outcome of eating preference. Data was used with permission from the former North West Public Health Observatory (NWPHO), now Public Health England (PHE). The confidentiality Code of Conduct relating to the IG Toolkit Requirement 220 was submitted (Department of Health, 2003) in keeping with the Data Protection Act (1998) and the Misuse of Computers Act (1990).

3.3.1 Questionnaire design[4]

The NWMWBS questionnaire was developed by the former NWPHO, now PHE [5] in collaboration with commissioners. Following discussions with colleagues from the former NWPHO, agreement was obtained for a question from the primary study in this PhD research to be included in the NWMWBS questionnaire. The question relates to general food preference, as detailed below.

Relevant questions from the NWMWBS that were used in this study are given here by question theme:

1. **Socio-demographics**

- Participant age – free text (numeric).
- Participant gender - categorical (male; female).
- Self-identified sexual identity – categorical (Lesbian/Gay; Bisexual; Heterosexual; Other; Refused [try to avoid]).
- Education level (the National Qualification Framework; 2006) – categorical (1+O levels/CSEs/GCSEs [any grades], Basic Skills; NVQ Level 1, Foundation GNVQ; 5+O levels [any grade], CSEs [grade 1], GCSEs [grades A*-C]; School Certificate, 1+ A levels/ AS levels/VCEs; NVQ Level 2, Intermediate GNVQ City and Guilds Craft, BTEC; First/General Diploma, RSA Diploma; Apprenticeship; 2+A levels, 4+AS levels, Higher school Certificate; NVQ Level 3, Advanced GNVQ, City and Guilds Advanced Craft;

[4] See appendices for full questionnaire.
[5] PHE is an operationally autonomous executive agency of the Department of Health (DoH).

ONC,OND, BTEC National, RSA Advanced Diploma; First Degree [e.g. BA, BSc], Higher degree [e.g. MA, PhD, PGCE]; NVQ Level 4-5, HNC, HND, RSA, Higher Diploma, BTEC Higher level; Professional Qualifications [e.g. nursing, teaching, accountancy]; Other vocational/work related qualifications; Foreign qualifications; No qualifications).

- Employment status – categorical (Paid Work: Full Time; Paid Work: Part Time; Self Employed; Full Time Education; Out Of Work, registered unemployed and actively seeking work; Out Of Work , registered unemployed but not actively seeking work; Permanently Sick Or Disabled; Not Working For Domestic Reasons; Retired; Other).
- Current deprivation - Allocated based on the IMD 2010 quintile of the LSOA in which the participant lived.
- Financial security and stability – Multiple choice (Which of these phrases comes closest to describing your feelings about your household income these days? Living comfortably on present income; coping on present income; finding it difficult on present income; finding it very difficult on present income).

2. Community

- Community belonging – Multiple choice (How strongly do you feel you belong to your immediate neighbourhood? Very strongly, fairly strongly, not strongly, not at all).
- Perceptions of community safety – five point Likert scale (How safe or unsafe do you feel outside after dark/outside during the day/home alone at night).

3. Adult well-being and general health

- The standardised SWEMWBS – five point Likert scale seven aspects of well-being (Section 3.2.1 – d).
- Self-reported general health – Multiple choice (How is your health in general? Very good, good, fair, bad, very bad, don't know).

4. Childhood experience

- Self-assessed childhood experience was measured - ten point Likert scale (Overall how happy would you say your childhood was).
- Self-assessed childhood violence was measured - ten point Likert scale (Overall how violent [this includes violence you may have witnessed] would you say your home life as a child was?).

5. Food preferences and behaviours

- Food preference - Binary choice (I prefer foods that are good for my long term health; I prefer foods that make me feel good when I eat them).
- Daily consumption of fruit and vegetable portions - categorical (0; 1; 2; 3; 4; 5 or more).

6. Physical activity

- Physical activity – free text (How many days in the past week have you accumulated at least 30 minutes of moderate intensity physical activity, such as brisk walking, cycling, sport, exercise and active recreation).
- Sedentary time – free text (Not including the time you spend sleeping, how much time do you usually spend sitting or reclining on a typical day).

7. Drinking alcohol

- Binge drinking – categorical (How often do you have six or more drinks in one session: never; less than monthly; 1 or 2 times a month; weekly; 2-4 times a week; daily or almost daily).
- Weekly alcohol consumption –Of participants who indicated they had consumed alcohol in the past week, total alcohol consumption was calculated by summing units reported for each day.

8. Smoking cigarettes

- Smoking status - categorical (Non-smoker; current smoker; ex-smoker).

9. Indirect evolutionary

i. **Trust**

- Trusting the general public – ten point Likert scale (Most people can be trusted or you can't be too careful).

i. **Altrusim**

- Voluntary work in the past twelve months – Categorical (Yes; No).

3.3.2 Data collection

Data collection for the NWMWBS 2012/13 was undertaken by a commercial market research company (MRUK Research Ltd) on behalf of the former NWPHO. The target sample size was 11,500 in order to provide a representative sample of the region. A clustered-random approach was employed using the national Postcode Address File, which details addresses and postcodes within lower super output areas (LSOAs). Each LSOA contains approximately 1,500 residents and is assigned a measure of deprivation based on 38 indicators (DCLG, 2016), as derived from the Index of Multiple Deprivation (IMD) 2010. A random selection of LSOAs were taken from each deprivation quintile in proportion with their occurrence for given administrative areas. A total of 21,694 households were selected to account for ineligibility and non-compliance (Bellis et al., 2012).

Between September 2012 and March 2013 a total of 14,737 households were approached, 67.9% of selected households, before the target sample size was reached. Trained interviewers attempted to visit each household on four occasions between the hours of 9:00 and 20:00 on weekdays and 10:00 and 18:00 at the weekend. Upon making contact with potential participants, interviewers gave information regarding the purpose of the research, assured confidentiality, anonymity and that participation was entirely voluntary. Within given households individuals were selected based on the person with the next birthday. Of the total households visited, 9.1% (1,339) refused to participate and 12.9% (1,898) were ineligible (e.g. household members were physically or mentally unable to participate; households were vacant or non-residential). Participation was successful for 89.6% of eligible households and 78.0% of the total visited addresses.

Hand-held computer-assisted interviewing devices were used to collect data with interviewers providing assistance where required. The structured survey included questions relating to demographics (such as gender, age and ethnicity), personal relationships, work and employment, physical health and well-being in addition to various lifestyle behaviours (such as diet and exercise). Participants were allocated a measure of deprivation based on the IMD 2010 quintile of the LSOA in which they lived. Employment categories were employed (full time, part-time or self-employed), unemployed (seeking work or not seeking work for reasons of disability), full-time student, retired or other/domestic. Standard UK ethnic group categories (ONS, 2001) were

used for the recording of ethnicity. For purposes of analyses, ethnicity was broadly categorised as white and non-white, owing to relatively small numbers of most minority groups.

3.3.3 Data cleaning

Consistent with study 1, unweighted data were used. This dataset allowed relationships from study 1 to be tested in a much larger dataset. While behavioural strategies were not recorded in study 2, relationships would be explored between socioeconomic variables and health outcomes. Similar to study 1, the exploratory analysis would seek to identify relative change in health outcomes between demographic and socioeconomic groups. Caveats to the comparison could arise if the demographics or socioeconomic variables differed substantially between the samples. Preliminary data cleaning was undertaken to remove missing and incomplete data. For the purposes of this study, for all analyses, respondents below the age of 18 (n=47) and above the age of 30 (n=9,404) were excluded; individuals missing data on key variables were also excluded (age n=90, ethnicity n=24, childhood happiness n=63, childhood violence n=67; individuals may have missed more than one data item). The total sample was 11,253 and the 18-30 year old sub sample was 2,047 (97.8% and 17.8% of all those completing the survey respectively).

3.3.4 Analyses

As far as possible, data categorisations and analyses were consistent with study 1. A sub-sample of 18-30 year olds was used for all analyses. There were insufficient variables to create indices of evolutionary strategies from NWMWBS data; measures of altruism and trust were used as single item measures.

As with the primary study, response categories were sometimes combined or dichotomised. Data categorisations have been divided according to question subject:

1. **Demographic categorisations**

Ethnicity was dichotomised into white (n=1877, 91.7%) and non-white (n=170, 8.3%).

Employment was dichotomised into employed full time (n=739, 36.1%) and not employed full time (n=1308, 63.9%).

Education was dichotomised into higher education (level 4+; n=309, 79.0%) and non-higher education (none, entry level 1, level 2-3; n=82, 21.0%).

Deprivation was dichotomised high (most and 2nd most deprived; n=560, 27.4%) and low (3rd most, 4th most, and least deprived; n=1487, 726.6%).

2. Childhood experience and well-being categorisations

Childhood happiness and violence were highly associated (correlation coefficient 0.497, p=0.000) and for the purposes of analyses, were combined into four categories happy and non-violent (n=1371, 67.0%), unhappy but non-violent (n=300, 14.7%), happy but violent (n=70, 3.4%) and unhappy and violent (n=306, 14.9%). Childhood experience was dichotomised as happy and non-violent (n=1371, 67.0%) and unhappy and/or violent (n=676, 33.0%).

Adult well-being was dichotomised into low (<1 SD below the mean WEMWBS score, (mean=27.49, SD 5.05; n=322, 15.7%) and high (n=1725, 84.3%).

3. Social and community

Community belonging was dichotomised into participants who felt a sense of community belonging (very strong and fairly strong, n=1233, 60.2%) and (not strong and not at all; n=814, 39.8%).

Perceptions of community safety scores were summed for three components: Outside after dark/outside during the day/home alone at night. Community safety was dichotomised into less safely perceived communities (<1SD below the mean, mean=13.02, SD=2.42; n=315, 15.5%) and safely perceived communities (n=1720, 84.5%).

4. Health behaviour categories

Daily fruit and vegetable consumption was dichotomised into low (2 or less portions per day; n=883, 43.2%) and high consumption (3 or more portions per day; n=1162, 56.8%).

Smoking status was dichotomised into current daily smokers (n=656, 32.0%) and non-current daily smokers (n=1391, 68.0%).

Binge drinking (consuming six or more drinks or a given occasion) was dichotomised into high (weekly or more often; n=289; 18.8%) and low (less than weekly; n=1251; 81.2%).

Weekly drinking (units consumed) was dichotomised into high (25 units or more per week; n=276, 13.5%) and low (less than 25 units per week; n=1771, 86.5%).

5. Lifestyle and behavioural strategies

Altruism was dichotomised into participants who had undertaken voluntary work in the last 12 months (n=227; 11.1%) and participants who had not (n=1820, 88.9%).

Level of trust of others was categorised into three groups: low trust of others, scores 1-3, 'you can't be too careful', middle ranking, scores 4-7, and high trust of others, scores 8-10, 'most people can be trusted'. Trust was then dichotomised into participants who reported low general trust of others (n=500, 24.4%) and participants who were averagely or highly trusting of others (n=1547, 75.6%).

6. Physical activity and exercise

Physical activity (30 minutes moderate intensity) was also dichotomised into high (more than four times per week (n=684, 33.6%) and low (four times per week and less; n=1350, 66.4%).

Daily sedentary time was categorised into <=2 hours, >2 and <=4 hours, >4 <=8 hours, and >8 hours. Sedentary time was dichotomised into low (<=4 hours; n=1479, 72.3%) and high (>4 hours; n=556, 27.2%).

3.5 Ethical approval

Ethical approval for both studies was granted by Liverpool John Moores University Research Ethics Committee.

4. DESCRIPTIVE STATISTICS

4.1 Study 1

4.1.1 Demographics

Study 1 was comprised of 393 participants, of which 171 (44.0%) were males and 218 (56.0%) were females. Of participants, 185 (47.1%) were aged between 18 and 24 years and 208 (52.9%) were aged between 25 and 30 years. In terms of self-reported ethnicity, 343 (87.3%) were white and 50 (12.7%) were non-white; of those non-white, 8 (2.0%) were Arab or middle eastern, 14 (3.6%) were Asian or Asian British, 10 (2.5%) were black or black British, 14 (3.6%) were Chinese and 3 (0.3%) identified themselves as 'other' ethnicity). In terms of sexuality, 363 (92.6%) described their sexuality as heterosexual, 21 (5.4%) as homosexual (lesbian or gay) and 8 (2.0%) as bisexual. In terms of education, 82 (21.0%) were educated to secondary education level and 309 (79.0%) to higher education level (university/college). In terms of employment 224 (57.0%) were employed full time, 29 (7.4%) were employed part time, 16 (4.1%) were unemployed and 124 (31.6%) were in full time education. In terms of total weekly household income, 57 (15.1%) reported an income of less than £200, 108 (28.7%) reported an income of between £200 and £500 (18.0%) reported an income of between £500 and £700 and 144 (38.2%) reported an income of £700 or more. Participants reported working for between 0 and 20 companies from the age of 18 (3.6 companies on average). Ninety-one participants reported being out of work or full time education since the age of 18 for between 0.5 and 25 years (mean 2.17, SD 3.14).

4.1.2 Family

In terms of family dynamics, 331 (84.2%) participants grew up with both parents until the age of 16, 61 (15.5%) lived with one parent until the age of 16, and 1 (0.3%) lived with neither parent until the age of 16. In terms of siblings, 30 (7.7%) were only children, 360 (92.3%) had/have siblings, (the range was 1-12 and mean number of siblings was 1.94, sibling age was not recorded). In terms of children, 351 (89.8%) did not have any children, 28 (7.2%) had one child and 12 (3.1%) had two children. In terms of grandparents, 131 (35.4%) reported that both their maternal and paternal grandparents lived until or beyond the age of 75 and 239 (64.6%) reported that one or more of their maternal and paternal grandparents died before the age of 75. In terms of wanting offspring 27 (7.1%) reported they did not want any children, 352 (92.9%) reported they did want children (the range was 1-7 and mean number of children was 2.31).

4.1.3 BMI and eating behaviours

In terms of BMI (as calculated from self-reported height and weight), 65 (20.2%) participants reported being underweight, 197 (61.4%) were normal weight, 51 (15.9%) were overweight, and 8 (2.5%) were obese. With respect to eating behaviours, 62 (15.8%) reported being a vegetarian at some time since the age of 18, and 329 (84.1%) reported not having been a vegetarian since the age of 18. In terms of general eating preference, 173 (50.4%) reported eating foods mainly for pleasure and 170 (49.6%) reported eating foods mainly for health. In terms of satiation, 226 (57.8%) reported preferring foods which made them feel full and 165 (42.2%) reported preferring foods which contained good quality ingredients. In terms of leaving food, 296 (75.7%) reported typically eating all the food on their plate and 95 (24.3%) reported usually leaving some food on their plate. In terms of care taken over diet, 189 (48.5%) reported being careful about what they ate and 201 (51.5%) reported eating anything.

4.1.4 Health risk behaviours

In terms of weekly drinking, 65 (16.9%) reported not drinking alcohol during the past week; of participants who reported drinking alcohol in the past week, 211 (55.2%) reported drinking on one or two occasions, and 112 (29.2%) reported drinking on more than two occasions. In terms of binge drinking, 72 (18.3%) participants reported not drinking five or more drinks during the past month, 211 (55.2%) participants reported drinking five or more drinks on one to four occasions, 59 (15.4%) participants reported drinking five or more drinks on five to eight occasions, and 40 (10.2%) participants reported drinking five or more drinks on nine or more occasions.

Of participants, 288 (75.8%) were not daily smokers (including non-smokers, ex-smokers and less than daily smokers, and 92 (24.2%) were daily smokers; of daily smokers the mean cigarettes smoked per day was 6.9 (range 1-24).

In terms of risky sexual practices, 107 participants (28.0%) believed unprotected sex was worth the risk, while 275 (72.0%) believed unprotected sex is something you should do only when you want to conceive. Of participants, 156 participants (42.6%) reported that they felt condoms made sex less enjoyable and 210 (57.4%) participants reported that condoms made them feel safer during sex.

In terms of violence, 327 (86.7%) participants reported they had not been involved in a violent fight in the past 12 months, and 50 (13.3%) reported that they had (of participants who had been involved in a violent fight, range=1-29, mean=2.18). Of participants, 185 participants (47.9%)

reported that they would fight back if hit by a person bigger than themselves and 201 (52.1%) reported that they would run away.

In terms of self-perceived fitness and healthiness, 189 (48.5%) participants perceived themselves to be fit and healthy, 51 (13.1%) perceived themselves to be fit but unhealthy, 113 (29.0%) perceived themselves to be unfit but healthy, and 37 (9.5%) perceived themselves to be unfit and unhealthy. In terms of attitudes to exercise, 192 (49.5%) participants reported that they already exercised for 30 minutes per day, 107 (27.6%) reported that they would exercise for 30 minutes per day if it extended their life by five years, 38 (9.8%) reported that they would exercise for 30 minutes per day if it made them look five years younger, and 51 (13.1%) reported that neither potential benefit would make them exercise for 30 minutes per day. In terms of enjoyment of exercise, 213 (54.6%) of participants reported that they enjoyed exercise, 105 (26.9%) reported that they did not enjoy it but did it anyway, and 72 (18.5%) reported that they did not enjoy and did not do it. Participants reported watching an average of 2.3 hours of television per day, spending an average of 7.8 hours per day in bed, spending a mean of 5.3 hours moving around, playing sport a mean of 2.5 days per week, and walking for at least 20 minutes per day a mean of 3.3 days per week. Participants estimated a mean 9.7 years lost due to not exercising for 30 minutes per day.

Table 1 displays the descriptive statistics for various health behaviours relating to exercise, food, alcohol and cigarette consumption; none of the variables were found to be normally distributed (Kolmogorov-Smirnov, all $p=0.000$).

Table 1. Descriptive statistics for food consumption, health risk behaviours, and activity

	N	%	Range	Mean	SD
Food consumption					
Total weekly meals consumed	385	98.0	6-21	17.86	3.77
Home prepared evening meals consumed per week	386	98.2	0-7	4.88	2.11
Readymade evening meals consumed per week	379	96.4	0-7	1.25	1.87
Takeaway evening meals consumed per week[6]	384	97.7	0-3.5	0.68	0.60
Pub or restaurant evening meals consumed per week[9]	384	97.7	0-7.5	0.74	0.72
Portions of fruit and vegetables consumed on a normal day	329	83.7	0-10	2.83	1.64
Snacks consumed per day	342	87.0	0-10	2.19	1.60
Alcohol Consumption					
Occasions alcohol was consumed in the previous week (all respondents)	384	97.7	0-7	1.98	1.69
Occasions alcohol was consumed in the previous week (last week drinkers only)	342	89.1	0-7	2.14	1.62
Occasions more than five drinks were consumed in previous last month (all respondents)	382	97.2	0-26	3.63	4.13
Occasions more than five drinks were consumed in the previous month (last month drinkers only)	310	78.9	1-26	4.47	4.16
Frequency of drunkenness in the last 12 months (all respondents)	378	96.2	0-180	21.37	27.87
Frequency of drunkenness in the last 12 months of drinkers (last year drinkers only)	327	83.2	1-180	24.71	28.56
Smoking					
Cigarette consumption (of daily smokers)	92	24.2	1-24	6.90	5.43
Activity and exercise					
Days in a typical week a sporting activity is played	385	98.0	0-7	2.46	1.96
Days in a typical week at least 20 minutes walking is undertaken	385	98.0	0-7	3.38	2.41
Hours per day watching tv	392	99.7	0-6	2.27	1.352
Hours per day in bed	392	99.7	0-17	7.82	1.642
Hours per day moving	389	99.0	0-20	5.29	3.881
Pleasure exercising (1-5)	391	99.5	1-5	3.67	1.131
Years lost due to not exercising for 30 mins per day	388	98.7	0-35	9.68	5.967

4.1.5 Childhood and well-being

On a scale between 1 and 10, where 1 was 'not at all' happy and 10 was 'very' happy, participants' median childhood happiness was 9 and modal happiness was 10 (range 1 to 10; N=391). For teenage and young adults' happiness (between ages of 11 and 20) median happiness was 8 and modal happiness was 9 (range 1 to 10; N=391). Participants' mean score for adult well-being was 3.76 (N=388, SD=0.62) and participants reported enjoying 4 (median and mode) days in a typical week (N=386). Two questions relating to temporal perception were combined; 36 (9.2%) reported mostly thinking in terms of the present moment, 132 (33.7%) reported thinking in terms of the

[6] As calculated from monthly frequency.

present, the past and the future and 224 (57.1%) reported rarely thinking in terms of the present moment (i.e. mostly thinking about the past or the future).

4.1.6 Distributions between behavioural strategies

Distributions of behavioural strategy behaviours and choices between demographic and socioeconomic groups are presented here; unless stated, differences in distributions between groups were not statistically significant.

A higher proportion of males were 1SD above the mean on the reproductive strategy index (representing having more children and at a younger age) than females 29 (17.0%) compared to 24 (11.0%). A higher proportion of females reported altruistic tendencies (would donate a kidney to a non-kin child) than males 130 (61.0%) compared to 94 (55.6%). A higher proportion of females reported cooperative tendencies ('in life we are all in it together') than males 127 (58.5%) compared to 82 (49.4%); the difference in distribution was statistically significant (n=383, X^2=3.161, p=0.047). A higher proportion of females reported trusting other people than males 138 (63.6%) compared to 97 (57.7%). Similar proportions of males and females reported saving their money 97 (44.7%) females and 77 (45.5%) males. A higher proportion of females were found to review their behaviour than males 157 (72.4%) compared to 108 (63.5%); the difference in distribution was found to be statistically significant (n=387, X^2=3.436, p=0.041). A higher proportion of females were found to plan for the future than males 130 (59.9%) compared to 92 (54.8%). Similar proportions were found to be highly achievement striving 134 (78.4%) males and 167 (76.6%) females.

A higher proportion of younger participants (aged 18 to 24) were 1SD above the mean on the reproductive strategy index (representing having more children and at a younger age) than older participants (aged 25 to 30), 36 (19.5%) compared to 17 (8.2%); this difference in distribution was found to be statistically significant (n=393, X^2=10.690, p=0.001). A higher proportion of younger participants reported altruistic tendencies than older participants 115 (63.2%) compared to 111 (54.7%). A higher proportion of older participants reported cooperative tendencies than younger participants 121 (59.0%) compared to 91 (50.3%). A higher proportion of older participants reported trusting others than younger participants 142 (68.9%) compared to 95 (52.2%), this difference in distribution was found to be statistically significant (n=388, X^2=11.383, p=0.001). Similar proportions of older and younger participants reported investing their money 93 (45.4%) and 83 (45.1), reviewing their decisions 141 (68.4%) and 126 (68.5%), planning for the future 119 (58.0%) and 105 (57.4%), and reported high achievement striving 160 (76.9%) and 145 (78.4%). The distributions between demographic variables of health risk behaviours are presented in chapter 6.

A lower proportion of participants who were employed full time were 1SD above the mean on the reproductive strategy index (representing having more children and at a younger age) than participants who were not employed full time 23 (9.1%) compared to 30 (21.4%); this difference in distribution was found to be statistically significant (n=393, X^2=11.759, p=0.001). Similar proportions of participants who were employed full time and those that were not reported altruistic tendencies 143 (57.9%) and 83 (60.1%), reported reviewing their decisions 172 (68.5%) and 95 (68.3%), reported planning for the future 142 (57.3%) and 82 (58.6%), reported saving their money 112 (45.0%) and 64 (45.7%), and reported high achievement striving 194 (76.7%) and 111 (79.3%). A higher proportion of participants who were employed full time were cooperative than those that were not 142 (57.3%) compared to 70 (50.7%). A higher proportion of participants who were employed full time were trusting of others than those that were not 161 (64.4%) compared to 70 (55.1%); the difference in distribution was found to be statistically significant (n=388, X^2=3.254, p=0.045).

A higher proportion of lower income participants were 1SD above the mean on the reproductive strategy index (representing having more children and at a younger age) than higher income participants 40 (17.2%) compared to 12 (8.3%); this difference in distribution was found to be statistically significant (n=377, X^2=5.841, p=0.010). Similar proportions of lower and higher income participants reported altruistic tendencies 143 (57.9%) and 83 (60.1%), cooperative tendencies 128 (55.4%) and 74 (52.9%), being trusting of other people 139 (60.7%) and 87 (60.8%), saving their money 101 (43.5%) and 66 (46.8%), reviewing their decisions 101 (70.6%) and 153 (66.2%), and high achievement striving 117 (81.3%) and 175 (75.1%) respectively. A higher proportion of higher income participants reported planning for the future than lower income participants 92 (65.2%) compared to 123 (53.2%); this difference in distribution was found to be statistically significant (n=372, X^2=5.170, p=0.015). The distributions between socioeconomic variables of health risk behaviours are presented in chapter 6.

Increasing security and stability was found to be positively associated with positive childhood experience (n=393, ρ= 232, adjusted α=0.0063, p=0.000), negatively associated with reproductive strategy (having more children and at a younger age; n=393, ρ= -0.167, adjusted α=0.0083, p=0.001), and positively associated with eating for health (n=393, ρ= 0.171, adjusted α=0.0071, p=0.001). There were no significant associations between the security and stability index and general health risk taking, financial risk taking, physical activity, health off setting and achievement striving.

4.2 Study 2

4.2.1 Demographics

The NWWBS 18-30 data set comprised 2,047 participants, of which, 850 (41.5%) were males and 1,197 (58.5%) were females. In terms of age, 975 (47.6%) were aged between 18 and 24 years and 1,072 (52.4%) were aged between 25 and 30 years. In terms of ethnicity, 1,877 (91.7%) were white and 170 (8.3%) were non-white. In terms of sexuality, 1,952 (95.4%) described their sexuality as heterosexual, 46 (2.2%) as homosexual (lesbian or gay), 24 (1.2%) as bisexual and 25 (1.2%) specified 'other' or refused to answer.

In terms of education, 310 (15.1%) participants reported that they did not have any qualifications, 1,421 (68.4%) were educated to secondary education level and 316 (15.5%) were educated to higher education level (university/college). In terms of employment, 780 (38.1%) were employed full-time (including participants who reported being self-employed), 268 (13.1%) were employed part-time, 41 (2.0%) were self-employed, 247 (12.1%) were in full time education, 385 (18.8%) were unemployed and 367 (17.9%) reported 'other' employment status, including domestic workers. Income was not recorded; however, 460 (22.5%) described themselves as 'living comfortably on their present income', 1072 (52.4%) described themselves as 'coping on their present income', 381 (18.6%) described themselves as 'finding it difficult on their present income' and 134 (6.5%) described themselves as 'finding it very difficult on their present income'.

4.2.2 Eating behaviours, general health and health risk behaviours

In terms of eating preferences, 1,272 (62.2%) of participants reported eating mainly for pleasure and 773 (37.8%) of participants reported eating mainly for health. In terms of self-perceived general health, 1,103 (53.9%) participants reported their health to be very good, 693 (33.9%) reported their health to be good, 206 (10.1%) reported their health to be fair and 40 (1.9%) reported their health to be bad or very bad. In terms of frequency of consuming six or more drinks, 6 (0.4%) participants reported daily or almost daily, 77 (5.0%) participants reported 2-4 times per week, 205 (13.3%) participants reported weekly, 324 (21.1%) participants reported 1 or 2 times per month, 527 (34.3%) participants reported less than monthly and 399 (25.9%) participants reported never consuming six or more drinks. In terms of cigarette consumption, 924 (45.2%) participants were non-smokers, 779 (38.1%) participants were current smokers, of which 655 (32.0%) were daily smokers, and 342 (16.7%) participants were not current smokers. Table 2 displays the descriptive statistics for various health behaviours relating to activity, fruit and vegetable consumption and drinking alcohol behaviours.

Table 2. Activity, fruit and vegetable consumption and drinking alcohol behaviours for all participants

	N	%	Range	Mean	SD
Fruit and vegetable consumption					
Portions of fruit or vegetables consumed on a typical day	2047	100	0-5	2.75	1.44
Activity					
Days in a typical week 30 minutes exercise is undertaken	2036	100	0-7	3.39	2.40
Hours of sedentary time (not sleeping) during a typical day	2040	99.7	0-20	3.54	2.27
Alcohol Consumption					
Total alcohol units consumed in the past week (all participants)	2047	100	0-178	10.55	20.55
Total alcohol units consumed in the past week (last week drinkers)	941	46.0	0-178	22.90	25.15

4.2.3 Childhood and well-being

On a scale between 1 and 10, where 1 was not at all happy and 10 was very happy, participants median childhood happiness value was 9, and the modal happiness value was 10 (N=2,047). Data were not normally distributed (Kolmogrov-Smirnov, p=0.000). Participants mean score for adult well-being was 4.00 (N=2047, SD=0.73). On scales between 1 and 10, where 1 was highly dissatisfied and 10 was highly satisfied, participants' median and mode satisfaction value was 8 (N=2,045), and the extent to which participants felt the things they did in life were worthwhile was median 8 and mode 10 (N=2,034).

4.2.4 Distributions between behavioural strategies

A higher proportion of females reported altruistic tendencies (doing voluntary work in the last 12 months) than males 146 (12.2%) compared to 81 (9.5%); the difference in distribution was statistically significant (n=2,047, X^2=3.588, p=0.034). A higher proportion of females were found to be less trusting of other people compared to males 866 (72.3%) compared to 681 (80.1%); the difference in distribution was statistically significant (n=2,047, X^2=16.256, p=0.000).

Similar proportions of younger (aged 18 to 24) and older (aged 25 to 30) participants reported altruistic tendencies 866 (88.8%) and 954 (88.9%), and trust of other people 801 (74.7%) and 746 (76.5%).

A higher proportion of participants from less deprived quintiles reported altruistic tendencies than participants from the most deprived quintiles 177 (11.9%) compared to 50 (8.9%); the difference in distribution was statistically significant (n=2,047, X^2=3.651, p=0.032). A higher proportion of participants from less deprived quintiles reported trusting other people compared to participants

from the most deprived quintiles, 1,172 (78.8%) compared to 375 (67.0%); the difference in distribution was statistically significant (n=2,047, X^2=30.956, p=0.000).

4.3 Summary

Study 1 was comprised of 393 participants, recruited using convenience sample, and was exploratory in nature. The 18 to 30 data set from study 2 was comprised of 2,047 participants, recruited via a cluster random approach. Both study 1 and 2 had a higher proportion of females (56.0% and 58.5% respectively) and we predominantly white ethnicity (87.3% and 91.7%). A key difference between the samples was the proportion who reported higher education (79.0% in study 1 and 15.5% in study 2). There was also a higher proportion in study 1 compared to study 2 who reported being in full time employment (57.0% and 38.1%).

In study 1, 18.4% of participants report being overweight or obese; in study 1, 50.4% of participants reported eating mainly for pleasure, compared to 62.2% in study 2. Similar daily portions of fruit and vegetables were reported to be consumed in study 1 and 2 (2.83 and 2.75 mean daily portions respectively). Study 1 participants reported an average of 3.38 days per week in which they walked for at least 20 minutes, while study 2 participants reported exercising for 30 minutes per day an average of 3.39 days per week. A key difference in terms of health risk behaviour was the reporting of binge drinking; 81.7% of study 1 participant reported drinking five or more drinks on at least one occasion in the past month, while 39.3% of participants from study 2 reported drinking six or more drinks at least once in a typical month. In terms of current daily smoking, 24.2% of participants from study 1 reported current daily smoking compared to 32.0% from study 2. Childhood experience scores were not comparable between samples but in terms of adult well-being using the standardised WEMWBS, participants from study 2 reported slightly higher well-being (4.00 compared to 3.76 in study 1).

In terms of sex and evolutionary strategies, males in study 1 were found to favour having more children and at a younger age, compared to females; females were found to be more altruistic and trusting than males in both studies; females were found to review and plan more than males in study 1. There were few differences in terms of age and evolutionary strategies; however, older participants (aged 25 to 30 years) were found to be more trusting than younger participants (aged 18 to 24 years) in study 1. In terms of socioeconomics and evolutionary strategies, in study 1, participants who were employed full time were found to favour having less children and at an older age, and were more trusting than participants not employed full time. In study 1, lower income participants were found to be associated with having more children and at a younger age and reviewing and planning their choices less than higher income participants. In study 2, increasingly deprived participants were found to be less altruistic and trusting compared to less deprived participants.

5. EATING BEHAVIOUR AND BEHAVIOURAL STRATEGIES

This chapter explores the relationships between eating behaviours and sociodemographic variables, evolutionary and lifestyle behaviours. For both studies this includes preference for health or 'feel good' foods and daily fruit and vegetable consumption, and for study 1 this also includes BMI and the index for eating for pleasure or health. Correlations, cross tabulations and predictive variables have been reported and relationships are considered within the context of social and demographic variables. Presented are the significant and non-significant relationships between known and unknown determinants and indicators of eating behaviour.

Findings relate to research questions regarding the links between behaviour and pathology among young adults, the influence of socioeconomic variables on eating behaviour, and the influences of childhood experiences and adult well-being on eating behaviour. This chapter also considers the influence of identified evolutionary strategies (including reproductive strategy, financial strategies, altruistic and cooperative behaviour, reviewing and planning behaviour, and achievement striving) on adult eating behaviours.

5.1 Study 1

Kolmogorov-Smirnov test for normality showed that the continuous data were not normally distributed for BMI ($p=0.006$), and daily fruit and vegetable portions consumed ($p=0.000$). The scale for eating for pleasure or health was found to be normally distributed ($p=0.200$). Of the correlates for this variable, only the scale for physical activity was also parametric.

5.1.1 Correlations

Table 3 displays correlates of BMI. After adjusting the alpha value based on the Bonferroni correction, BMI was not found to be significantly associated with any variables tested. BMI was found to be approaching significance and negatively associated with increasing achievement striving ($p=0.008$) and increasing pleasure derived from eating fruit ($p=0.006$). BMI was also found to be approaching significance and positively associated with increasing frequency of binge drinking (drinking five or more drinks on five or more occasions per month; $p=0.009$), and increasing financial risk taking ($p=0.017$).

Table 3. Correlates of BMI (14.02 – 37.14)

	N	ρ	Adjusted α	Sig
Indicators of eating behaviour				
Eating for pleasure or health: (-12.3 – 9.5)	321	-0.065	0.0031	0.244
Daily fruit and vegetable consumption: (0-10)	307	0.003	0.0250	0.961
Family and social variables				
Number of siblings: (1-12)	318	0.051	0.0050	0.361
Days per month you see close friends (0-31)	312	0.058	0.0036	0.304
Income and security				
Income: Low (1) High (6)	308	0.029	0.0071	0.614
Security and stability index: Insecure (-7.8) Secure (6.8)	321	0.027	0.0083	0.636
Health, well-being and childhood experience				
Adult well-being: (0-5)	316	-0.003	0.0500	0.959
Childhood experience score: Adverse (-14.8) Positive (3.1)	321	-0.082	0.0026	0.141
Lifestyle behaviours				
Hours per day watching TV: (0-6)	320	0.072	0.0028	0.199
Hours per day in bed: (0-17)	320	-0.058	0.0038	0.300
Smoking and drinking alcohol				
Times per day smoke a cigarette: (0-24)	310	-0.030	0.0063	0.600
Binge drinking frequency: (0-26)	314	0.147	0.0021	0.009
Eating behaviours				
Days per week homemade meal: (0-7)	316	0.015	0.0100	0.785
Days per week eat ready meal: (0-7)	310	-0.065	0.0033	0.251
Days per week eat chips: (0-8)	311	0.013	0.0125	0.818
Days per month eat takeaway: (0-14)	315	0.056	0.0042	0.322
Total weekly meals: (6-21)	314	-0.009	0.0167	0.867
Pleasure eating takeaway: (1-5)	321	0.069	0.0029	0.220
Pleasure eating vegetables: (1-5)	321	-0.055	0.0045	0.325
Pleasure eating fruit: (1-5)	321	-0.154	0.0019	0.006
Behavioural strategies				
Reproductive strategy index: Less children at older age (-7.14) More children at younger age (15.11)	321	-0.083	0.0025	0.136
Activity index: Inactive (-8.7) Active (8.9)	321	-0.043	0.0056	0.440
Risk taking – health: Low (-6.7) High (14.1)	321	0.096	0.0024	0.086
Risk taking – financial: Low (-2.5) High (7.6)	321	0.133	0.0022	0.017
Offsetting index: Don't offset (-2.4) Offset (5.7)	321	-0.116	0.0023	0.038
Achievement striving: Don't strive (-3.1) Strive (2.4)	321	-0.148	0.0020	0.008

Table 4 displays correlates of the eating for pleasure or health index; variables included in the index have been omitted from analyses. In terms of income and security, increasing eating for health was positively associated with increasing security (p=0.001). In terms of childhood experience, increasing eating for health was positively associated with increasing positive childhood experiences (p=0.000). In terms of lifestyle behaviours, increasing eating for health was negatively associated with increasing time spent watching television (p=0.001). In terms of smoking cigarettes and drinking alcohol, increasing eating for health was negatively associated

with increasing number of cigarettes smoked per day (p=0.000), and increasing binge drinking (p=0.002). In terms of eating behaviours, increasing eating for health was negatively associated with increasing ready meals consumed per week (p=0.000), and increasing pleasure taken from eating takeaway meals (p=0.000), and positively associated with increasing total weekly meals (p=0.000), pleasure eating vegetables (p=0.000) and pleasure eating fruit (p=0.000). In terms of behavioural strategies, increasing eating for health was negatively associated with increasing health risk taking (p=0.000) and financial risk taking (p=0.000), and positively associated with increasing physical activity (p=0.000), increasing willingness to offset (p=0.000), and increasing achievement striving (p=0.000).

Eating for pleasure or health was also associated with estimated years lost due to health risks of being overweight or obese; increasing eating for health was positively associated with increasing estimated years lost due to being overweight or obese (N=384, ρ= 0.102, p=0.046).

Table 4. Correlates of eating for pleasure (-12.3) vs health (9.5)

	N	ρ	Adjusted α	Sig
Indicators of eating behaviour				
BMI: (14.02 – 37.14)	321	-0.065	0.0125	0.244
Family and social variables				
Number of siblings: (1-12)	390	-0.013	0.0500	0.803
Days per month you see close friends (0-31)	381	-0.060	0.0167	0.243
Income and security				
Income: Low (1) High (6)	377	0.102	0.0071	0.048
Security and stability index: Insecure (-7.8) Secure (6.8)	393	0.161	0.0050	0.001
Health, well-being and childhood experience				
Adult well-being: (0-5)	388	0.096	0.0083	0.059
Childhood experience score: Adverse (-14.8) Positive (3.1)	393	0.194	0.0038	0.000
Lifestyle behaviours				
Hours per day watching TV: (0-6)	392	-0.168	0.0045	0.001
Hours per day in bed: (0-17)	392	-0.130	0.0063	0.010
Smoking and drinking alcohol				
Times per day smoke a cigarette: (0-24)	380	-0.216	0.0036	0.000
Binge drinking frequency: (0-26)	382	-0.155	0.0056	0.002
Eating behaviours				
Days per week eat ready meal: (0-7)	379	-0.277	0.0026	0.000
Total weekly meals: (6-21)	385	0.239	0.0029	0.000
Pleasure eating takeaway: (1-5)	392	-0.233	0.0031	0.000
Pleasure eating vegetables: (1-5)	392	0.229	0.0033	0.000
Pleasure eating fruit: (1-5)	392	0.192	0.0042	0.000
Behavioural strategies				
Reproductive strategy index: Less children at older age (-7.14) More children at younger age (15.11)	393	-0.072	0.0100	0.157
Activity index: Inactive (-8.7) Active (8.9)	393	0.348	0.0024	0.000
Risk taking – health: Low (-6.7) High (14.1)	393	-0.407	0.0023	0.000
Risk taking – financial: Low (-2.5) High (7.6)	393	-0.250	0.0028	0.000
Offsetting index: Don't offset (-2.4) Offset (5.7)	393	0.336	0.0025	0.000
Achievement striving: Don't strive (-3.1) Strive (2.4)	393	0.030	0.0250	0.556

Table 5 displays correlates of daily fruit and vegetable consumption (data not normally distributed p=0.000). In terms of eating behaviours, increasing daily fruit and vegetable consumption was found to be positively associated with increasing homemade meals consumed per week (p=0.000), and pleasure eating vegetables (p=0.000), increasing daily fruit and vegetable consumption was negatively associated with increasing consumption of chips per week (p=0.000), and takeaway meals eaten per month (p=0.000). In terms of behavioural strategies, increasing daily fruit and vegetable consumption was positively associated with increasing physical activity (p=0.000), and willingness to offset (p=0.000).

Table 5. Correlates of daily fruit and vegetable consumption (0-10)

	N	ρ	Adjusted α	Sig
Indicators of eating behaviour				
BMI: (14.02 – 37.14)	307	0.018	0.0500	0.759
Family and social variables				
Number of siblings: (1-12)	372	-0.074	0.0045	0.153
Days per month you see close friends (0-31)	364	0.077	0.0042	0.142
Income and security				
Income: Low (1) High (6)	358	0.043	0.0071	0.418
Security and stability index: Insecure (-7.8) Secure (6.8)	374	0.030	0.0125	0.568
Health, well-being and childhood experience				
Adult well-being: (0-5)	371	0.031	0.0100	0.547
Childhood experience score: Adverse (-14.8) Positive (3.1)	374	0.041	0.0083	0.427
Lifestyle behaviours				
Hours per day watching TV: (0-6)	374	-0.070	0.0050	0.178
Hours per day in bed: (0-17)	374	-0.059	0.0056	0.258
Smoking and drinking alcohol				
Times per day smoke a cigarette: (0-24)	364	-0.135	0.0028	0.010
Binge drinking frequency: (0-26)	365	0.093	0.0038	0.076
Eating behaviours				
Days per week homemade meal: (0-7)	368	0.315	0.0020	0.000
Days per week eat ready meal: (0-7)	361	-0.126	0.0029	0.016
Days per week eat chips: (0-8)	363	-0.198	0.0024	0.000
Days per month eat takeaway: (0-14)	367	-0.185	0.0025	0.000
Total weekly meals: (6-21)	368	0.099	0.0036	0.057
Pleasure eating takeaway: (1-5)	373	-0.029	0.0167	0.582
Pleasure eating vegetables: (1-5)	373	0.218	0.0022	0.000
Pleasure eating fruit: (1-5)	373	0.125	0.0031	0.016
Behavioural strategies				
Reproductive strategy index: Less children at older age (-7.14) More children at younger age (15.11)	374	0.026	0.0250	0.614
Activity index: Inactive (-8.7) Active (8.9)	374	0.248	0.0021	0.000
Risk taking – health: Low (-6.7) High (14.1)	374	-0.145	0.0026	0.005
Risk taking – financial: Low (-2.5) High (7.6)	374	-0.116	0.0033	0.025
Offsetting index: Don't offset (-2.4) Offset (5.7)	374	0.201	0.0023	0.000
Achievement striving: Don't strive (-3.1) Strive (2.4)	374	0.053	0.0063	0.307

5.1.2 Cross tabulations

Table 6 displays cross-tabulations of demographic, behavioural strategies and lifestyle behaviours in terms of proportions that were overweight or obese. In terms of social and demographic variables, there were significant differences in distribution between males and females (p=0.000), and white and non-white participants (p=0.006). There were no significant differences in distribution between participants aged between 18 and 24 years and 25 and 30 years (p=0.330). In terms of childhood weight, there were significant differences in distribution between participants who reported being skinny or a healthy weight as a child and participants who reported being overweight (p=0.000). In terms of self-reported fitness and healthiness, there were significant differences in distribution between participants who reported being fit and healthy and participants who reported being unfit and/or unhealthy (p=0.026). In terms of developmental variables, there were significant differences in distribution between participants who reported growing up in communities where people kept alone and those where people knew each other (p=0.020). There were no significant differences in distribution between participants who reported growing up with both parents until the age of 16 and those that grew up with one parent or less (p=0.240). In terms of behavioural strategies, there were significant differences between participants who planned for the future and those that did not (p=0.042), and those that tended to spend extra money and those that tended to save extra money (p=0.013). There were no significant differences between participants who reviewed or rarely reviewed their experiences (p=0.116), who were altruistic or not (p=0.132), who were cooperative or not (p=0.168), and who found people to be generally trustworthy or not (p=0.427). In terms of eating behaviours, there were significant differences between participants who preferred foods which made them feel full rather than those with good quality ingredients (p=0.000), and who liked to feel full and did not like to feel full (p=0.000). There were no significant differences between those who were careful with what they ate compared to eating anything they want (p=0.058).

Table 6. Cross tabulations of BMI: Percentage overweight and obese

	All	Total	N	%	χ^2	Sig
Demographics	**Age**	321				
	18-24	150	26	17.3		
	25-30	171	34	19.9	0.342	0.330
	Sex	318				
	Male	145	48	33.1		
	Female	173	12	6.9	35.284	0.000
	Ethnicity	321				
	White	279	58	20.8		
	Non-white	42	2	4.8	6.170	0.006
Childhood weight	**Weight as a child**	310				
	Healthy weight or skinny	281	39	13.9		
	Overweight	29	17	58.6	35.552	0.000
Fitness and healthiness	**Self-reported fitness and healthiness**	320				
	Fit and healthy	156	22	14.1		
	Not fit and healthy	164	38	23.2	4.316	0.026
Development	**Parents lived with until age 16**	321				
	Both parents	269	48	17.8		
	One parent or no parents	52	12	23.1	0.785	0.240
	Developmental community	317				
	Grew up where people knew each other	211	32	15.2		
	Grew up where people kept alone	106	27	25.5	4.951	0.020
Behavioural Strategies	**Reviewing**	319				
	I review my experiences	225	38	16.9		
	I rarely review my experiences	94	22	23.4	1.843	0.116
	Planning	318				
	Plan for the future	175	26	14.9		
	Wait and see	143	33	23.1	3.519	0.042
	Altruism	314				
	Would donate a kidney for non-relative	190	32	16.8		
	Would not donate a kidney for non-relative	124	28	22.6	1.599	0.132
	Cooperation	317				
	In life it is every man for himself	146	31	21.2		
	In life we are all in it together	171	28	16.4	1.227	0.168
	Investing	319				
	Save extra money	141	18	12.8		
	Spend extra money	178	41	23.0	5.502	0.013
	Trust	317				
	Most people can be trusted	196	36	18.4		
	Most people cannot be trusted	121	24	19.8	0.105	0.427
Eating behaviours	**Food preference**	319				
	I'm careful with what I eat	151	22	14.6		
	I eat anything I want	168	37	22.0	2.931	0.058
	Food quality	320				
	I like good quality ingredients	138	11	8.0		
	I like food that makes me feel full	182	49	26.9	18.505	0.000
	Satiation	317				
	Do not like to feel full	102	4	3.9		
	Like to feel full	215	54	25.1	20.789	0.000

Figure 1 displays the percentages of participants who reported preferring foods with good quality ingredients compared to those who preferred foods which made them feel full by current self-reported BMI categories. Of underweight participants 29.7% reported preferring foods with good quality ingredients and 13.2% reported preferring food which made them feel full, normal weight participants (62.3% and 60.4% respectively), overweight participants (8.0% and 22.0% respectively) and obese participants (0.0% and 4.4% respectively; χ^2=26.323, p=0.000).

Figure 1. Percentage who reported preferring foods with good quality ingredients compared to those who preferred foods by current self-reported BMI categories, with 95% confidence intervals

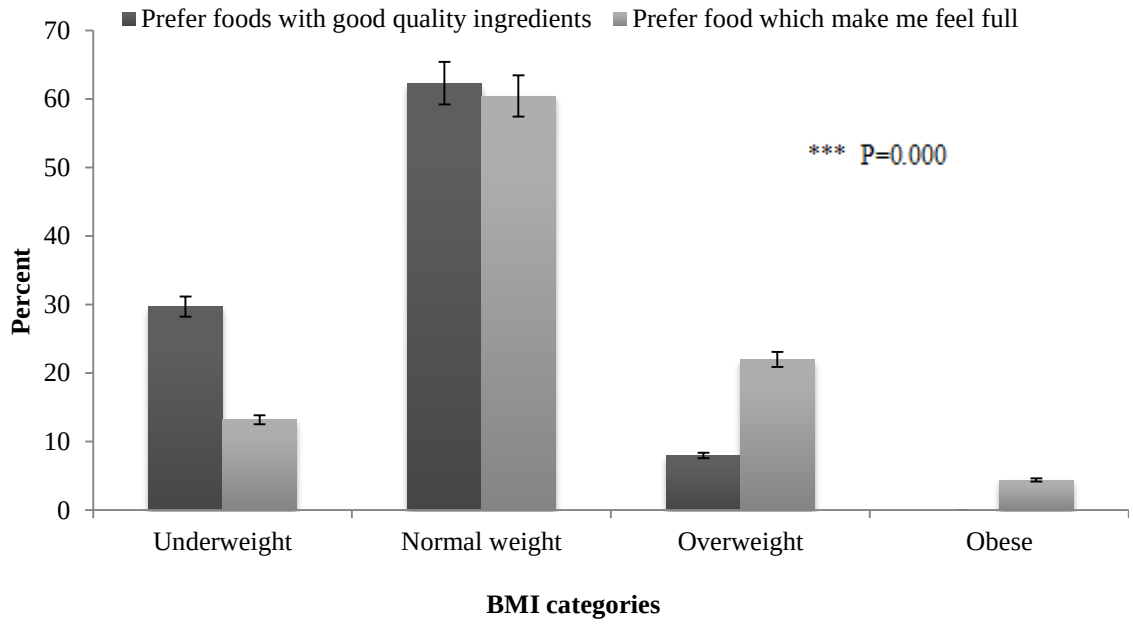


Figure 2 displays current self-reported BMI category by childhood weight. There were significant differences in distribution between participants adult weight when considered by childhood weight; 42.2% of underweight adults reported being 'skinny' as a child, 73.3% of normal weight adults reported being a 'healthy' weight as a child and 27.1% and 57.1% of overweight and obese adults reported being overweight as a child (χ^2=55.539, p=0.000).

Figure 2. Current self-reported BMI category by childhood weight, with 95% confidence intervals

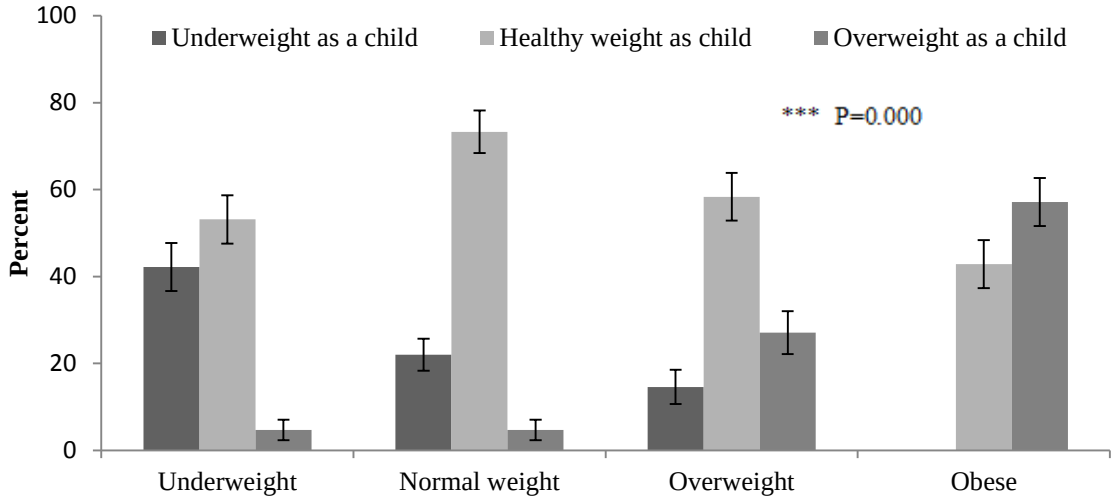


Table 7 displays cross-tabulations of demographic, behavioural strategies and lifestyle behaviours in terms of proportions that preferred 'feel good' rather than healthy foods. In terms of social and demographic variables, there were significant differences in distribution between participants aged between 18 and 24 years and 25 and 30 years (p=0.050), and white and non-white participants (p=0.001). There were no significant differences in distribution between males and females (p=0.379). In terms of childhood weight, there were no significant differences in distribution between participants who reported being skinny or a healthy weight as a child and participants who reported being overweight (p=0.556). In terms of self-reported fitness and healthiness, there were significant differences in distribution between participants who reported being fit and healthy and participants who reported being unfit and/or unhealthy (p=0.000). In terms of developmental variables, there were significant differences in distribution between participants who reported growing up in communities where people kept alone and those where people knew each other (p=0.004). There were no significant differences in distribution between participants who reported growing up with both parents until the age of 16 and those that grew up with one parent or less (p=0.244). In terms of behavioural strategies, there were significant differences between participants who planned for the future and those that did not (p=0.037), and those that tended to spend extra money and those that tended to save extra money (p=0.001). There were no significant differences between participants who reviewed or rarely reviewed their experiences (p=0.121), who were altruistic or not (p=0.500), who were cooperative or not (p=0.269), and who found people to be generally trustworthy or not (p=0.220). In terms of eating behaviours, there were significant differences between participants who were careful with what they ate compared to eating anything they want (p=0.000), and who preferred foods which made them feel full rather than those with good quality ingredients (p=0.003). There were no significant differences between those who liked to feel full and did not like to feel full (p=0.102).

Table 7. Cross tabulations of eating preferences: Percentage preferring 'feel good' rather than healthy foods

	All	Total	N	%	χ^2	Sig
Demographics	**Age**	390				
	18-24	183	100	54.6		
	25-30	207	95	45.9	2.975	0.050
	Sex	386				
	Male	170	87	51.2		
	Female	216	106	49.1	0.168	0.379
	Ethnicity	390				
	White	341	181	53.1		
	Non-white	49	14	28.6	10.293	0.001
Childhood weight	**Weight as a child**	377				
	Healthy weight or skinny	333	166	49.8		
	Overweight	44	22	50.0	0.000	0.556
Fitness and healthiness	**Self-reported fitness and healthiness**	387				
	Fit and healthy	186	68	36.6		
	Not fit and healthy	201	125	62.2	25.384	0.000
Development	**Parents lived with until age 16**	390				
	Both parents	328	161	49.1		
	One parent or no parents	62	34	54.8	0.690	0.244
	Developmental community	385				
	Grew up where people knew each other	252	113	44.8		
	Grew up where people kept alone	133	79	59.4	7.379	0.004
Behavioural Strategies	**Reviewing**	387				
	I review my experiences	265	127	47.9		
	I rarely review my experiences	122	67	54.9	1.634	0.121
	Planning	385				
	Plan for the future	222	101	45.5		
	Wait and see	163	90	55.2	3.552	0.037
	Altruism	382				
	Would donate a kidney for non-relative	223	111	49.8		
	Would not donate a kidney for non-relative	159	80	50.3	0.011	0.500
	Cooperation	384				
	In life it is every man for himself	173	102	59.0		
	In life we are all in it together	211	109	51.7	0.515	0.269
	Investing	386				
	Save extra money	174	72	41.4		
	Spend extra money	212	122	57.5	9.993	0.001
	Trust	385				
	Most people can be trusted	237	114	48.1		
	Most people cannot be trusted	148	78	52.7	0.772	0.220
Eating behaviours	**Food preference**	387				
	I'm careful with what I eat	188	56	29.8		
	I eat anything I want	199	138	69.3	60.515	0.000
	Food quality	389				
	I like food with good quality ingredients	163	68	41.7		
	I like food that makes me feel full	226	127	56.2	7.939	0.003
	Satiation	383				
	Do not like to feel full	125	57	45.6		
	Like to feel full	258	137	53.1	1.895	0.102

Table 8 displays cross-tabulations of demographic, behavioural strategies and lifestyle behaviours in terms of proportions that consumed low daily fruit and vegetable portions. In terms of social and demographic variables, there were significant differences in distribution between participants aged between 18 and 24 years and 25 and 30 years (p=0.007). There were no significant differences in distribution between males and females (p=0.145), and between white and non-white participants (p=0.517). In terms of childhood weight, there were no significant differences in distribution between participants who reported being skinny or a healthy weight as a child and participants who reported being overweight (p=0.175). In terms of self-reported fitness and healthiness, there were significant differences in distribution between participants who reported being fit and healthy and participants who reported being unfit and/or unhealthy (p=0.039). There were no significant differences in distribution between participants who reported growing up with both parents until the age of 16 and those that grew up with one parent or less (p=0.543), or between participants who reported growing up in communities where people kept alone and those where people knew each other (p=0.260). In terms of behavioural strategies, there were no significant differences between participants who reviewed or rarely reviewed their experiences (p=0.420), who planned for the future and those that did not (p=0.294), who were altruistic or not (p=0.279), who were cooperative or not (p=0.130), who tended to spend extra money and those that tended to save extra money (p=0.495), and who found people to be generally trustworthy or not (p=0.298). In terms of eating behaviours, there were significant differences between participants who were careful with what they ate compared to eating anything they want (p=0.000), and who preferred foods which made them feel full rather than those with good quality ingredients (p=0.025). There were no significant differences between those who liked to feel full and did not like to feel full (p=0.181).

Table 8. Cross tabulations of daily fruit and vegetable consumption: Percentage who consume low daily fruit and vegetables (2 or less per day)

	All	Total	N	%	χ^2	Sig
Demographics	**Age**	374				
	18-24	178	97	54.5		
	25-30	196	81	41.3	6.485	0.007
	Sex	370				
	Male	164	84	51.2		
	Female	206	93	45.1	1.350	0.145
	Ethnicity	374				
	White	327	156	47.7		
	Non-white	47	22	46.8	0.013	0.517
Childhood weight	**Weight as a child**	363				
	Healthy weight or skinny	320	155	48.4		
	Overweight	43	17	39.5	1.205	0.175
Fitness and healthiness	**Self-reported fitness and healthiness**	371				
	Fit and healthy	177	75	42.4		
	Not fit and healthy	194	101	52.1	3.485	0.039
Development	**Parents lived with until age 16**	374				
	Both parents	317	151	47.6		
	One parent or no parents	57	27	47.4	0.001	0.543
	Developmental community	369				
	Grew up where people knew each other	242	112	46.3		
	Grew up where people kept alone	127	64	50.4	0.564	0.260
Behavioural Strategies	**Reviewing**	371				
	I review my experiences	258	121	46.9		
	I rarely review my experiences	113	55	48.7	0.099	0.420
	Planning	369				
	Plan for the future	211	97	46.0		
	Wait and see	158	78	49.4	0.418	0.294
	Altruism	366				
	Would donate a kidney for non-relative	213	98	46.0		
	Would not donate a kidney for non-relative	153	76	49.7	0.479	0.279
	Cooperation	367				
	In life it is every man for himself	169	86	50.9		
	In life we are all in it together	198	88	44.4	1.518	0.130
	Investing	370				
	Save extra money	167	80	47.9		
	Spend extra money	203	96	47.3	0.014	0.495
	Trust	370				
	Most people can be trusted	227	105	46.3		
	Most people cannot be trusted	143	71	49.7	0.405	0.298
Eating behaviours	**Food preference**	371				
	I'm careful with what I eat	176	63	35.8		
	I eat anything I want	195	113	57.9	18.207	0.000
	Food quality	372				
	I like good quality ingredients	153	63	41.2		
	I like food that makes me feel full	219	114	52.1	4.274	0.025
	Satiation	366				
	Do not like to feel full	118	61	51.7		
	Like to feel full	248	114	46.0	1.051	0.181

5.1.3 Regressions

Binary logistic regression was undertaken to examine the predictive effect of demographics, behavioural strategies and lifestyle behaviours on overweight or obesity, while controlling for other social and demographic variables (Table 9). The overall model was significant (p=0.000, Nagelkereke R^2=0.322, overall percentage predicted 82.2%). In terms of demographic variables, compared with females, male participants had adjusted odds of being overweight or obese of 6.315 (95% CIs 3.129-13.486). In terms of behavioural strategies compared with participants who preferred to have fewer children at an older age, participants who preferred to start younger and have more children had adjusted odds of being overweight or obese of 3.713 (95% CIs 1.239-11.125); and in terms of lifestyle behaviours, compared with participants who saved spare money, participants who spent spare money adjusted odds of being overweight or obese were 2.193 (95% CIs 1.057-4.550). In terms of food preference, compared with participants who preferred healthy foods, participants who preferred 'feel good' foods had adjusted odds of being overweight or obese of 2.069 (95% CIs 1.014-4.221); and compared to participants who did not like feeling full, participants who reported liking feeling full had adjusted odds of being overweight or obese of 5.684 (95% CIs 1.558-20.735).

Table 9. Predictors of being overweight or obese (BMI>=25kg/m^2) rather than healthy weight with demographic factors and behavioural strategies

	OR	AOR	95% Cls	Sig
Sex				
Female (ref)				
Male	6.404	6.315	3.129-13.486	0.000
Reproductive strategy				
Start older and have fewer children (ref)				
Start young have lots of children	3.314	3.713	1.239-11.125	0.019
Investing				
Save extra money (ref)				
Spend extra money	2.346	2.193	1.057-4.550	0.035
Food preference				
Healthy food (ref)				
Feel good food	2.310	2.069	1.014-4.221	0.046
Satiation				
Do not like to feel full (ref)				
Like to feel full	5.995	5.684	1.558-20.735	0.009

Binary logistic regression was undertaken to estimate the predictive effect of behavioural strategies and lifestyle health behaviours on preference for pleasurable rather than healthy foods, while controlling for social and demographic variables (Table 10). The overall model was significant (p=0.000, Nagelkereke R^2=0.284, overall percentage predicted 82.3%). In terms of self-reported fitness and healthiness, compared with participants who perceived themselves to be

fit and healthy, participants who perceived themselves not to be fit and healthy had adjusted odds of preferring pleasurable foods of 2.218 (95% CIs 1.012-4.860). In terms of behavioural strategies, compared with participants who were financially risk averse, participants who were financial risk takers had adjusted odds of preferring pleasurable foods of 5.368 (95% CIs 1.215-23.707), and compared with participants who were willing to offset, participants who were unwilling to offset had adjusted odds of preferring pleasurable foods of 4.477 (95% CIs 1.146-17.483). In terms of smoking, compared with participants who were not current daily smokers, participants who were current daily smokers had adjusted odds of preferring pleasurable foods of 2.798 (95% CIs 1.002-7.809). In terms of eating behaviours, compared with participants who were careful with what they eat, participants who reported eating anything had adjusted odds of preferring pleasurable foods of 2.218 (95% CIs 1.012-4.860).

Table 10. Predictors of preferring pleasurable rather than healthy foods with demographic factors and behavioural strategies

	OR	AOR	95% Cls	Sig
Self-reported fitness and healthiness				
Fit and healthy (ref)				
Not fit and healthy	2.313	2.218	1.012-4.860	0.047
Financial risk taking				
Risk averse (ref)				
Risk taking	6.059	5.368	1.215-23.707	0.027
Offsetting				
High (ref)				
Low	4.156	4.477	1.146-17.483	0.031
Daily smoking				
Non-current daily smoker (ref)				
Current daily smoker	3.318	2.798	1.002-7.809	0.049
Eating preference				
I'm careful with what I eat (ref)				
I eat anything I want	2.587	2.218	1.012-4.860	0.047

Binary logistic regression was undertaken to estimate the predictive effect of behavioural strategies and lifestyle health behaviours on preference for 'feel good' rather than healthy foods, while controlling for social and demographic variables (Table 11). The overall model was significant (p=0.000, Nagelkereke R^2=0.612, overall percentage predicted 82.2%). In terms of demographics, compared with non-white participants, white participants had adjusted odds of preferring 'feel good' foods of 3.415 (95% CIs 1.202-9.697). In terms of binge drinking, compared with participants who reported low binge drinking, participants who reported high binge drinking had adjusted odds of preferring 'feel good' foods of 1.949 (95% CIs 0.999-3.801). In terms of behavioural strategies, compared with secure and stable participants, insecure and unstable participants had adjusted odds of preferring 'feel good' foods of 2.438 (95% CIs 1.119-5.312), and compared with active participants, inactive participants had adjusted odds of preferring 'feel good' foods of 3.190 (95% CIs 1.529-6.656).

Table 11. Predictors of preferring 'feel good' rather than healthy foods with demographic factors and behavioural strategies

		OR	AOR	95% Cls	Sig
Ethnicity					
	Non-white (ref)				
	White	3.446	3.415	1.202-9.698	0.021
Binge drinking					
	Low (ref)				
	High	2.037	1.949	0.999-3.801	0.050
Security					
	Secure and stable (ref)				
	Insecure and unstable	2.448	2.438	1.119-5.312	0.025
Activity					
	Active (ref)				
	Inactive	2.527	3.190	1.529-6.656	0.002

Backwards stepwise regression was undertaken in order to identify predictors (eating behaviours, childhood experience and behavioural strategies) of ratings of eating for pleasure or health in the sample (Table 12). The overall model was highly significant (p=0.000, R^2 =0.484, DF=345). In terms of eating behaviours, significant inverse predictors of eating for pleasure or health (-12.33 – 9.46; where higher scores represent increasingly eating for health) were the number of snacks eaten per day (p=0.007), the number of ready meals eaten per week (p=0.000), self-rated pleasure taken from eating takeaways (p=0.001). The rating of pleasure eating vegetables was a positive predictor (p=0.008) of preferring pleasurable rather than healthy foods. Childhood experience was also a significant predictor (p=0.000) where higher positive experiences were associated with higher ratings of eating for health. In terms of behavioural strategies, significant predictors of eating for pleasure or health, were the activity index (p=0.000) and the offsetting index (p=0.000), which were positively associated with eating for health. The health risk taking index (p=0.000)

and financial risk taking index (p=0.017) were also significant predictors of eating for pleasure or health; both were negatively associated with eating for health.

Table 12. Predictors of preferring pleasurable rather than healthy foods with eating behaviours, childhood experience and behavioural strategies

	β	95% Cls	Sig
Eating behaviours			
Snacks eaten per day: (0-10)	-0.110	-0.404 - -0.065	0.007
Days per week ready meals are consumed: (0-7)	-0.210	-0.550 - -0.250	0.000
Pleasure eating vegetables: (1-5)	0.103	0.042 – 0.276	0.008
Pleasure eating takeaway: (1-5)	-0.137	-0.744 - -0.205	0.001
Childhood experience			
Childhood experience score: Adverse (-14.8) Positive (3.1)	0.152	0.070 – 0.221	0.000
Behavioural strategies			
Activity index: Inactive (-8.7) Active (8.9)	0.222	0.149 – 0.310	0.000
Risk taking – health: Low (-6.7) High (14.1)	-0.248	-0.337 - -0.169	0.000
Risk taking – financial: Low (-2.5) High (7.6)	-0.101	-0.221 - -0.022	0.017
Offsetting index: Don't offset (-2.4) Offset (5.7)	0.278	0.336 – 0.605	0.000

Binary logistic regression was undertaken to estimate the predictive effect of behavioural strategies and lifestyle health behaviours on daily fruit and vegetable consumption, while controlling for social and demographic variables (Table 13). The overall model was highly significant (p=0.000, Nagelkereke R^2=0.100, overall percentage predicted 52.7%). In terms of demographics, compared with participants who were aged between 25 and 30 years, participants aged between 18 and 24 years had adjusted odds of having low daily fruit and vegetable consumption of 1.687 (95% CIs 1.100-2.587). In terms of behavioural strategies, compared with participants who were highly offsetting, participants who were not highly offsetting had adjusted odds of having low daily fruit and vegetable consumption of 1.704 (95% CIs 0.943-3.080). In terms of eating behaviours, compared with participants who were careful with what they ate, participants who ate anything had adjusted odds of having low daily fruit and vegetable consumption of 1.802 (95% CIs 1.044-3.110).

Table 13. Predictors of eating low daily fruit and vegetable consumption with demographic factors and behavioural strategies

	OR	AOR	95% Cls	Sig
Age				
25-30 (ref)				
18-24	1.602	1.687	1.100-2.587	0.016
Offsetting				
High (ref)				
Low	1.620	1.704	0.943-3.080	0.047
Eating preference				
I'm careful with what I eat (ref)				
I eat anything I want	2.402	1.802	1.044-3.110	0.000

Backwards stepwise regression was undertaken in order to identify predictors (eating behaviours and behavioural strategies) of daily consumption fruit and vegetable portions in the sample (Table 14). The overall model was highly significant (p=0.000, R^2=0.218, DF=358). In terms of eating behaviours, the number of homemade meals eaten per week (p=0.000) and pleasure taken from eating vegetables (p=0.002) were significant positive predictors. The number of days chips were eaten per week was a significant inverse predictor (p=0.001). In terms of behavioural strategies, significant positive predictors of daily fruit and vegetable consumption were the activity index (p=0.000) and the offsetting index (p=0.000).

Table 14. Predictors of daily consumption fruit and vegetable portions (0 - 10) with eating behaviours and behavioural strategies

	β	95% Cls	Sig
Eating behaviours			
Days per week homemade meal: (0-7)	0.256	0.129 – 0.278	0.000
Pleasure eating vegetables: (1-5)	0.148	0.039 – 0.174	0.002
Days per week eat chips: (0-8)	-0.158	-0.297 - -0.075	0.001
Behavioural strategies			
Activity index: Inactive (0) Active (10)	0.160	0.031 – 0.122	0.001
Offsetting index: Don't offset (0) Offset (10)	0.166	0.058 – 0.211	0.001

5.2 Study 2

Kolmogorov-Smirnov test for normality showed that the continuous data were not normally distributed for daily fruit and vegetable portions consumed (p=0.000).

5.2.1 Correlations

Table 15 displays correlates of daily fruit and vegetable consumption, as displayed increasing daily portions of fruit and vegetables was found to be positively associated with decreasing deprivation (p=0.000), increasing adult well-being (p=0.000) and general health (p=0.000), happy childhoods (p=0.000) and non-violent childhoods (p=0.000), increasing exercise (p=0.000) and decreasing cigarette (p=0.000) and alcohol consumption (p=0.000). Correlations were significant after applying the Bonferroni adjustment.

Table 15. Correlates of daily fruit and vegetable portions consumed (0-5+)

	N	ρ	Adjusted α	Sig
Social and demographic variables				
Social deprivation: least deprived (3.3) most deprived (81.6)	2047	-0.140	0.0250	0.000
Well-being and childhood experience				
Adult well-being: Low (1) high (5)	2045	0.154	0.0167	0.000
Childhood happiness: Unhappy (1) happy (10)	2045	0.190	0.0100	0.000
Childhood violence: Non-violent (1) violent (10)	2045	-0.191	0.0083	0.000
Lifestyle behaviours				
Days per week undertaken 30 minutes exercise (0-7)	2045	0.189	0.0125	0.000
Health risk behaviours				
Units of alcohol consumed in past week: (0-178)	2045	-0.102	0.0500	0.000

5.2.2 Cross tabulations

Table 16 displays cross-tabulations of demographics, behavioural strategies and lifestyle behaviours in terms of the proportion of the sample that preferred to 'feel good' rather than consume healthy foods. In terms of social and demographic variables, there were no significant differences in distribution between participants aged between 18 and 24 years and 25 and 30 years (p=0.090), but there were significant differences in distribution between males and females (p=0.000), between white and non-white participants (p=0.032), between participants in full time employment or not (p=0.000), and between participants who had received higher education or not (p=0.000). In terms of deprivation, there were significant differences in distribution between the most and 2nd most deprived, and the 3rd, 4th and least deprived participants (p=0.000). In terms of financial security and stability, there were significant differences in distribution between participants who reported being comfortable or coping on present income, and participants who

reported finding it difficult or very difficult (p=0.000). In terms of community, there were significant differences in distribution between participants who felt a sense of community belonging and those that did not (p=0.000). In terms of well-being and childhood experience, there were significant differences in distribution between participants with lower and, average or higher adult well-being (p=0.000), and those who reported happy and non-violent childhood experiences, and unhappy and/or violent childhood experiences (p=0.000). In terms of behavioural strategies, there were significant differences in distribution between altruistic and less altruistic participants (p=0.000), but there were no significant differences in distribution between participants who were averagely trusting or trusting, and untrusting participants (p=0.064). In terms of lifestyle and health behaviours, there were significant differences in distribution between participants who were more or less active (p=0.000), had high or low daily sedentary time (p=0.005), had high monthly binge drinking (drink six or more drinks four or more times per month) or low binge drinking (p=0.000), and between participants who were current daily smokers or not (p=0.000).

Table 16. Cross tabulations of eating preferences: Percentage who preferred 'feel good' rather than healthy foods

	All	Total	N	%	χ^2	Sig
Demographics	**Age group**	2047				
	18-24	975	622	63.8		
	25-30	1072	652	60.8	1.922	0.090
	Sex	2047				
	Female	1197	703	58.7		
	Male	850	571	67.2	15.087	0.000
	Ethnicity	2047				
	Non-white	170	94	55.3		
	White	1877	1180	62.9	3.803	0.032
	Employment	2047				
	Employed full time	739	381	51.6		
	Not employed full time	1308	893	68.3	56.142	0.000
	Education	2047				
	Higher education	316	143	45.3		
	Less than higher education	1731	1131	65.3	45.866	0.000
Deprivation	**Deprivation**	2047				
	3rd, 4th and least deprived	612	347	56.7		
	Most and 2nd most deprived	1435	927	64.6	11.393	0.000
Security and stability	**Financial security**	2047				
	Comfortable/coping on present income	1532	899	58.7		
	Finding it very/difficult on present income	515	375	72.8	32.762	0.000
Community	**Feel a sense of community belonging**	2047				
	Yes	1233	727	59.0		
	No	814	547	67.2	14.155	0.000

Table 16 (continued). Cross tabulations of eating preferences: Percentage who preferred 'feel good' rather than healthy foods

Well-being and childhood experience	**Childhood experience**	2047				
	Happy and non-violent	1371	785	57.3		
	Unhappy and/or violent	676	489	72.3	43.807	0.000
	Adult well-being	2047				
	Average and high	1725	1047	60.7		
	Low	322	227	70.5	11.901	0.000
Behavioural Strategies	**Altruism**	2047				
	Undertakes voluntary work	227	112	49.3		
	Does not undertake voluntary work	1820	1162	63.8	18.072	0.000
	Trust	2047				
	Averagely trusting or trusting	1547	948	61.3		
	Untrusting	500	326	65.2	2.471	0.064
Lifestyle and health behaviours	**Exercise per week**	2036				
	Average or high	1243	711	57.2		
	Low	793	558	70.4	35.738	0.000
	Sedentary time	2035				
	Low	1479	889	60.1		
	High	556	376	67.6	10.554	0.005
	Monthly binge drinking	1540				
	Low	1251	788	63.0		
	High	289	214	74.0	12.631	0.000
	Smoking	2047				
	Non-current daily smoker	1391	799	57.4		
	Current daily smoker	656	475	72.4	42.493	0.000

Table 17 displays cross-tabulations of demographics, behavioural strategies and lifestyle behaviours in terms of the proportion of the sample that had low (two or less portions) daily consumption of fruit and vegetables. In terms of social and demographic variables, there were significant differences in distribution between participants aged between 18 and 24 years and 25 and 30 years (p=0.025), between males and females (p=0.019), between white and non-white participants (p=0.000), between participants in full time employment or not (p=0.000), and between participants who had received higher education or not (p=0.000). In terms of deprivation, there were significant differences in distribution between the most and 2nd most deprived, and the 3rd, 4th and least deprived participants (p=0.000). In terms of financial security and stability, there were significant differences in distribution between participants who reported being comfortable or coping on present income, and participants who reported finding it difficult or very difficult (p=0.000). In terms of community there were no significant differences in distribution between participants who felt a sense of community belonging and those that did not (p=0.065). In terms of well-being and childhood experience, there were significant differences in distribution between participants with lower and average or higher adult well-being (p=0.000), and those who reported

happy and non-violent childhood, and unhappy and/or violent childhood experiences (p=0.000). In terms of behavioural strategies, there were significant differences in distribution between altruistic and less altruistic participants (p=0.009), and between participants who were averagely trusting or trusting, and untrusting participants (p=0.000). In terms of lifestyle and health behaviours, there were significant differences in distribution between participants who were more or less active (p=0.000), had high or low daily sedentary time (p=0.000), had high monthly binge drinking (drink six or more drinks four or more times per month) or low binge drinking (p=0.000), and who were current daily smokers or not (p=0.000).

Table 17. Cross tabulations of eating preferences: Percentage who had low (two or less portions) daily consumption of fruit and vegetables

	All	Total	N	%	χ^2	Sig
Demographics	**Age group**	2047				
	18-24	975	444	45.5		
	25-30	1072	441	41.1	4.029	0.025
	Sex	2047				
	Female	1197	494	41.3		
	Male	850	391	46.0	4.531	0.019
	Ethnicity	2047				
	White	1877	833	44.4		
	Non-white	170	52	30.6	12.080	0.000
	Employment	2047				
	Employed full time	739	238	32.2		
	Not employed full time	1308	647	49.5	57.314	0.000
	Education	2047				
	Higher education	316	97	30.7		
	Less than higher education	1731	788	45.5	23.935	0.000
Deprivation	**Deprivation**	2047				
	3rd, 4th and least deprived	612	221	36.1		
	Most and 2nd most deprived	1435	664	46.3	18.047	0.000
Security and stability	**Financial security**	2047				
	Comfortable/coping on present income	1532	573	37.4		
	Finding it very/difficult on present income	515	312	60.6	84.387	0.000
Community	**Feel a sense of community belonging**	2047				
	Yes	1233	516	41.8		
	No	814	369	45.3	2.423	0.065
Well-being and childhood experience	**Childhood experience**	2047				
	Happy and non-violent	1371	501	36.5		
	Unhappy or violent or both	676	384	56.8	75.739	0.000
	Adult well-being	2047				
	Average or high	1725	700	40.6		
	Low	322	185	57.5	31.480	0.000

Table 17 (continued). Cross tabulations of eating preferences: Percentage who had low (two or less portions) daily consumption of fruit and vegetables

Behavioural Strategies	**Altruism**	2047				
	Undertakes voluntary work	227	81	35.7		
	Does not undertake voluntary work	1820	804	44.2	5.932	0.009
	Trust	2047				
	Averagely trusting or trusting	1547	624	40.3		
	Untrusting	500	261	52.2	21.671	0.000
Lifestyle and health behaviours	**Exercise per week**	2036				
	Average and high	1243	448	36.0		
	Low	793	432	54.5	67.044	0.000
	Sedentary time	2035				
	Low	1479	556	37.6		
	High	556	322	57.9	69.111	0.000
	Monthly binge drinking	1540				
	Low	1251	530	42.4		
	High	289	173	59.9	28.963	0.000
	Smoking	2047				
	Non-current daily smoker	1391	493	35.4		
	Current daily smoker	656	392	59.8	107.377	0.000

5.2.3 Regressions

Binary logistic regression was undertaken to estimate the predictive effect of behavioural strategies and lifestyle health behaviours on preference for 'feel good' rather than healthy foods, while controlling for social and demographic variables (Table 18). The overall model was significant (p=0.000, Nagelkereke R^2=0.139, overall percentage predicted 65.1%). In terms of demographics, compared with females, males had adjusted odds of preferring 'feel good' foods of 1.534 (95% CIs 1.245-1.888), compared with non-white participants, white participants had adjusted odds of preferring 'feel good' foods of 1.405 (95% CIs 1.006-1.961). In terms of education and employment, compared with participants who were currently employed full time, participants who were not currently employed full time had adjusted odds of preferring 'feel good' foods of 1.925 (95% CIs 1.567-2.365), and compared to participants who had been in higher education, participants who had not been in higher education had adjusted odds of preferring 'feel good' foods of 1.592 (95% CIs 1.226-2.067). In terms of childhood experience, compared with participants who reported happy and non-violent childhoods, participants who reported unhappy and/or violent childhoods had adjusted odds of preferring 'feel good' foods of 1.539 (95% CIs 1.240-1.908). In terms of behavioural strategies, compared with altruistic participants, less altruistic participants had adjusted odds of preferring 'feel good' foods of 1.574 (95% CIs 1.172-2.115). In terms of lifestyle and health behaviours, compared with participants with high weekly exercise, participants with low weekly exercise had adjusted odds of preferring 'feel good' foods

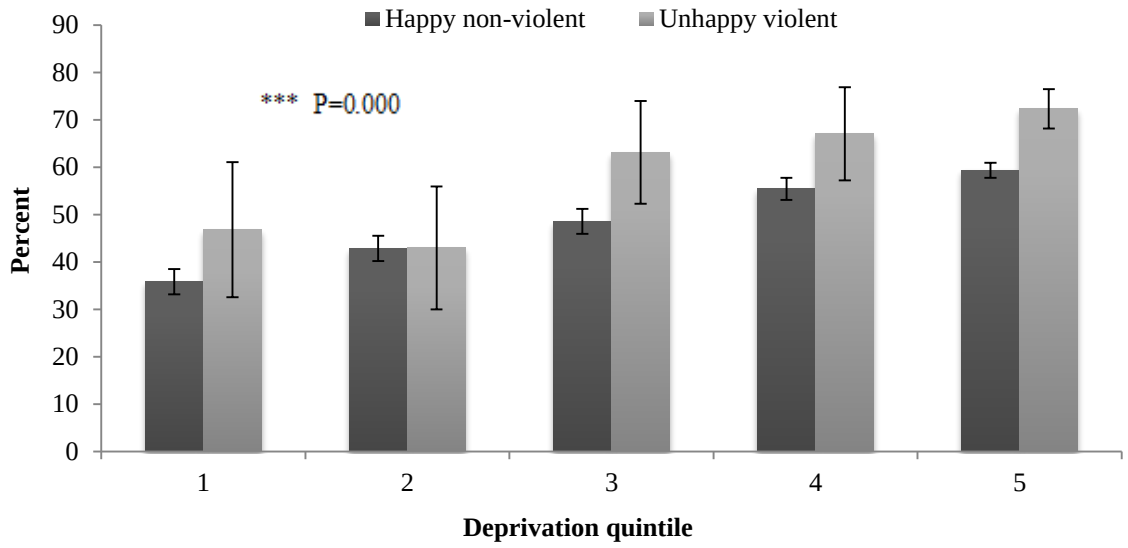
of 1.589 (95% CIs 1.299-1.945), compared with participants who were not current daily smokers, participants who were current daily smokers had adjusted odds of preferring 'feel good' foods of 1.302 (95% CIs 1.044-1.623); and, compared with participants who reported low weekly alcohol consumption, participants who reported high weekly alcohol consumption had adjusted odds of preferring 'feel good' foods of 2.383 (95% CIs 1.693-3.355).

Table 18. Predictors of preferring 'feel good' rather than healthy foods with demographic factors and behavioural strategies

	OR	AOR	95% Cls	Sig
Sex				
Female (ref)				
Male	1.531	1.534	1.245 – 1.888	0.000
Ethnicity				
Non-white (ref)				
White	1.402	1.405	1.006 – 1.961	0.046
Employment				
Employed full time (ref)				
Not employed full time	1.908	1.925	1.567 – 2.365	0.000
Education				
Higher education (ref)				
Less than higher education	1.592	1.592	1.226 – 2.067	0.000
Childhood experience				
Happy and non-violent (ref)				
Unhappy and/or violent	1.538	1.539	1.240 – 1.908	0.000
Altruism				
Undertakes voluntary work (ref)				
Does not undertake voluntary work	1.584	1.575	1.172 – 2.115	0.003
Exercise				
Average and high (ref)				
Low	1.594	1.589	1.299 – 1.945	0.000
Smoking				
Non-current daily smoker (ref)				
Current daily smoker	1.297	1.302	1.044 – 1.623	0.019
Drinking alcohol				
Low (ref)				
High	2.373	2.383	1.693 – 3.355	0.000

The percentage of participants who reported low fruit and vegetable intake was 22.0% higher for those with unhappy violent childhoods (35.0%) compared to happy nonviolent childhoods (Figure 3). Layered Pearson X^2 found the overall trend to be highly significant (X^2=60.285, p=0.000).

Figure 3. Preference for pleasurable foods by current level of deprivation and childhood experience, with 95% confidence intervals



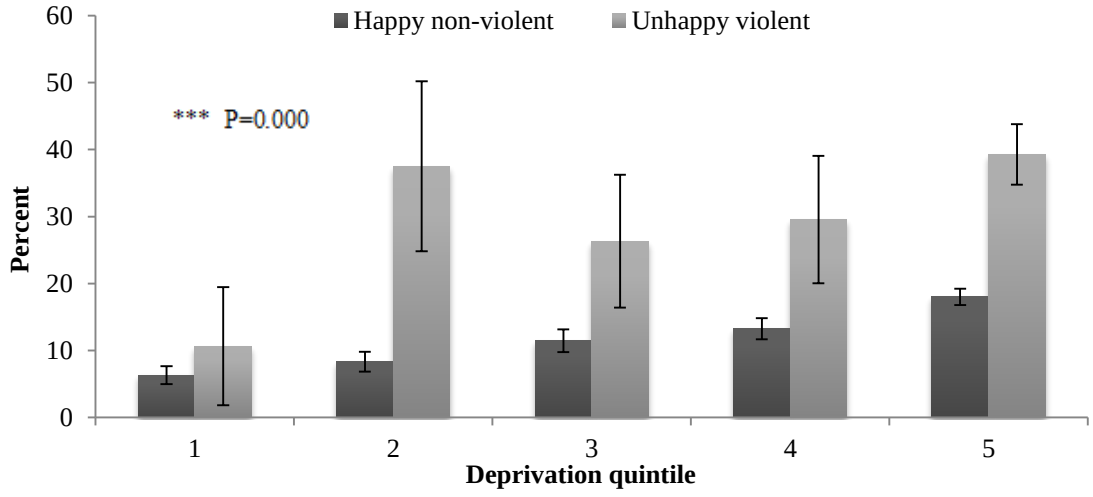
Binary logistic regression was undertaken to estimate the predictive effect of behavioural strategies and lifestyle health behaviours on daily fruit and vegetable consumption, while controlling for social and demographic variables (Table 19). The overall model was highly significant (p=0.000, Nagelkereke R^2=0.161, overall percentage predicted 65.7%). In terms of demographics, compared with females, males had adjusted odds of low daily fruit and vegetable consumption of 1.408 (95% CIs 1.146-1.730), compared with non-white participants, white participants had adjusted odds of low daily fruit and vegetable consumption of 1.877 (95% CIs 1.310-2.688). In terms of employment, compared with participants who were currently employed full time, participants who were not currently employed full time had adjusted odds of low daily fruit and vegetable consumption of 1.787 (95% CIs 1.455-2.195). In terms of deprivation, compared with less deprived participants, more deprived participants had adjusted odds of low daily fruit and vegetable consumption of 1.262 (95% Cis 1.024-1.556). In terms of financial security, compared with participants who reported being comfortable or coping on present income, participants who reported finding it difficult or very difficult on present income had adjusted odds of low daily fruit and vegetable consumption of 1.724 (95% CIs 1.377-2.158). In terms of childhood experience, compared with participants who reported happy and non-violent childhoods, participants who reported unhappy and/or violent childhoods had adjusted odds of low daily fruit and vegetable consumption of 1.610 (95% CIs 1.306-1.985). In terms of lifestyle and health behaviours, compared with participants with high weekly exercise, participants with low weekly exercise had adjusted odds of low daily fruit and vegetable consumption of 1.835 (95% CIs 1.511-2.230), and, compared with participants who were not current daily smokers, participants who were current daily smokers had adjusted odds of low daily fruit and vegetable consumption of 1.877 (95% CIs 1.524-2.311).

Table 19. Predictors of low daily fruit and vegetable consumption (2 or less portions per day) with demographic factors and behavioural strategies

	OR	AOR	95% Cls	Sig
Sex				
Female (ref)				
Male	1.467	1.408	1.146 – 1.730	0.001
Ethnicity				
Non-white (ref)				
White	1.920	1.877	1.310 – 2.688	0.001
Employment				
Employed full time (ref)				
Not employed full time	1.816	1.787	1.455 - 2.195	0.000
Deprivation				
3rd, 4th and least deprived (ref)				
Most and 2nd most deprived	1.292	1.262	1.024 – 1.556	0.029
Financial security				
Coping/comfortable on income (ref)				
Finding it difficult/very difficult on income	1.724	1.724	1.377 – 2.158	0.000
Childhood experience				
Happy and non-violent (ref)				
Unhappy and/or violent	1.732	1.610	1.306 – 1.985	0.000
Exercise				
Average and high (ref)				
Low	1.868	1.835	1.511 – 2.230	0.000
Smoking				
Non-current daily smoker (ref)				
Current daily smoker	1.977	1.877	1.524 – 2.311	0.000

The percentage of participants who reported a preference for 'feel good' foods was significantly higher for those who reported unhappy violent childhoods, compared to happy non-violent childhoods (Figure 4). Layered Pearson X^2 found the overall trend to be highly significant (X^2=241.598, p=0.000).

Figure 4. Low fruit and vegetable consumption (<=2 portions per day) by current level of deprivation and childhood experience, with 95% confidence intervals



5.3 Summary

In study 1, after applying the Bonferroni adjustment, BMI was not found to be correlated with behavioural strategies. However, in terms of distributions, higher proportions of males compared to females, white participants compared to non-white participants, participants who planned less compared to planning participants, and saved less money compared to participants who saved more, were found to be overweight or obese. Increasing consumption of fruit and vegetables was found to be associated with increasing physical activity and health offsetting in study 1, and with decreasing deprivation, increasing adult well-being, and positive childhood experiences in study 2. In study 1, eating for pleasure was found to be associated with decreasing financial security, adverse childhood experiences, increased health and financial risk taking, physical inactivity, low health offsetting and low achievement striving. In terms of distributions, across both studies, higher proportions of people who reported isolated developmental communities/less community belonging reported eating for pleasure rather than health. In study 1, higher proportions of people who reported lower planning and less investing behaviours reported eating for pleasure rather than health. In study 2, higher proportions of participants who reported unhappy and/or violent childhoods, low adult well-being, and lower levels of altruistic behaviour, reported eating for pleasure rather than health.

In study 1, binary logistic regression revealed significant predictors of BMI to be sex, reproductive strategy, investing behaviour, food preference and satiation, where males, preference for having many children at a young age, spending extra money, eating 'feel good' foods, and liking to feel full were significant predictors of being overweight or obese, independent of other variables. In addition to various eating behaviours, backwards stepwise regression revealed the predictors of preferring pleasurable foods rather than healthy foods to be childhood experience, physical activity, health and financial risk taking, and health offsetting, where adverse childhoods, inactivity, high health and financial risk taking, and low offsetting were significant predictors of eating for pleasure, independent of other variables. In study 2, in addition to various sociodemographic and health risk behaviour variables, childhood experience, altruism and physical activity were found to be significant predictors of preferring 'feel good' rather than healthy foods, where unhappy and/or violent childhoods, not undertaking voluntary work (less altruistic) and investing less in physical exercise were found to be significant predictors of preferring 'feel good' foods, independent of other variables.

6. HEALTH RISK BEHAVIOURS

This chapter explores the relationships between health risk behaviours and sociodemographic variables, evolutionary and lifestyle behaviours. For both studies this includes cigarette smoking, alcohol consumption, and for study 1 this also includes risky sexual behaviours and violence. Correlations, cross tabulations and predictive variables have been reported and relationships are considered within the context of social and demographic variables. Presented are the significant and non-significant relationships between known and unknown determinants and indicators of health risk behaviours.

Findings relate to research questions regarding the influence of socioeconomic variables of childhood experiences and adult well-being on the health risk behaviours of cigarette smoking, alcohol consumption, risky sexual behaviours and violence. This chapter also considers the influence of identified evolutionary strategies (including reproductive strategy, financial strategies, altruistic and cooperative behaviour, reviewing and planning behaviour, and achievement striving) on these health risk behaviours.

6.1 Study 1

Kolmogorov-Smirnov test for normality showed that the continuous data were not normally distributed for health risk taking (p=0.000), financial risk taking (p=0.000), and frequency of drinking five or more drinks in a month (p=0.000), times drunk in the last 12 months (p=0.000), number of cigarettes smoked in a day (p=0.000), and number of violent fights in last 12 months (p=0.000).

6.1.1 Correlations

Health risk behaviours were found to be associated with one another. Eating for pleasure or health (0-10) was negatively associated with frequency of binge drinking (0-26 occasions per month; N=382, ρ= -0.155, adjusted α=0.025, p=0.002), negatively associated with daily cigarettes smoked (0-24 cigarettes per day; N=380, ρ= -2.65, adjusted α=0.008, p=0.000), and negatively associated with number of violent fights over the last 12 months (0-50 occasions per month; N=377, ρ= -0.193, adjusted α=0.013, p=0.000). Frequency of binge drinking (0-26 occasions per month) was positively associated with daily cigarettes smoked (0-24 cigarettes per day; N=374, ρ= 2.13, adjusted α=0.01, p=0.000), and positively associated with number of violent fights over the last 12 months (0-50 occasions per month; N=371, ρ= 0.144, adjusted α=0.05, p=0.006). Daily cigarettes smoked (0-24 cigarettes per day) was positively associated with number of violent fights over the last 12 months (0-50 occasions per month; N=369, ρ= 0.178, adjusted α=0.016, p=0.001). Participants who smoked were also found to estimate years lost due to daily smoking

(mean=11.38 years, SD=6.57) to be significantly less than non-smokers (mean=14.34 years, SD 8.28, p=0.002).

The associations between health risk taking and eating behaviours were explored in section 5.1.1. Table 20 displays other correlates of the health risk taking index. In terms of social variables and sexual activity, increasing health risk behaviour was found to be positively associated with increasing days per month spent with close friends (p=0.000), and positively associated with perceived healthy sex lives in terms of increasing frequency per month (p=0.001). In terms of childhood experience, increasing health risk behaviour was negatively associated with increasingly positive childhoods (p=0.006). In terms of eating behaviours, increasing health risk behaviour was positively associated with increasing consumption of chips per week (p=0.000), and increasing consumption of takeaways per week (p=0.000), and negatively associated with increasing consumption of homemade meals per week (p=0.001), and total weekly meals consumed (p=0.000). In terms of behavioural strategies, increasing health risk behaviour was positively associated with increasing financial risk taking (p=0.000).

Table 20. Correlates of health risk behaviour: Risk averse (-6.7) Risk taking (14.14)

	N	ρ	Adjusted α	Sig
Family and social variables				
Number of siblings: (1-12)	390	-0.036	0.0029	0.484
Days per month you see close friends (0-31)	381	0.253	0.0125	0.000
Healthy sex life frequency per month (0-100)	376	0.175	0.0083	0.001
Income and security				
Income: Low (1) High (6)	377	-0.112	0.0045	0.029
Security and stability index: Insecure (-7.8) Secure (6.8)	393	-0.093	0.0036	0.066
Well-being and childhood experience				
Adult well-being: (0-5)	388	0.111	0.0042	0.029
Childhood experience score: Adverse (-14.8) Positive (3.1)	393	-0.136	0.0063	0.006
Eating behaviours				
Days per week homemade meal: (0-7)	386	-0.173	0.0071	0.001
Days per week eat ready meal: (0-7)	379	0.130	0.0050	0.011
Days per week eat chips: (0-8)	381	0.426	0.0500	0.000
Days per month eat takeaway: (0-14)	384	0.328	0.0250	0.000
Total weekly meals: (6-21)	385	-0.222	0.0100	0.000
Behavioural strategies				
Reproductive strategy index: Less children at older age (-7.14) More children at younger age (15.11)	393	0.036	0.0031	0.482
Activity index: Inactive (-8.7) Active (8.9)	393	-0.065	0.0033	0.199
Risk taking – financial: Low (-2.5) High (7.6)	393	0.293	0.0167	0.000
Achievement striving: Don't strive (-3.1) Strive (2.4)	391	-0.108	0.0038	0.033
Offsetting index: Don't offset (-2.4) Offset (5.7)	391	-0.133	0.0056	0.008

Table 21 displays correlates of drinking frequency (consuming five or more alcoholic drinks per month). In terms of social variables and sexual activity, increasing binge drinking was found to be positively associated with increasing days per month spent with close friends (p=0.000), and positively associated with perceived healthy sex lives in terms of increasing frequency per month (p=0.001). In terms of eating behaviours, increasing binge drinking was positively associated with increasing consumption of chips per week (p=0.000), and increasing consumption of takeaways per week (p=0.000). In terms of behavioural strategies, increasing binge drinking was positively associated with increasing financial risk taking (p=0.000).

Table 21. Correlates of binge drinking frequency: Number of days in the last month five or more alcoholic drinks were consumed (0-26)

	N	ρ	Adjusted α	Sig
Family and social variables				
Number of siblings: (1-12)	379	-0.053	0.0050	0.303
Days per month you see close friends (0-31)	378	0.424	0.0500	0.000
Healthy sex life frequency per month (0-100)	366	0.173	0.0100	0.001
Income and security				
Income: Low (1) High (6)	366	-0.137	0.0083	0.009
Security and stability index: Insecure (-7.8) Secure (6.8)	382	-0.006	0.0031	0.901
Well-being and childhood experience				
Adult well-being: (0-5)	378	0.035	0.0045	0.495
Childhood experience score: Adverse (-14.8) Positive (3.1)	382	-0.109	0.0071	0.032
Eating behaviours				
Days per week homemade meal: (0-7)	378	-0.071	0.0056	0.167
Days per week eat ready meal: (0-7)	373	-0.009	0.0033	0.863
Days per week eat chips: (0-8)	377	0.184	0.0125	0.000
Days per month eat takeaway: (0-14)	380	0.282	0.0250	0.000
Total weekly meals: (6-21)	379	-0.078	0.0063	0.131
Behavioural strategies				
Reproductive strategy index: Less children at older age (-7.14) More children at younger age (15.11)	382	-0.026	0.0036	0.615
Activity index: Inactive (-8.7) Active (8.9)	382	0.026	0.0038	0.613
Risk taking – financial: Low (-2.5) High (7.6)	382	0.211	0.0167	0.000
Offsetting index: Don't offset (-2.4) Offset (5.7)	382	-0.028	0.0042	0.585
Achievement striving: Don't strive (-3.1) Strive (2.4)	382	0.003	0.0029	0.952

Table 22 displays correlates of cigarettes smoked per day. In terms of sexual activity, increasing daily smoking was found to be positively associated with increasing frequency of sex per month (as perceived as a 'healthy sex life'; p=0.000). In terms of financial security and stability, increasing daily smoking was negatively associated with increasing security (p=0.000). In terms of eating behaviours, increasing daily smoking was positively associated with increasing consumption of ready meals per week (p=0.002), increasing consumption of chips per week

(p=0.000), increasing consumption of takeaways per week (p=0.000), and negatively associated with increasing consumption of homemade meals (p=0.002) and total weekly meals (p=0.000). In terms of behavioural strategies, increasing daily smoking was positively associated with increasing financial risk taking (p=0.000).

Table 22. Correlates of smoking frequency: Cigarettes consumed per day (0-24)

	N	ρ	Adjusted α	Sig
Family and social variables				
Number of siblings: (1-12)	379	-0.024	0.0031	0.635
Days per month you see close friends (0-31)	371	0.095	0.0045	0.067
Healthy sex life frequency per month (0-100)	364	0.203	0.0083	0.000
Income and security				
Income: Low (1) High (6)	364	-0.122	0.0050	0.020
Security and stability index: Insecure (-7.8) Secure (6.8)	380	-0.195	0.0071	0.000
Well-being and childhood experience				
Adult well-being: (0-5)	376	-0.049	0.0033	0.343
Childhood experience score: Adverse (-14.8) Positive (3.1)	380	-0.238	0.0167	0.000
Eating behaviours				
Days per week homemade meal: (0-7)	374	-0.158	0.0056	0.002
Days per week eat ready meal: (0-7)	369	0.161	0.0063	0.002
Days per week eat chips: (0-8)	371	0.236	0.0125	0.000
Days per month eat takeaway: (0-14)	372	0.245	0.0250	0.000
Total weekly meals: (6-21)	373	-0.228	0.0100	0.000
Behavioural strategies				
Reproductive strategy index: Less children at older age (-7.14) More children at younger age (15.11)	380	0.066	0.0036	0.196
Activity index: Inactive (-8.7) Active (8.9)	380	-0.093	0.0038	0.071
Risk taking – financial: Low (-2.5) High (7.6)	380	0.281	0.0500	0.000
Achievement striving: Don't strive (-3.1) Strive (2.4)	380	-0.093	0.0042	0.071
Offsetting index: Don't offset (-2.4) Offset (5.7)	380	-0.002	0.0029	0.962

Table 23 displays correlates of risky violent behaviour indicated by frequency of violent fights during the past 12 months. In terms of sexual activity, increasing risky violent behaviour was found to be positively associated with increasing frequency of sex per month (perceived as 'healthy'; p=0.002). In terms of childhood experience, increasing risky violent behaviour was negatively associated with increasingly positive childhoods (p=0.000). In terms of financial security and stability, increasing risky violent behaviour was negatively associated with increasing security (p=0.003). In terms of eating behaviours, increasing risky violent behaviour was positively associated with increasing consumption of ready meals per week (p=0.001) and increasing consumption of chips per week (p=0.001). In terms of behavioural strategies, increasing risky violent behaviour was positively associated with increasing financial risk taking (p=0.000).

Table 23. Correlates of risky violence (number of fights in the last year 0-10)

	N	ρ	Adjusted α	Sig
Family and social variables				
Number of siblings: (1-12)	376	-0.010	0.0031	0.841
Days per month you see close friends (0-31)	370	0.147	0.0071	0.005
Healthy sex life frequency per month (0-100)	362	0.162	0.0100	0.002
Income and security				
Income: Low (1) High (6)	361	-0.111	0.0050	0.036
Security and stability index: Insecure (-7.8) Secure (6.8)	377	-0.153	0.0083	0.003
Well-being and childhood experience				
Adult well-being: (0-5)	373	0.038	0.0033	0.464
Childhood experience score: Adverse (-14.8) Positive (3.1)	377	-0.206	0.0250	0.000
Eating behaviours				
Days per week homemade meal: (0-7)	372	-0.140	0.0063	0.007
Days per week eat ready meal: (0-7)	368	0.178	0.0125	0.001
Days per week eat chips: (0-8)	371	0.179	0.0167	0.001
Days per month eat takeaway: (0-14)	371	0.091	0.0045	0.080
Total weekly meals: (6-21)	371	-0.045	0.0036	0.386
Behavioural strategies				
Reproductive strategy index: Less children at older age (-7.14) More children at younger age (15.11)	377	0.118	0.0056	0.022
Activity index: Inactive (-8.7) Active (8.9)	377	0.084	0.0042	0.105
Risk taking – financial: Low (-2.5) High (7.6)	377	0.218	0.0500	0.000
Achievement striving: Don't strive (-3.1) Strive (2.4)	377	-0.062	0.0038	0.232
Offsetting index: Don't offset (-2.4) Offset (5.7)	377	0.006	0.0029	0.914

6.1.2 Cross tabulations

Table 24 displays cross-tabulations of demographic, behavioural strategies and lifestyle behaviours in terms of proportions that were high health risk takers (participant scores more than one standard deviation above the mean, health risk taking index) rather than moderate or risk averse participants. In terms of demographic variables, there were significant differences in distribution between participants aged between 18 and 24 years and 25 and 30 years (p=0.005), between males and females (p=0.001), and between participants reporting high or low weekly incomes (p=0.008). There were no significant differences in distribution between white and non-white participants (p=0.291). In terms of BMI, there were no significant differences in distribution between overweight and obese rather than normal and underweight participants (p=0.099). In terms of developmental environments, there were significant differences in distribution between participants who grew up with both parents until the age of 16 compared to those that did not (p=0.008). In terms of behavioural strategies, there were significant differences in distribution between participants who were financially risk averse or risk taking (p=0.008), who reviewed or rarely reviewed their experiences (p=0.016), who planned for the future or preferred to wait and see (p=0.015), who invested rather than spent their spare money (p=0.002), and between participants who found people to be generally trustworthy or not (0.027). There were no significant differences in distribution between participants who were altruistic or not (p=0.537), or who were cooperative or not (p=0.081). In terms of eating behaviours, there were significant differences in distribution between participants who were careful with what they ate compared to eating anything they want (p=0.000), and who ate mostly for pleasure rather than health (p=0.000). There were no significant differences in distribution between participants who liked to feel full rather than those that did not (p=0.489).

Table 24. Cross tabulations of health risk: Percentage of high health risk takers (1 standard deviation or more above the mean, health risk taking index)

	All	Total	N	%	χ^2	Sig
Demographics	**Age**	393				
	18-24	185	39	21.1		
	25-30	208	23	11.1	7.404	0.005
	Sex	389				
	Male	171	39	22.8		
	Female	218	22	10.1	11.718	0.001
	Ethnicity	393				
	White	343	56	16.3		
	Non-white	50	6	12.0	0.615	0.291
	Income	377				
	High	144	15	10.4		
	Low	233	47	20.2	6.163	0.008
BMI	**Overweight**	321				
	Overweight or obese	60	14	23.3		
	Normal or underweight	261	40	15.3	2.236	0.099
Developmental	**Parents lived with until age 16**	393				
	Both parents	331	45	13.6		
	One parent or no parents	62	17	27.4	7.511	0.008
Behavioural strategies	**Financial risk taking**	393				
	Risk averse	331	45	13.6		
	Risk taking	62	17	27.4	7.511	0.008
	Reviewing	390				
	I review my experiences	267	34	12.7		
	I rarely review my experiences	123	27	22.0	5.422	0.016
	Planning	388				
	Plan for the future	224	27	12.1		
	Wait and see	164	34	20.7	5.381	0.015
	Altruism	385				
	Would donate a kidney for non-relative	226	36	15.9		
	Would not donate a kidney for non-relative	159	25	15.7	0.003	0.537
	Cooperation	386				
	In life it is every man for himself	174	33	19.0		
	In life we are all in it together	212	28	13.2	2.381	0.081
	Investing	389				
	Save extra money	176	17	9.7		
	Spend extra money	213	44	20.7	8.816	0.002
	Trust	388				
	Most people can be trusted	237	30	12.7		
	Most people cannot be trusted	151	31	20.5	4.313	0.027

Table 24 (continued). Cross tabulations of health risk: Percentage of high health risk takers (1 standard deviation or more above the mean, health risk taking index)

Eating behaviours	**Food preference**	390				
	I'm careful with what I eat	189	18	9.5		
	I eat anything I want	201	43	21.4	10.400	0.000
	Eat for pleasure or health	393				
	Eat mostly for pleasure	327	60	18.3		
	Eat mostly for health	66	2	3.0	9.698	0.000
	Satiation	385				
	Do not like to feel full	126	19	15.1		
	Like to feel full	259	41	15.8	0.036	0.489

Table 25 displays cross-tabulations of demographic, behavioural strategies and lifestyle behaviours in terms of proportions that were calculated to be high binge drinkers (drank five or more drinks on five or more occasion during the last month) compared to average or low binge drinkers. In terms of demographic variables, there were significant differences in distribution between participants aged between 18 and 24 years and 25 and 30 years (p=0.019), and between males and females (p=0.000). There were no significant differences in distribution between white and non-white participants (p=0.413) or between participants reporting high or low weekly incomes (p=0.067). In terms of BMI, there were significant differences in distribution between overweight and obese rather than normal and underweight participants (p=0.003). In terms of developmental environments, there were significant differences in distribution between participants who grew up with both parents until the age of 16 compared to those that did not (p=0.031). In terms of behavioural strategies, there were significant differences in distribution between participants who were financially risk averse or risk taking (p=0.023), and between participants who invested rather than spent their spare money (p=0.032). There were no significant differences in distribution between participants who reviewed or rarely reviewed their experiences (p=0.087), who planned for the future or preferred to wait and see (p=0.072), who were altruistic or not (p=0.476), who were cooperative or not (p=0.355), or who found people to be generally trustworthy or not (p=0.397). In terms of eating behaviours, there were significant differences in distribution between participants who were careful with what they ate compared to eating anything they want (p=0.048), and who ate mostly for pleasure rather than health (p=0.001). There were no significant differences in distribution between participants who liked to feel full rather than those that did not (p=0.428).

Table 25. Cross tabulations of binge drinking frequency: High monthly binge drinking (drank five or more drinks on five or more occasions during the last month)

	All	Total	N	%	χ^2	Sig
Demographics	**Age**	382				
	18-24	180	56	31.1		
	25-30	202	43	21.3	4.785	0.019
	Sex	378				
	Male	168	62	36.9		
	Female	210	37	17.6	17.958	0.000
	Ethnicity	382				
	White	335	88	26.3		
	Non-white	47	11	23.4	0.176	0.413
	Income	366				
	High	142	31	21.8		
	Low	224	66	29.5	2.600	0.067
BMI	**Overweight**	314				
	Overweight or obese	59	25	42.4		
	Normal or underweight	255	59	23.1	9.047	0.003
Developmental	**Parents lived with until age 16**	382				
	Both parents	322	77	23.9		
	One parent or no parents	60	22	36.7	4.285	0.031
Behavioural strategies	**Financial risk taking**	382				
	Risk averse	320	76	23.8		
	Risk taking	62	23	37.1	4.819	0.023
	Reviewing	379				
	I review my experiences	260	62	23.8		
	I rarely review my experiences	119	37	31.1	2.221	0.087
	Planning	377				
	Plan for the future	218	50	22.9		
	Wait and see	159	48	30.2	2.514	0.072
	Altruism	375				
	Would donate a kidney for non-relative	219	58	26.5		
	Would not donate a kidney for non-relative	156	40	25.6	0.034	0.476
	Cooperation	375				
	In life it is every man for himself	170	41	24.1		
	In life we are all in it together	205	54	26.3	0.243	0.355
	Investing	378				
	Save extra money	171	36	21.1		
	Spend extra money	207	62	30.0	3.862	0.032
	Trust	377				
	Most people can be trusted	233	59	25.3		
	Most people cannot be trusted	144	39	27.1	0.144	0.397

Table 25 (continued). Cross tabulations of binge drinking frequency: High monthly binge drinking (drank five or more drinks on five or more occasions during the last month)

Eating behaviours	**Food preference**	379				
	I'm careful with what I eat	184	40	21.7		
	I eat anything I want	195	58	29.7	3.164	0.048
	Eat for pleasure or health	382				
	Eat mostly for pleasure	317	92	29.0		
	Eat mostly for health	65	7	10.8	9.360	0.001
	Satiation	374				
	Do not like to feel full	123	30	24.4		
	Like to feel full	251	65	25.9	0.099	0.428

Table 26 displays cross-tabulations of demographic, behavioural strategies and lifestyle behaviours in terms of proportions that were current daily smokers compared to occasional, ex-smokers and non-smokers. In terms of demographic variables, there were significant differences in distribution between participants aged between 18 and 24 years rather than 25 and 30 years (p=0.033), between males and females (p=0.010), and between participants reporting high or low weekly incomes (p=0.003). There were no significant differences in distribution between white and non-white participants (p=0.058). In terms of BMI, there were no significant differences in distribution between overweight and obese rather than normal and underweight participants (p=0.454). In terms of developmental environments, there were significant differences in distribution between participants who grew up with both parents until the age of 16 compared to those that did not (p=0.001). In terms of behavioural strategies, there were significant differences in distribution between participants who were financially risk averse or risk taking (p=0.007), who planned for the future or preferred to wait and see (p=0.003), who were cooperative or not (p=0.000), who invested rather than spent their spare money (p=0.000), and participants who found people to be generally trustworthy or not (0.045). There were no significant differences in distribution between participants who reviewed or rarely reviewed their experiences (p=0.125), or who were altruistic or not (p=0.388). In terms of eating behaviours, there were significant differences in distribution between participants who ate mostly for pleasure rather than health (p=0.000), and participants who liked to feel full rather than those that did not (p=0.023). There were no significant differences in distribution between participants who were careful with what they ate compared to eating anything they want (p=0.070).

Table 26. Cross tabulations of smoking: Percentage of current daily smokers

	All	Total	N	%	χ^2	Sig
Demographics	**Age**	380				
	18-24	181	52	28.7		
	25-30	199	40	20.1	3.846	0.033
	Sex	376				
	Male	165	50	30.3		
	Female	211	41	19.4	5.966	0.010
	Ethnicity	380				
	White	334	76	22.8		
	Non-white	46	16	34.8	3.188	0.058
	Income	364				
	High	141	24	17.0		
	Low	223	68	30.5	8.301	0.003
BMI	**Overweight**	310				
	Overweight or obese	57	14	24.6		
	Normal or underweight	253	67	26.5	0.089	0.454
Developmental	**Parents lived with until age 16**	380				
	Both parents	321	67	20.9		
	One parent or no parents	59	25	42.4	12.556	0.001
Behavioural strategies	**Financial risk taking**	380				
	Risk averse	319	69	21.6		
	Risk taking	61	23	37.7	7.211	0.007
	Reviewing	377				
	I review my experiences	258	58	22.5		
	I rarely review my experiences	119	34	28.6	1.638	0.125
	Planning	375				
	Plan for the future	212	40	18.9		
	Wait and see	163	52	31.9	8.455	0.003
	Altruism	372				
	Would donate a kidney for non-relative	218	55	25.2		
	Would not donate a kidney for non-relative	154	36	23.4	0.168	0.388
	Cooperation	373				
	In life it is every man for himself	171	57	33.3		
	In life we are all in it together	202	35	17.3	12.769	0.000
	Investing	376				
	Save extra money	169	25	14.8		
	Spend extra money	207	66	31.9	13.705	0.000
	Trust	375				
	Most people can be trusted	230	49	21.3		
	Most people cannot be trusted	145	43	29.7	3.350	0.045
Eating behaviours	**Food preference**	377				
	I'm careful with what I eat	183	38	20.8		
	I eat anything I want	194	54	27.8	2.552	0.070
	Eat for pleasure or health	380				
	Eat mostly for pleasure	317	87	27.4		
	Eat mostly for health	63	5	7.9	10.900	0.000
	Satiation	372				
	Do not like to feel full	120	38	31.7		
	Like to feel full	252	54	21.4	4.577	0.023

Cross-tabulations were analysed for health risk behaviours in terms of proportions that believed unprotected sex was worth the risk (sexual risk takers) compared to those that were risk averse in terms of sexual health. There were significant differences in distribution between participants who ate for pleasure rather than health (respectively n=95, 30.1% and n=12, 18.2%; overall n=382, X^2=3.822, p=0.032); high binge drinkers compared to low (respectively n=40, 41.7% and n=66, 23.9%; overall n=372, X^2=11.018, p=0.001); current daily smokers compared to non-current daily smokers (respectively n=39, 43.3% and n=66, 23.7%; overall n=369, X^2=12.942, p=0.000); and people who reported a violent fight in the last 12 months compared to those that did not (respectively n=24, 49.0% and n=80, 25.2%; overall n=366, X^2=11.762, p=0.001).

Table 27 displays significant cross-tabulations of demographic, behavioural strategies and lifestyle behaviours in terms of proportions that believed unprotected sex was worth the risk (sexual risk takers) compared to those that were risk averse in terms of sexual health. In terms of demographic variables, there were significant differences in distribution between males and females (p=0.000). There were no significant differences in distribution between people aged between 18 and 24 years and 25 and 30 years (p=0.282), white and non-white participants (p=0.055), or participants reporting high or low weekly incomes (p=0.364). In terms of BMI, there were significant differences in distribution between overweight and obese rather than normal and underweight participants (p=0.012). In terms of developmental environments, there were no significant differences in distribution between participants who grew up with both parents until the age of 16 compared to those that did not (p=0.443). In terms of behavioural strategies, there were significant differences in distribution between participants who were financially risk averse or risk taking (p=0.004), who reviewed or rarely reviewed their experiences (p=0.039), who planned for the future or preferred to wait and see (p=0.037), and participants who were cooperative or not (p=0.039). There were no significant differences in distribution between participants who were altruistic or not (p=0.473), who invested rather than spent their spare money (p=0.067), and participants who found people to be generally trustworthy or not (p=0.354). In terms of eating behaviours, there were significant differences in distribution between participants who were careful with what they ate compared to eating anything they want (p=0.033), who ate mostly for pleasure rather than health (p=0.032), and participants who liked to feel full rather than those that did not (p=0.035).

Table 27. Cross tabulations of sexual practice: Percentage of sexual risk takers (those that believed unprotected sex was worth the risk)

	All	Total	N	%	χ^2	Sig
Demographics	**Age**	382				
	18-24	182	54	29.7		
	25-30	200	53	26.5	0.475	0.282
	Sex	379				
	Male	168	70	41.7		
	Female	211	37	17.5	26.880	0.000
	Ethnicity	382				
	White	333	88	26.4		
	Non-white	49	19	38.8	3.230	0.055
	Income	364				
	High	140	42	30.0		
	Low	227	63	27.8	0.214	0.364
BMI	**Overweight**	312				
	Overweight or obese	58	24	41.4		
	Normal or underweight	254	64	25.2	6.106	0.012
Development	**Parents lived with until age 16**	382				
	Both parents	321	89	27.7		
	One parent or no parents	61	18	29.5	0.081	0.443
Behavioural strategies	**Financial risk taking**	382				
	Risk averse	322	81	25.2		
	Risk taking	60	26	43.3	8.288	0.004
	Reviewing	381				
	I review my experiences	259	65	25.1		
	I rarely review my experiences	122	42	34.4	3.574	0.039
	Planning	380				
	Plan for the future	221	54	24.4		
	Wait and see	159	53	33.3	3.620	0.037
	Altruism	379				
	Would donate a kidney for non-relative	223	61	27.4		
	Would not donate a kidney for non-relative	156	44	28.2	0.033	0.473
	Cooperation	379				
	In life it is every man for himself	171	56	32.7		
	In life we are all in it together	208	50	24.0	3.534	0.039
	Investing	381				
	Save extra money	171	41	24.0		
	Spend extra money	210	66	31.4	2.591	0.067
	Trust	379				
	Most people can be trusted	232	67	28.9		
	Most people cannot be trusted	147	39	26.5	0.246	0.354

Table 27 (continued). Cross tabulations of sexual practice: Percentage of sexual risk takers (those that believed unprotected sex was worth the risk)

Eating behaviours	**Food preference**	382				
	I'm careful with what I eat	184	43	23.4		
	I eat anything I want	198	64	32.3	3.792	0.033
	Eat for pleasure or health	382				
	Eat mostly for pleasure	316	95	30.1		
	Eat mostly for health	66	12	18.2	3.822	0.032
	Satiation	377				
	Do not like to feel full	124	27	21.8		
	Like to feel full	253	79	31.2	3.678	0.035

Table 28 displays significant cross-tabulations of demographic, behavioural strategies and lifestyle behaviours in terms of proportions that had engaged in a violent fight in the past 12 months compared to those that had not engaged in a violent fight. In terms of demographic variables, there were significant differences in distribution between people aged between 18 and 24 years and 25 and 30 years (p=0.000), between males and females (p=0.000), and between white and non-white participants (p=0.036). There were no significant differences in distribution between participants reporting high or low weekly incomes (p=0.101). In terms of BMI, there were significant differences in distribution between overweight and obese rather than normal and underweight participants (p=0.050). In terms of developmental environments, there were no significant differences in distribution between participants who grew up with both parents until the age of 16 compared to those that did not (p=0.075). In terms of behavioural strategies, there were significant differences in distribution between participants who were financially risk averse or risk taking (p=0.012), and participants who found people to be generally trustworthy or not (p=0.019). There were no significant differences in distribution between participants who reviewed or rarely reviewed their experiences (p=0.313), who planned for the future or preferred to wait and see (p=0.135), who were altruistic or not (p=0.071), who were cooperative or not (p=0.095), or participants who invested rather than spent their spare money (p=0.197). In terms of eating behaviours, there were significant differences in distribution between participants who ate mostly for pleasure rather than health (p=0.013). There were no significant differences in distribution between participants who were careful with what they ate compared to eating anything they want (p=0.542), and participants who liked to feel full rather than those that did not (p=0.474).

Table 28. Cross tabulations of violent fighting: Percentage of people who have had a violent fight in the last 12 months

	All	Total	N	%	χ^2	Sig
Demographics	**Age**	377				
	18-24	178	40	22.5		
	25-30	199	10	5.0	24.862	0.000
	Sex	374				
	Male	164	38	23.2		
	Female	210	12	5.7	24.229	0.000
	Ethnicity	377				
	White	329	39	11.9		
	Non-white	48	11	22.9	4.456	0.036
	Income	361				
	High	139	14	10.1		
	Low	222	34	15.3	2.039	0.101
BMI	**Overweight**	309				
	Overweight or obese	58	13	22.4		
	Normal or underweight	251	32	12.7	3.537	0.050
Developmental	**Parents lived with until age 16**	377				
	Both parents	317	38	12.0		
	One parent or no parents	60	12	20.0	2.816	0.075
Behavioural strategies	**Financial risk taking**	377				
	Risk averse	318	36	11.3		
	Risk taking	59	14	23.7	6.661	0.012
	Reviewing	374				
	I review my experiences	259	32	12.4		
	I rarely review my experiences	115	17	14.8	0.412	0.313
	Planning	372				
	Plan for the future	213	24	11.3		
	Wait and see	159	25	15.7	1.580	0.135
	Altruism	369				
	Would donate a kidney for non-relative	217	34	15.7		
	Would not donate a kidney for non-relative	152	15	9.9	2.611	0.071
	Cooperation	370				
	In life it is every man for himself	168	27	16.1		
	In life we are all in it together	202	22	10.9	2.142	0.095
	Investing	374				
	Save extra money	170	19	11.2		
	Spend extra money	204	30	14.7	1.015	0.197
	Trust	372				
	Most people can be trusted	229	23	10.0		
	Most people cannot be trusted	143	26	18.2	5.098	0.019

Table 28 (continued). Cross tabulations of violent fighting: Percentage of people who have had a violent fight in the last 12 months

Eating behaviours	**Food preference**	374				
	I'm careful with what I eat	182	24	13.2		
	I eat anything I want	192	25	13.0	0.002	0.542
	Eat for pleasure or health	377				
	Eat mostly for pleasure	312	47	15.1		
	Eat mostly for health	65	3	4.6	5.105	0.013
	Satiation	369				
	Do not like to feel full	121	15	12.4		
	Like to feel full	248	33	13.3	0.059	0.474

Table 29 displays significant cross-tabulations of attitudes towards violence in terms of proportions that were calculated to be overweight and obese. There were significant differences in distribution between participants who reported higher levels of tolerance or acceptance towards violence rather than people who reported lower tolerance; participants who thought slapping naughty children could be an acceptable form of discipline rather than those who thought it wrong (p=0.004), those who thought violence could be the best option rather than those who thought it never was (p=0.002), those who thought violence was natural rather than learned (p=0.029), and those who would buy a gun compared to those that would not (p=0.003).

Table 29. Cross tabulations of overweight or obese and attitudes to violence: Percentage of people who were overweight or obese

All	**Total**	**N**	**%**	χ^2	P
Attitudes to violence	313				
Slapping naughty children is wrong	144	18	12.50		
Slapping naughty children can be the best form of discipline	169	42	24.85	7.656	0.004
	315				
Violence is never the right option	190	25	13.16		
Violence can be the best option	125	34	27.20	9.767	0.002
	315				
Violence is learned	171	25	14.62		
Violence is natural	144	34	23.61	4.152	0.029
	319				
I would not buy a gun if they were readily available	257	40	15.56		
I would buy a gun if they were readily available	62	20	32.79	9.115	0.003

6.1.3 Regressions

Binary logistic regression was undertaken to estimate the predictive effect of behavioural strategies and lifestyle health behaviours on health risk taking, while controlling for social and demographic variables (Table 30). The overall model was highly significant (p=0.000, Nagelkereke R^2=0.172, overall percentage predicted 83.8%). In terms of demographic variables, compared with females, males had adjusted odds of being health risk taking of 1.957 (95% CIs 1.060-3.614), and compared with participants who reported high weekly income, participants who reported low weekly income had adjusted odds of being health risk taking of 1.810 (95% CIs 0.932-3.515). In terms of behavioural strategies, compared with participants who invested spare money, participants who spent spare money had adjusted odds of being health risk taking of 2.179 (95% CIs 1.137-4.178), and compared with participants who found people to be generally trustworthy, participants found people to be generally untrustworthy had adjusted odds of being health risk taking of 1.787 (95% CIs 0.982-3.252). In terms of eating behaviour and food preference, compared with participants who ate mostly for health, participants who ate mostly for pleasure had adjusted odds of being health risk takers of 4.069 (95% CIs 0.929-17.824), and compared with participants who were careful with what they ate, participants who ate anything they wanted had adjusted odds of being health risk takers of 2.147 (95% CIs 1.115-4.135).

Table 30. Changes in adjusted odds of health risk taking rather than being risk averse with demographic factors and behavioural strategies

	OR	AOR	95% Cls	Sig
Sex				
Female (ref)				
Male	2.038	1.957	1.060-3.614	0.032
Income				
High (ref)				
Low	1.939	1.810	0.932-3.515	0.080
Investing				
Save extra money (ref)				
Spend extra money	2.153	2.179	1.137-4.178	0.019
Trust				
Most people can be trusted (ref)				
Most people cannot be trusted	1.876	1.787	0.982-3.252	0.041
Eat for pleasure or health				
Eat mostly for health (ref)				
Eat mostly for pleasure	4.287	4.069	0.929-17.824	0.063
Food preference				
I'm careful with what I eat (ref)				
I eat anything I want	1.883	2.147	1.115-4.135	0.022

Binary logistic regression was undertaken to estimate the predictive effect of behavioural strategies and lifestyle health behaviours on high binge drinking, while controlling for social and demographic variables (Table 31). The overall model was highly significant (p=0.000, Nagelkereke R^2=0.105, overall percentage predicted 73.2%). In terms of sex, compared with females, males had adjusted odds of being a high binge drinker of 2.265 (95% CIs 1.338-3.834). In terms of behavioural strategies, compared with participants who invest spare money, participants who spend spare money had adjusted odds of being a high binge drinker of 1.707 (95% CIs 0.993-2.934), and compared with participants who ate mostly for health, participants who ate mostly for pleasure had adjusted odds of being a high binge drinker of 3.143 (95% CIs 1.183-8.352).

Table 31. Changes in adjusted odds of high monthly binge drinking (drank more than five drinks on five or more occasions in the last month) with demographic factors and behavioural strategies

	OR	AOR	95% Cls	Sig
Sex				
Female (ref)				
Male	2.550	2.265	1.338-3.834	0.002
Investing				
Save spare money (ref)				
Spend spare money	1.508	1.707	0.993-2.934	0.043
Eat for pleasure or health				
Eat mostly for health (ref)				
Eat mostly for pleasure	2.739	3.143	1.183-8.352	0.022

Binary logistic regression was undertaken to estimate the predictive effect of behavioural strategies and lifestyle health behaviours on daily smoking, while controlling for social and demographic variables (Table 32). The overall model was highly significant (p=0.000, Nagelkereke R^2=0.224, overall percentage predicted 73.5%). In terms of demographic variables, compared with females, males had adjusted odds of being current daily smokers of 1.796 (95% CIs 1.040-3.101), and compared with participants who reported high income, participants who reported low income had adjusted odds of being a current daily smoker of 1.853 (95% CIs 1.047-3.279). In terms of behavioural strategies, compared with participants who invested spare money, participants who spent spare money had adjusted odds of being current daily smokers of 2.487 (95% CIs 1.406-4.440), compared with participants who plan for the future, participants who did not tend to plan for the future had adjusted odds of being current daily smokers of 1.741 (95% CIs 1.022-2.966), compared with participants who believed in cooperation, participants who did not believe in cooperation had adjusted odds of being current daily smokers of 2.521 (95% CIs 1.472-4.318), and compared with participants who ate mostly for health, participants who ate mostly for pleasure had adjusted odds of being current daily smokers of 3.238 (95% CIs 1.197-

8.759). In terms of eating behaviour, compared with participants who do not like to feel full, participants who like to feel full had adjusted odds of being current daily smokers of 2.488 (95% CIs 1.402-4.415).

Table 32. Changes in adjusted odds of daily smoking with demographic factors and behavioural strategies

	OR	AOR	95% CIs	Sig
Sex				
Female (ref)				
Male	1.783	1.796	1.040-3.101	0.036
Income				
High (ref)				
Low	1.830	1.853	1.047-3.279	0.034
Investing				
Save spare money (ref)				
Spend spare money	2.501	2.487	1.406-4.400	0.002
Planning				
Tend to plan for the future (ref)				
Don't tend to plan for the future	1.734	1.741	1.022-2.966	0.041
Cooperation				
We are all in it together (ref)				
In life it is every man for himself	2.582	2.521	1.472-4.318	0.001
Eat for pleasure or health				
Eat mostly for health (ref)				
Eat mostly for pleasure	3.232	3.238	1.197-8.759	0.021
Satiation				
Do not like to feel full (ref)				
Like to feel full	2.496	2.488	1.402-4.415	0.002

Binary logistic regression was undertaken to estimate the predictive effect of behavioural strategies and lifestyle health behaviours on tolerance to risky sexual practices, while controlling for social and demographic variables (Table 33). The overall model was highly significant (p=0.000, Nagelkereke R^2=0.150, overall percentage predicted 73.9%). In terms of demographic variables, compared with females, males had adjusted odds of believing unprotected sex was worth the risk of 3.096 (95% CIs 2.057-6.082). In terms of behavioural strategies, compared with participants who were financially risk averse, participants who were financial risk takers had adjusted odds of believing unprotected sex was worth the risk of 1.818 (95% CIs 0.943-3.699), and compared with participants who tended to plan for the future, participants who did not tend to plan for the future had adjusted odds of believing unprotected sex was worth the risk of 1.495 (95% CIs 0.955-2.875).

Table 33. Changes in adjusted odds of tolerance to risky sexual practice (believing unprotected sex was worth the risk)

	OR	AOR	95% Cls	p-value
Sex				
Female (ref)				
Male	3.537	3.096	2.057 – 6.082	0.000
Financial risk taking				
Risk averse (ref)				
Risk taking	1.867	1.818	0.943 – 3.699	0.052
Planning				
Tend to plan for the future (ref)				
Don't tend to plan for the future	1.691	1.495	0.955 – 2.875	0.050

Binary logistic regression was undertaken to estimate the predictive effect of behavioural strategies and lifestyle health behaviours on engaging in a violent fight in the last 12 months, while controlling for social and demographic variables (Table 34). The overall model was highly significant (p=0.000, Nagelkereke R^2=0.249, overall percentage predicted 86.3%). In terms of demographic and socioeconomic variables, compared with females, males had adjusted odds of engaging in a violent fight of 4.452 (95% CIs 2.096-9.454), compared with participants aged between 25 and 30 years, participants who were aged between 18 and 24 years had adjusted odds of engaging in a violent fight of 5.666 (95% CIs 2.552-12.575). In terms of childhood experience, compared to participants who reported positive childhood experiences, participants who reported adverse childhood experiences had adjusted odds of engaging in a violent fight of 2.401 (95% CIs 1.040-5.541).

Table 34. Changes in adjusted odds of engaging in a violent fight in the last 12 months with demographic factors and behavioural strategies

	OR	AOR	95% Cls	p-value
Sex				
Female (ref)				
Male	4.579	4.452	2.096 – 9.454	0.000
Age				
25-30 (ref)				
18-24	5.416	5.666	2.552 – 12.575	0.000
Childhood experience				
Positive (ref)				
Adverse	2.363	2.401	1.040 – 5.541	0.040

6.2 Study 2

Kolmogorov-Smirnov test for normality showed that the continuous data were not normally distributed for weekly alcohol units consumed (p=0.000).

6.2.1 Correlations

The associations between health risk behaviours and eating behaviours were explored in section 5.2.1. Table 35 displays other correlates of total weekly alcohol units, as displayed increasing weekly alcohol units was found to be negatively associated with increasing adult well-being (p=0.001), increasing childhood happiness (p=0.000) and positively associated with increasing childhood violence (p=0.001). Correlations were significant after applying the Bonferroni adjustment. Weekly alcohol units was not found to be significantly associated with deprivation (p=0.577) or weekly exercise (0.681).

Table 35. Correlates of weekly alcohol units consumed (0-178)

	N	ρ	Adjusted α	Sig
Social and demographic variables				
Social deprivation: least deprived (3.3) most deprived (81.6)	2047	-0.012	0.0250	0.577
Well-being and childhood experience				
Adult well-being: Low (1) high (5)	2045	-0.075	0.0167	0.001
Childhood happiness: Unhappy (1) happy (10)	2045	-0.127	0.0100	0.000
Childhood violence: Non-violent (1) violent (10)	2045	0.076	0.0125	0.001
Lifestyle behaviours				
Days per week undertaken 30 minutes activity (0-7)	2045	-0.009	0.0500	0.681

6.2.2 Cross tabulations

Cross-tabulations were run between the health risk behaviours of binge drinking and current daily smoking. There were significant differences in distribution between risky drinkers (those that reported high binge drinking) compared to low binge drinkers, in terms of the proportion that reported current daily smoking (respectively n=141, 48.8% and n=381, 30.5%; overall n=1540, X^2=35.216, p=0.000).

Table 36 displays cross-tabulations of demographics, behavioural strategies and lifestyle behaviours in terms of the proportion of the sample that were high monthly binge drinkers (of drinkers). In terms of social and demographic variables, there were significant differences in distribution between participants aged between 18 and 24 years and 25 and 30 years (p=0.001), between males and females (p=0.000), and between participants who had been received higher education or not (p=0.004), there were no significant differences in distribution between white and non-white participants (p=0.485), and between participants in full time employment or not (p=0.101). In terms of deprivation, there were significant differences in distribution between the most and 2nd most deprived, and the 3rd, 4th and least deprived participants (p=0.000). In terms of financial security and stability, there were significant differences in distribution between participants who reported being comfortable or coping on present income, and participants who reported finding it difficult or very difficult (p=0.000). In terms of community, there were significant differences in distribution between participants who felt a sense of community belonging and those that did not (p=0.000). In terms of well-being and childhood experience, there were significant differences in distribution between participants with lower and, average or higher adult well-being (p=0.000), and those who reported happy and non-violent childhood experiences, and unhappy and/or violent childhood experiences (p=0.000). In terms of behavioural strategies, there were no significant differences in distribution between altruistic and less altruistic participants (p=0.501), or between participants who were averagely trusting or trusting, and untrusting participants (p=0.130). In terms of lifestyle and health behaviours, there were significant differences in distribution between participants who were more or less active (p=0.017), had high or low daily sedentary time (p=0.000), and between participants who were current daily smokers or not (p=0.000).

Table 36. Cross tabulations of binge drinking frequency: High monthly binge drinking (drank six or more drinks on four or more occasions during the last month)

	All	Total	N	%	χ^2	Sig
Demographics	**Age group**	1540				
	25-30	809	127	15.7		
	18-24	731	162	22.2	10.522	0.001
	Sex	1540				
	Female	882	108	12.2		
	Male	658	181	27.5	57.587	0.000
	Ethnicity	1540				
	Non-white	41	7	17.1		
	White	1499	282	18.8	0.079	0.485
	Employment	1540				
	Employed full time	586	100	17.1		
	Not employed full time	954	189	19.8	1.796	0.101
	Education	1540				
	Higher education	250	32	12.8		
	Less than higher education	1290	257	19.9	6.969	0.004
Deprivation	**Deprivation**	1540				
	3rd, 4th and least deprived	1139	189	16.6		
	Most and 2nd most deprived	401	100	24.9	13.546	0.000
Security and stability	**Financial security**	1540				
	Comfortable/coping on present income	1140	172	15.1		
	Finding it very/difficult on present income	400	117	29.3	38.958	0.000
Community	**Feel a sense of community belonging**	1540				
	Yes	900	134	14.9		
	No	640	155	24.2	21.357	0.000
Well-being and childhood experience	**Childhood experience**	1540				
	Happy and non-violent	1029	151	14.7		
	Unhappy and/or violent	511	138	27.0	34.059	0.000
	Adult well-being	1540				
	Average and high	1300	222	17.1		
	Low	240	67	27.9	15.616	0.000
Behavioural Strategies	**Altruism**	1540				
	Undertakes voluntary work	163	31	19.0		
	Does not undertake voluntary work	1377	258	18.7	0.008	0.501
	Trust	1540				
	Averagely trusting or trusting	1182	214	18.1		
	Untrusting	358	75	20.9	1.459	0.130
Lifestyle and health behaviours	**Exercise per week**	1536				
	Average or high	952	161	16.9		
	Low	584	125	21.4	4.821	0.017
	Sedentary time	1536				
	Low	1133	179	15.8		
	High	403	109	27.0	24.775	0.000
	Smoking	1540				
	Non-current daily smoker	1018	148	14.5		
	Current daily smoker	522	141	27.0	35.216	0.000

Table 37 displays cross-tabulations of demographics, behavioural strategies and lifestyle behaviours in terms of the proportion of the sample that were current daily smokers. In terms of social and demographic variables, there were no significant differences in distribution between participants aged between 18 and 24 years and 25 and 30 years (p=0.225), but there were significant differences in distribution between males and females (p=0.000), between white and non-white participants (p=0.000), between participants in full time employment or not (p=0.000), and between participants who had received higher education or not (p=0.000). In terms of deprivation, there were significant differences in distribution between the most and 2nd most deprived, and the 3rd, 4th and least deprived participants (p=0.000). In terms of financial security and stability, there were significant differences in distribution between participants who reported being comfortable or coping on present income, and participants who reported finding it difficult or very difficult (p=0.000). In terms of community there were significant differences in distribution between participants who felt a sense of community belonging and those that did not (p=0.000). In terms of well-being and childhood experience, there were significant differences in distribution between participants with lower and, average or higher adult well-being (p=0.000), and those who reported happy and non-violent childhood experiences, and unhappy and/or violent childhood experiences (p=0.000). In terms of behavioural strategies, there were significant differences in distribution between altruistic and less altruistic participants (p=0.001), and between participants who were averagely trusting or trusting, and untrusting participants (p=0.000). In terms of lifestyle and health behaviours, there were significant differences in distribution between participants who were more or less active (p=0.000), had high or low daily sedentary time (p=0.000), and between participants who had high monthly binge drinking (drink six or more drinks four or more times per month) or low binge drinking (p=0.000).

Table 37. Cross tabulations of daily smoking: Percentage of current daily smokers

	All	Total	N	%	χ^2	Sig
Demographics	**Age group**	2047				
	18-24	975	304	31.2		
	25-30	1072	352	32.8	0.643	0.225
	Sex	2047				
	Female	1197	348	29.1		
	Male	850	308	36.2	11.710	0.000
	Ethnicity	2047				
	Non-white	170	26	15.3		
	White	1877	630	33.6	23.894	0.000
	Employment	2047				
	Employed full time	739	175	23.7		
	Not employed full time	1308	481	36.8	37.172	0.000
	Education	2047				
	Higher education	316	42	13.3		
	Less than higher education	1731	614	35.5	60.365	0.000
Deprivation	**Deprivation**	2047				
	3rd, 4th and least deprived	612	154	25.2		
	Most and 2nd most deprived	1435	502	35.0	18.995	0.000
Security and stability	**Financial security**	2047				
	Comfortable/coping on present income	1532	407	26.6		
	Finding it very/difficult on present income	515	249	48.3	83.982	0.000
Community	**Feel a sense of community belonging**	2047				
	Yes	1233	344	27.9		
	No	814	312	38.3	24.492	0.000
Well-being and childhood experience	**Childhood experience**	2047				
	Happy and non-violent	1371	327	23.9		
	Unhappy and/or violent	676	329	48.7	128.052	0.000
	Adult well-being	2047				
	Average and high	1725	488	28.3		
	Low	322	168	52.2	71.080	0.000
Behavioural Strategies	**Altruism**	2047				
	Undertakes voluntary work	227	51	22.5		
	Does not undertake voluntary work	1820	605	33.2	10.760	0.001
	Trust	2047				
	Averagely trusting or trusting	1547	443	28.6		
	Untrusting	500	213	42.6	33.835	0.000
Lifestyle and health behaviours	**Exercise per week**	2036				
	Average or high	1243	339	27.3		
	Low	793	312	39.3	32.435	0.000
	Sedentary time	2035				
	Low	1479	420	28.4		
	High	556	233	41.9	34.138	0.000
	Monthly binge drinking	1540				
	Low	1251	381	30.5		
	High	289	141	48.8	35.216	0.000

6.2.3 Regressions

Binary logistic regression was undertaken to estimate the predictive effect of behavioural strategies and lifestyle health behaviours on being a high monthly binge drinker, while controlling for social and demographic variables (Table 38). The overall model was significant (p=0.000, Nagelkereke R^2=0.135, overall percentage predicted 81.7%). In terms of demographics, compared with participants aged between 25 and 30 years, participants aged between 18 and 24 years had adjusted odds of being a high monthly binge drinker of 1.640 (95% CIs 1.249-2.153), and compared with females, males had adjusted odds of being a high monthly binge drinker of 2.768 (95% CIs 2.103-3.642). In terms of deprivation, compared with participants who were less deprived, participants who were more deprived had adjusted odds of being a high monthly binge drinker of 1.468 (95% CIs 1.070-2.012). In terms of financial security, compared with participants who reported being comfortable or coping on present income, participants who reported finding it difficult or very difficult on present income had adjusted odds of being a high monthly binge drinker of 1.818 (95% CIs 1.386-2.524). In terms of community belonging, compared with participants who felt a sense of community belonging, participants who did not had adjusted odds of being a high monthly binge drinker of 1.507 (95% CIs 1.143-1.987). In terms of childhood experience, compared with participants who reported happy and non-violent childhoods, participants who reported unhappy and/or violent childhoods had adjusted odds of being a high monthly binge drinker of 1.764 (95% CIs 1.319-2.360). In terms of lifestyle and health behaviours, compared with participants who were not current daily smokers, participants who were current daily smokers had adjusted odds of being a high monthly binge drinker of 1.649 (95% CIs 1.243-2.188).

Table 38. Predictors of being a high monthly binge drinker with demographic factors and behavioural strategies

	OR	AOR	95% Cls	Sig
Age				
25-30 (ref)				
18-24	1.673	1.640	1.249 – 2.153	0.000
Sex				
Female (ref)				
Male	2.737	2.768	2.103 – 3.642	0.000
Deprivation				
3rd, 4th and least deprived (ref)				
Most and 2nd most deprived	1.487	1.468	1.070 – 2.012	0.017
Financial security				
Comfortable/coping on present income (ref)				
Finding it very/difficult on present income	1.871	1.818	1.386-2.524	0.000
Feel a sense of community belonging				
Yes (ref)				
No	1.485	1.507	1.143 – 1.987	0.004
Childhood experience				
Happy and non-violent (ref)				
Unhappy and/or violent	1.780	1.764	1.319 – 2.360	0.000
Smoking				
Non-current daily smoker (ref)				
Current daily smoker	1.654	1.649	1.243 – 2.188	0.001

Binary logistic regression was undertaken to estimate the predictive effect of behavioural strategies and lifestyle health behaviours on being a current daily smoker, while controlling for social and demographic variables (Table 39). The overall model was significant (p=0.000, Nagelkereke R^2=0.214, overall percentage predicted 71.8%). In terms of demographics, compared with females, males had adjusted odds of being a current daily smoker of 1.536 (95% CIs 1.201-1.965). In terms of education and employment, compared with participants who were currently employed full time, participants who were not currently employed full time had adjusted odds of being a current daily smoker of 1.530 (95% CIs 1.183-1.980), and compared to participants who had been in higher education, participants who had not been in higher education had adjusted odds of being a current daily smoker of 3.312 (95% CIs 2.149-5.104). In terms of childhood experience and adult well-being, compared with participants who reported happy and non-violent childhoods, participants who reported unhappy and/or violent childhoods had adjusted odds of being a current daily smoker of 2.158 (95% CIs 1.685-2.764), and compared to participants with average or high adult well-being, participants with low adult well-being had adjusted odds of being a current daily smoker of 2.010 (95% CIs 1.474-2.743). In terms of financial security, compared with participants who reported being comfortable or coping on present income, participants who reported finding it difficult or very difficult on present income had adjusted odds of being a current daily smoker of 1.620 (95% CIs 1.280-2.051). In terms of

behavioural strategies, compared with participants who were averagely trusting or trusting, untrusting participants had adjusted odds of being a current daily smoker of 1.315 (95% CIs 1.000-1.728). In terms of lifestyle and health behaviours, compared with participants with high weekly exercise, participants with low weekly exercise had adjusted odds of being a current daily smoker of 1.508 (95% CIs 1.187-1.916), and, compared with participants who reported low weekly alcohol consumption, participants who reported high weekly alcohol consumption had adjusted odds of being a current daily smoker of 1.562 (95% CIs 1.165-2.094).

Table 39. Predictors of being a current daily smoker with demographic factors and behavioural strategies

	OR	AOR	95% Cls	Sig
Sex				
Female (ref)				
Male	1533	1.536	1.201 – 1.965	0.001
Employment				
Employed full time (ref)				
Not employed full time	1.531	1.530	1.183 – 1.980	0.000
Education				
Higher education (ref)				
Less than higher education	3.554	3.312	2.149 – 5.104	0.000
Childhood experience				
Happy and non-violent (ref)				
Unhappy and/or violent	2.219	2.158	1.685 – 2.764	0.000
Adult well-being				
Average and high (ref)				
Low	2.006	2.010	1.474 – 2.743	0.000
Financial security				
Comfortable/coping on present income (ref)				
Finding it very/difficult on present income	1.662	1.620	1.280-2.051	0.000
Trust				
Averagely trusting or trusting (ref)				
Untrusting	1.341	1.315	1.000 – 1.728	0.050
Exercise				
Average and high (ref)				
Low	1.505	1.508	1.187 – 1.916	0.001
Drinking alcohol				
Low (ref)				
High	1.570	1.562	1.165 – 2.094	0.003

6.3 Summary

Health risk behaviours were found to be associated with one another across both studies. In study 1, eating for pleasure was associated with high binge drinking, smoking cigarettes, and violent fights; high binge drinking was associated with smoking cigarettes and violent fights; and, daily smoking was associated with violent fights. In study 2, higher proportions of participants who reported high binge drinking also reported daily smoking and low weekly exercise.

Health risk behaviours across both studies were also associated with key sociodemographic variables; in study 1 for the general health risk taking index, higher proportions of males, younger participants (aged 18 to 24 years), low income participants, participants who did not grow up with both parents until the age of 16, all reported high general health risk taking. In study 2, higher proportions of males and participants from more deprived areas reported high binge drinking and current daily smoking.

In terms of developmental factors, general health risk taking, daily smoking, and violence were associated with and adverse childhood experiences. In study 2 higher proportions of participant who reported unhappy and/or violent childhoods reported high binge drinking and current daily smoking. In study 1, higher proportions of participants who did not grow up with both parents until the age of 16 reported high general health risk taking, high binge drinking, and current daily smoking, compared to participants who grew up with both parents.

In terms of evolutionary behaviours, higher proportions of financial risk takers, participants who rarely reviewed their choices, low planning participants, low investing participants, and participants who were not trusting of others all reported higher general health risk taking.

In study 1, in addition to key sociodemographic variables (particularly sex and income), investing behaviour and trust were found to significantly predict general risk taking; investing behaviour, planning decisions and level of cooperation significantly predicted current daily smoking; and financial risk taking and planning decisions significantly predicted participants' views of risky sexual behaviour.

In study 2, sociodemographic variables were found to be strong predictors of high binge drinking, including sex, deprivation, financial security, community belonging and childhood experience. Sociodemographic variables were also found to be strong predictors of current daily smoking, including sex, financial security, education level and childhood experience; however, trust was also found to be a significant predictor, where untrusting participants significantly predicted current daily smoking, independent of other variables.

7. ACTIVITY AND EXERCISE

This chapter explores the relationships between physical activity or exercise and sociodemographic variables, evolutionary and lifestyle behaviours. Physical activity was primarily indicated in study 1 by the activity index, and in study 2 by days in the week 30 minutes exercise was undertaken. Self-perceptions of health and fitness, and lifestyle behaviours are also explored for study 1. Correlations, cross tabulations and predictive variables have been reported and relationships are considered within the context of social and demographic variables. Presented are the significant and non-significant relationships between known and unknown determinants and indicators of activity and exercise.

Findings relate to research questions regarding the influence of socioeconomic variables of childhood experiences and adult well-being on activity and exercise. This chapter also considers the influence of identified evolutionary strategies (including reproductive strategy, financial strategies, altruistic and cooperative behaviour, reviewing and planning behaviour, and achievement striving) on activity and exercise.

7.1 Study 1

The Kolmogorov-Smirnov test for normality revealed that the distribution for the activity index was not normal or non-parametric (p=0.001).

7.1.1 Correlations

The associations between the activity index and eating behaviours were explored in section 5.1.1, and the associations between the activity index and health risk behaviours were explored in section 6.1.1. Table 40 displays other correlates of the activity index; variables included in the index have been omitted from analyses.

In terms of family and social variables the activity index was found to positively correlate with increasing number of reported close friends (p=0.002). In terms of well-being, the activity index was found to positively correlate with increasing adult well-being (p=0.008). In terms of lifestyle and health behaviours, the activity index was found to negatively correlate with increasing hours per day of television watching (p=0.001), and positively with increasing willingness to offset (p=0.001).

The activity index was also significantly associated with the estimated years lost due to not exercising for 30 minutes per day; increasing estimate of years lost correlated positively with increasing physical activity (n=388, ρ=0.106, p=0.036).

Table 40. Correlates of the activity index: Inactive (-8.7) Active (8.9)

	N	ρ	Adjusted α	Sig
Family and social variables				
Number of siblings: (1-12)	390	0.077	0.0083	0.129
How many children you want: (0-7)	379	0.105	0.0063	0.041
How many close friends do you have: (0-40)	389	0.155	0.0045	0.002
Education and employment				
Income: Low (1) High (6)	377	-0.088	0.0071	0.090
Security and stability index: Insecure (-7.8) Secure (6.8)	393	0.062	0.0100	0.222
Well-being and childhood experience				
Adult well-being: (0-5)	388	0.135	0.0050	0.008
Childhood experience score: Adverse (-14.8) Positive (3.1)	393	0.054	0.0125	0.283
Lifestyle behaviours				
Hours per day watching TV: (0-6)	392	-0.165	0.0042	0.001
Total weekly meals: (6-21)	385	0.117	0.0056	0.004
Behavioural strategies				
Reproductive strategy index: Less children at older age (-7.14) More children at younger age (15.11)	393	0.052	0.0167	0.300
Achievement striving: Don't strive (-3.1) Strive (2.4)	393	0.014	0.0500	0.789
Risk taking – financial: Low (-2.5) High (7.6)	393	-0.020	0.0250	0.698
Offsetting index: Don't offset (-2.4) Offset (5.7)	393	0.171	0.0038	0.001

7.1.2 Cross-tabulations

Table 41 displays cross-tabulations of key independent variables in terms of proportions that were calculated to be inactive (1 standard deviation below the mean, physical activity index). In terms of demographic variables, there were significant differences in distribution between participants aged between 18 and 24 years and 25 and 30 years (p=0.009), between males and females (p=0.005), between white and non-white participants (p=0.030), and between participants reporting high or low weekly incomes (p=0.041). In terms of developmental environments, there were significant differences in distribution between participants who reported adverse compared to positive childhood experiences (p=0.027). There were no significant differences between participants who grew up with both parents until the age of 16 compared to those that did not (p=0.553). In terms of behavioural strategies, there were no significant differences in distribution between participants who invested in a pension or not (p=0.125), who reviewed or rarely reviewed their experiences (p=0.517), who planned for the future or preferred to wait and see (p=0.402), who were cooperative or not (p=0.178), who found people to be generally trustworthy or not (p=0.512), or who were altruistic or not (p=0.109).

Table 41. Cross tabulations of physical activity: Percentage of participants who were relatively inactive (1SD below the mean)

	All	Total	N	%	χ^2	Sig
Demographics	**Age**	393				
	18-24	185	24	13.0		
	25-30	208	47	22.6	6.126	0.009
	Sex	389				
	Male	171	21	12.3		
	Female	218	50	22.9	7.292	0.005
	Ethnicity	393				
	White	343	67	19.5		
	Non-white	50	4	8.0	3.922	0.030
	Income	377				
	High	144	32	22.2		
	Low	233	34	14.6	3.588	0.041
Development	**Childhood experience**	393				
	Adverse	58	5	8.6		
	Positive	335	66	19.7	4.101	0.027
	Parents lived with until age 16	393				
	Both parents	331	60	18.1		
	One parent or no parents	62	11	17.7	0.005	0.553
Behavioural strategies	**Investing**	391				
	Pay a pension	177	37	20.9		
	Do not pay a pension	214	34	15.9	1.640	0.125
	Reviewing	390				
	I review my experiences	267	49	18.4		
	I rarely review my experiences	123	22	17.9	0.012	0.517
	Planning	388				
	Plan for the future	224	39	17.4		
	Wait and see	164	31	18.9	0.142	0.402
	Cooperation	386				
	In life it is every man for himself	174	36	20.7		
	In life we are all in it together	212	35	16.5	1.113	0.178
	Trust	388				
	Most people can be trusted	237	43	18.1		
	Most people cannot be trusted	151	28	18.5	0.010	0.512
	Altruism	385				
	Would donate a kidney for non-relative	226	36	15.9		
	Would not donate a kidney for non-relative	159	34	21.4	1.867	0.109

7.1.3 Regressions

Binary logistic regression was undertaken to examine the predictive effect of demographics, behavioural strategies and lifestyle behaviours on physical inactivity, while controlling for other social and demographic variables (Table 42). The overall model was significant (p=0.000, Nagelkereke R^2=0.093, overall percentage predicted 82.3%). In terms of demographic variables, compared with participants who were aged between 18 and 24 years, participants who were aged between 25 and 30 years had adjusted odds of being physically inactive of 1.977 (95% CIs 1.108-3.527), and compared with males, female participants had adjusted odds of being physically inactive of 2.064 (95% CIs 1.120-3.633). In terms of childhood experience, compared with participants who reported positive childhood experiences, participants who reported adverse childhood experiences had adjusted odds of being physically inactive of 2.474 (95% CIs 1.035-8.834). In terms of behavioural strategies, compared with participants who were inclined to offset, participants who were not inclined to offset had adjusted odds of being physically inactive of 2.012 (95% CIs 1.118-3.619).

Table 42. Changes in adjusted odds participants being inactive (1SD below the mean) with demographic variables and behavioural strategies

		OR	AOR	95% Cls	Sig
Age					
	18-24 (ref)				
	25-30	2.017	1.977	1.108 – 3.527	0.021
Sex					
	Male (ref)				
	Female	2.064	2.017	1.120 – 3.633	0.019
Childhood experience					
	Positive (ref)				
	Adverse	2.474	3.023	1.035 – 8.834	0.043
Offsetting					
	Offset (ref)				
	Don't offset	2.018	2.012	1.118 – 3.619	0.020

7.2 Study 2

The Kolmogorov-Smirnov test for normality revealed that the distribution for days in the week 30 minutes exercise was undertaken was not normal or non-parametric (p=0.000).

7.2.1 Correlations

The associations between days in the week 30 minutes exercise was undertaken and eating behaviours were explored in section 5.2.1; the associations between weekly exercise and health risk behaviours (binge drinking and daily smoking) were explored in section 6.2.1. Table 43 displays other correlates of weekly exercise, as displayed increasing weekly exercise was found to be negatively associated with increasing deprivation (p=0.000), positively associated with increasing adult well-being (p=0.000), increasing childhood happiness (p=0.000) and negatively associated with increasing childhood violence (p=0.000). Days in the week 30 minutes exercise was undertaken was negatively associated with daily sedentary time (n=2025, ρ=-0.104, p=0.000). Correlations were significant after applying the Bonferroni adjustment.

Table 43. Correlates of days in the week 30 minutes exercise was undertaken (0-7)

	N	ρ	Adjusted α	Sig
Social and demographic variables				
Social deprivation: least deprived (3.3) most deprived (81.6)	2036	-0.089	0.0500	0.000
Well-being and childhood experience				
Adult well-being: Low (1) high (5)	2045	0.156	0.0125	0.000
Childhood happiness: Unhappy (1) happy (10)	2045	0.141	0.0167	0.000
Childhood violence: Non-violent (1) violent (10)	2045	-0.109	0.0250	0.000

7.2.2 Cross-tabulations

Table 44 displays cross-tabulations of demographics, behavioural strategies and lifestyle behaviours in terms of the proportion of the sample that reported low weekly exercise. In terms of social and demographic variables, there were no significant differences in distribution between participants aged between 18 and 24 years and 25 and 30 years (p=0.110), but there were significant differences in distribution between males and females (p=0.000), between white and non-white participants (p=0.022), between participants in full time employment or not (p=0.000), and between participants who had received higher education or not (p=0.002). In terms of deprivation, there were significant differences in distribution between the most and 2nd most deprived, and the 3rd, 4th and least deprived participants (p=0.012). In terms of financial security

and stability, there were significant differences in distribution between participants who reported being comfortable or coping on present income, and participants who reported finding it difficult or very difficult (p=0.000). In terms of community there were significant differences in distribution between participants who felt a sense of community belonging and those that did not (p=0.001). In terms of well-being and childhood experience, there were significant differences in distribution between participants with lower and, average or higher adult well-being (p=0.000), and those who reported happy and non-violent childhood experiences, and unhappy and/or violent childhood experiences (p=0.000). In terms of behavioural strategies, there were significant differences in distribution between altruistic and less altruistic participants (p=0.024), and between participants who were averagely trusting or trusting, and untrusting participants (p=0.000).

Table 44. Cross tabulations of weekly exercise frequency: Percentage participants who reported low weekly exercise frequency

	All	Total	N	%	χ^2	Sig
Demographics	**Age group**	2036				
	18-24	968	391	40.4		
	25-30	1068	402	37.6	1.617	0.110
	Sex	2036				
	Female	1188	508	42.8		
	Male	848	285	33.6	17.431	0.000
	Ethnicity	2036				
	Non-white	170	79	46.5		
	White	1866	714	38.3	4.413	0.022
	Employment	2036				
	Employed full time	738	217	29.4		
	Not employed full time	1298	576	44.4	44.354	0.000
	Education	2036				
	Higher education	315	99	31.4		
	Less than higher education	1721	694	40.3	8.863	0.002
Deprivation	**Deprivation**	2036				
	3rd, 4th and least deprived	609	214	35.1		
	Most and 2nd most deprived	1427	579	40.6	5.303	0.012
Security and stability	**Financial security**	2036				
	Comfortable/coping on present income	1521	548	36.0		
	Finding it very/difficult on present income	515	245	47.6	21.561	0.000
Community	**Feel a sense of community belonging**	2036				
	Yes	1226	443	36.1		
	No	810	350	43.2	10.271	0.001
Well-being and childhood experience	**Childhood experience**	2036				
	Happy and non-violent	1365	470	34.4		
	Unhappy and/or violent	671	323	48.1	35.534	0.000
	Adult well-being	2036				
	Average and high	1715	638	37.2		
	Low	321	155	48.3	13.974	0.000
Behavioural Strategies	**Altruism**	2036				
	Undertakes voluntary work	226	74	32.7		
	Does not undertake voluntary work	1810	719	39.7	4.117	0.024
	Trust	2036				
	Averagely trusting or trusting	1539	551	35.8		
	Untrusting	497	242	48.7	26.249	0.000

7.2.3 Regressions

Binary logistic regression was undertaken to estimate the predictive effect of behavioural strategies and lifestyle health behaviours on reporting low weekly exercise, while controlling for social and demographic variables (Table 45). The overall model was significant (p=0.000, Nagelkereke R^2=0.069, overall percentage predicted 62.7%). In terms of demographics, compared with males females had adjusted odds of reporting low weekly exercise of 1.367 (95% CIs 1.128-1.657), and compared with white participants, non-white participants had adjusted odds of reporting low weekly exercise of 1.456 (95% CIs 1.052-2.015). In terms of employment, compared with participants who were currently employed full time, participants who were not currently employed full time had adjusted odds of reporting low weekly exercise of 1.640 (95% CIs 1.342-2.004). In terms of childhood experience, compared with participants who reported happy and non-violent childhoods, participants who reported unhappy and/or violent childhoods had adjusted odds of reporting low weekly exercise of 1.457 (95% CIs 1.190-1.783). In terms of behavioural strategies, compared with participants who were averagely trusting or trusting, untrusting participants had adjusted odds of reporting low weekly exercise of 1.359 (95% CIs 1.096-1.687).

Table 45. Predictors of reporting low weekly exercise frequency

	OR	AOR	95% Cls	Sig
Sex				
Male (ref)				
Female	1.328	1.367	1.128 – 1.657	0.001
Ethnicity				
White (ref)				
Non-white	1.419	1.456	1.052 – 2.015	0.024
Employment				
Employed full time (ref)				
Not employed full time	1.654	1.640	1.342 – 2.004	0.000
Childhood experience				
Happy and non-violent (ref)				
Unhappy and/or violent	1.563	1.457	1.190 – 1.783	0.000
Trust				
Averagely trusting or trusting (ref)				
Untrusting	1.415	1.359	1.096 – 1.687	0.005

7.3 Summary

In study 1, physical inactivity was found to be associated with various lifestyle behaviours, including television watching time and increasing total weekly meals. In terms of behaviours, physical inactivity was found to be associated with low health offsetting. In terms of sociodemographics, higher proportions of older participants (aged 25 to 30 years), females, and low income participants reported physical inactivity. In terms of developmental variables, higher proportions of participants who reported adverse childhood experiences reported physical inactivity. In study 2, deprivation, low adult well-being and adverse childhood experiences were all found to be associated with lower levels of weekly exercise. In study 2 in terms of behavioural strategies, higher proportions of participants who did not report voluntary work (less altruistic) and untrusting participants reported low levels of weekly exercise.

In study 1, in addition to age and sex, childhood experience and health offsetting were found to be significant predictors of activity levels, where adverse childhood experiences and low health offsetting were significant predictors of physical inactivity, independent of other variables. In study 2, in addition to sex, ethnicity and employment, childhood experience and trust were found to be significant predictors of exercise, where unhappy and/or violent childhoods and low levels of trust were significant predictors of low weekly exercise, independent of other variables.

8. CHILDHOOD EXPERIENCE AND ADULT WELL-BEING

This chapter explores the relationship between childhood experience and adult well-being, and the relationships between childhood experience and adult well-being with sociodemographic variables, evolutionary strategies and lifestyle behaviours. Childhood experience is measured in study 1 using the childhood experience index, in study 2 by the measures of childhood happiness and violence, or a combination of the two; in both studies, adult well-being is measured using the WEMWBS. Correlations, cross tabulations and predictive variables have been reported and relationships are considered within the context of social and demographic variables.

Findings relate to research questions regarding the influence of childhood experiences on adult well-being, and the determinants of them. Findings also relate to childhood experience and adult well-being as determinants of evolutionary strategies.

8.1 Study 1

The Kolmogorov-Smirnov test for normality revealed that the distribution for the indicators of adult well-being and childhood experience were not normal; WEMWBS (p=0.000), index for childhood experience (p=0.000).

8.1.1 Correlations

Childhood experience and adult well-being were found to be associated with one another. Childhood experience (-14.80–3.09) was positively associated with adult well-being (1.60-5.00; N=388, ρ=0.297, p=0.000). The associations between childhood experience and adult well-being, and eating behaviours were explored in section 5.1.1; between childhood experience and adult well-being, and health risk behaviours in section 6.1.1; and between childhood experience and adult well-being, and activity and exercise in section 7.1.1. Table 46 displays other correlates of the childhood experience index. In terms of family and social variables, increasingly positive childhood experience was found to be positively associated with increasing number of children participants wanted (p=0.006), and number of close friends participants reported having (p=0.010). In terms of security and stability, increasingly positive childhood experience was positively associated with increasingly security and stability (p=0.000). In terms of lifestyle behaviours, increasingly positive childhood experience was positively associated with increasing hours of television watched per day (p=0.006), and increasing number of total weekly meals (p=0.008). In terms of behavioural strategies, increasingly positive childhood experience was negatively associated with increasing financial risk taking (p=0.000).

Table 46. Correlates of the childhood experience index (-14.80 – 3.09)

	N	ρ	Adjusted α	Sig
Family and social variables				
Number of siblings: (1-12)	390	0.016	0.0167	0.745
How many children you want: (0-7)	379	0.139	0.0063	0.006
How many close friends do you have: (0-40)	389	0.131	0.0083	0.010
Education and employment				
Income: Low (1) High (6)	377	0.108	0.0125	0.035
Security and stability index: Insecure (-7.8) Secure (6.8)	393	0.232	0.0045	0.000
Lifestyle behaviours				
Hours per day watching TV: (0-6)	392	0.140	0.0056	0.006
Total weekly meals: (6-21)	385	0.134	0.0071	0.008
Behavioural strategies				
Reproductive strategy index: Less children at older age (-7.14) More children at younger age (15.11)	393	-0.009	0.0500	0.860
Achievement striving: Don't strive (-3.1) Strive (2.4)	393	0.115	0.0100	0.023
Risk taking – financial: Low (-2.5) High (7.6)	393	-0.231	0.0050	0.000
Offsetting index: Don't offset (-2.4) Offset (5.7)	393	0.013	0.0250	0.801

Table 47 displays other correlates of WEMWBS scores. In terms of family and social variables, increasing adult well-being was found to be positively associated with increasing number of close friends participants reported having (p=0.007). In terms of security and stability, increasing adult well-being was positively associated with increasing security and stability (p=0.000). In terms of lifestyle behaviours, increasing adult well-being was positively associated with number of total weekly meals (p=0.008). In terms of behavioural strategies, increasing adult well-being was positively associated with increasing achievement striving (p=0.003) and increasing willingness to offset (p=0.001).

Table 47. Correlates of WEMWBS scores (1.60 – 5.00)

	N	ρ	Adjusted α	Sig
Family and social variables				
Number of siblings: (1-12)	385	0.014	0.0250	0.788
How many children you want: (0-7)	374	0.106	0.0083	0.041
How many close friends do you have: (0-40)	385	0.137	0.0063	0.007
Education and employment				
Income: Low (1) High (6)	372	0.061	0.0125	0.239
Security and stability index: Insecure (-7.8) Secure (6.8)	388	0.206	0.0045	0.000
Lifestyle behaviours				
Hours per day watching TV: (0-6)	388	-0.009	0.0500	0.857
Total weekly meals: (6-21)	381	0.135	0.0071	0.008
Behavioural strategies				
Reproductive strategy index: Less children at older age (-7.14) More children at younger age (15.11)	393	0.024	0.0167	0.632
Achievement striving: Don't strive (-3.1) Strive (2.4)	388	0.148	0.0056	0.003
Risk taking – financial: Low (-2.5) High (7.6)	388	0.080	0.0100	0.117
Offsetting index: Don't offset (-2.4) Offset (5.7)	388	0.173	0.0050	0.001

8.1.2 Cross tabulations

Table 48 displays cross-tabulations of key independent variables in terms of proportions that reported adverse childhood experiences (1 standard deviation below the mean, childhood experience index). In terms of demographic variables, there were no significant differences in distribution between participants aged between 18 and 24 years rather than 25 and 30 years (p=0.265), between participants reporting high or low weekly incomes (p=0.102), or between secondary school and university educated participants (p=0.287). There were significant differences in distribution between males and females (p=0.011), and between white and non-white participants (p=0.000). In terms of developmental environments, there were significant differences in distribution between participants who grew up with both parents until the age of 16 compared to those that did not (p=0.000). In terms of behavioural strategies, there were no significant differences in distribution between participants who invested in a pension or not (p=0.360), who reviewed or rarely reviewed their experiences (p=0.295), who planned for the future or preferred to wait and see (p=0.193), or who were altruistic or not (p=0.230). There were significant differences in distribution between participants who were cooperative or not (p=0.006), and between participants who found people to be generally trustworthy or not (p=0.043).

Table 48. Cross tabulations of childhood experience: Percentage of participants who reported adverse childhood experiences (1SD below the mean)

	All	Total	N	%	χ^2	Sig
Demographics	**Age**	393				
	18-24	185	30	16.2		
	25-30	208	28	13.5	0.591	0.265
	Sex	389				
	Male	171	34	19.9		
	Female	218	24	11.0	5.948	0.011
	Ethnicity	393				
	White	343	41	12.0		
	Non-white	50	17	34.0	16.860	0.000
	Income	377				
	High	144	17	11.8		
	Low	233	40	17.2	1.994	0.102
	Education	391				
	Secondary	82	14	17.1		
	University	309	43	13.9	0.519	0.287
Development	**Parents lived with until age 16**	393				
	Both parents	331	37	11.2		
	One parent or no parents	62	21	33.9	21.375	0.000
Behavioural strategies	**Investing**	391				
	Pay a pension	177	28	15.8		
	Do not pay a pension	214	30	14.0	0.249	0.360
	Reviewing	390				
	I review my experiences	267	42	15.7		
	I rarely review my experiences	123	16	13.0	0.493	0.295
	Planning	388				
	Plan for the future	224	37	16.5		
	Wait and see	164	21	12.8	1.027	0.193
	Cooperation	386				
	In life it is every man for himself	174	35	20.1		
	In life we are all in it together	212	22	10.4	7.200	0.006
	Trust	388				
	Most people can be trusted	237	29	12.2		
	Most people cannot be trusted	151	29	19.2	3.523	0.043
	Altruism	385				
	Would donate a kidney for non-relative	226	31	13.7		
	Would not donate a kidney for non-relative	159	27	17.0	0.777	0.230

Table 49 displays cross-tabulations of key independent variables in terms of proportions that reported low adult well-being (1 standard deviation below the mean, WEMWBS score). In terms of demographic variables, there were no significant differences in distribution between participants aged between 18 and 24 years and 25 and 30 years (p=0.061), between males and females (p=0.413), between white and non-white participants (p=0.135), and between participants reporting high or low weekly incomes (p=0.294). There were significant differences in distribution between secondary school and university educated participants (p=0.010). In terms of developmental environments, there were significant differences in distribution between participants who grew up with both parents until the age of 16 compared to those that did not (p=0.008). In terms of behavioural strategies, there were no significant differences in distribution between participants who invested in a pension or not (p=0.176), who reviewed or rarely reviewed their experiences (p=0.116), who planned for the future or preferred to wait and see (p=0.386), who were cooperative or not (p=0.246), who found people to be generally trustworthy or not (p=0.123), or, who were altruistic or not (p=0.139).

Table 49. Cross tabulations of adult well-being: Percentage of participants who reported low adult well-being (1SD below the mean)

	All	Total	N	%	χ^2	Sig
Demographics	**Age**	388				
	18-24	181	37	20.4		
	25-30	207	29	14.0	2.830	0.061
	Sex	384				
	Male	167	30	18.0		
	Female	217	36	16.6	0.125	0.413
	Ethnicity	388				
	White	340	61	17.9		
	Non-white	48	5	10.4	1.687	0.135
	Income	372				
	High	143	27	18.9		
	Low	229	37	16.2	0.459	0.294
	Education	386				
	Secondary	79	21	26.6		
	University	307	44	14.3	6.733	0.010
Development	**Parents lived with until age 16**	388				
	Both parents	330	49	14.8		
	One parent or no parents	58	17	29.3	7.308	0.008
Behavioural strategies	**Investing**	386				
	Pay a pension	175	26	14.9		
	Do not pay a pension	211	40	19.0	1.135	0.176
	Reviewing	385				
	I review my experiences	265	50	18.9		
	I rarely review my experiences	120	16	13.3	1.781	0.116
	Planning	383				
	Plan for the future	223	40	17.9		
	Wait and see	160	26	16.3	0.186	0.386
	Cooperation	381				
	In life it is every man for himself	170	32	18.8		
	In life we are all in it together	211	33	15.6	0.674	0.246
	Trust	383				
	Most people can be trusted	236	36	15.3		
	Most people cannot be trusted	147	30	20.4	1.687	0.123
	Altruism	380				
	Would donate a kidney for non-relative	222	43	19.4		
	Would not donate a kidney for non-relative	158	23	14.6	1.490	0.139

8.2 Study 2

The Kolmogorov-Smirnov test for normality revealed that the distribution for the indicators of adult well-being and childhood experience were not normal; WEMWBS (p=0.000), index for childhood experience (p=0.000).

8.2.1 Correlations

Childhood experience and adult well-being were found to be associated with one another. Increasing childhood happiness (1–10) was negatively associated with increasing childhood violence (1-10; N=2047, ρ= -0.639, p=0.000); increasing childhood happiness was positively associated with increasing adult well-being (1.00-5.00; N=2047, ρ=0.328, p=0.000); and increasing childhood violence was negatively associated with increasing adult well-being (N=2047, ρ= -0.238, p=0.000). The associations between childhood experience/adult well-being, and eating behaviours were explored in section 5.2.1; between childhood experience/adult well-being and health risk behaviours in section 6.2.1; and between childhood experience/adult well-being and physical activity in section 7.2.1. Increasing deprivation was negatively associated with increasing childhood happiness (N=2047, ρ= -0.149, p=0.000), and increasing adult well-being (N=2047, ρ= -0.055, p=0.012), and positively associated with increasing childhood violence (N=2047, ρ= 0.178, p=0.000).

8.2.2 Cross tabulations

Table 50 displays cross-tabulations of demographics, behavioural strategies and lifestyle behaviours in terms of the proportion of the sample that reported unhappy and/or violent childhoods. In terms of social and demographic variables, there were no significant differences in distribution between participants aged between 18 and 24 years and 25 and 30 years (p=0.060), between males and females (p=0.165), between white and non-white participants (p=0.216). There were significant differences in distribution between participants in full time employment or not (p=0.000), and between participants who had received higher education or not (p=0.000). In terms of deprivation, there were significant differences in distribution between the most and 2nd most deprived, and the 3rd, 4th and least deprived participants (p=0.000). In terms of financial security and stability, there were significant differences in distribution between participants who reported being comfortable or coping on present income, and participants who reported finding it difficult or very difficult (p=0.000). In terms of community there were significant differences in distribution between participants who felt a sense of community belonging and those that did not (p=0.000). In terms of behavioural strategies, there were no significant differences in distribution between altruistic and less altruistic participants (p=0.077), but there were significant differences

between participants who were averagely trusting or trusting, and untrusting participants (p=0.000).

Table 50. Cross tabulations of childhood experience: Percentage participants who reported unhappy and/or violent childhoods

	All	Total	N	%	χ^2	Sig
Demographics	**Age group**	2047				
	18-24	975	305	31.3		
	25-30	1072	371	34.6	2.554	0.060
	Sex	2047				
	Female	1197	406	33.9		
	Male	850	270	31.8	1.042	0.165
	Ethnicity	2047				
	Non-white	170	51	30.0		
	White	1877	625	33.3	0.766	0.216
	Employment	2047				
	Employed full time	739	179	24.2		
	Not employed full time	1308	497	38.0	40.511	0.000
	Education	2047				
	Higher education	316	64	20.3		
	Less than higher education	1731	612	35.4	27.555	0.000
Deprivation	**Deprivation**	2047				
	3rd, 4th and least deprived	612	147	24.0		
	Most and 2nd most deprived	1435	529	36.9	32.002	0.000
Security and stability	**Financial security**	2047				
	Comfortable/coping on present income	1532	408	26.6		
	Finding it very/difficult on present income	515	268	52.0	112.488	0.000
Community	**Feel a sense of community belonging**	2047				
	Yes	1233	315	25.5		
	No	814	361	44.3	78.362	0.000
Behavioural Strategies	**Altruism**	2047				
	Undertakes voluntary work	227	65	28.6		
	Does not undertake voluntary work	1820	611	33.6	2.224	0.077
	Trust	2047				
	Averagely trusting or trusting	1547	427	27.6		
	Untrusting	500	249	49.8	84.184	0.000

Table 51 displays cross-tabulations of demographics, behavioural strategies and lifestyle behaviours in terms of the proportion of the sample that reported low adult well-being. In terms of social and demographic variables, there were no significant differences in distribution between participants aged between 18 and 24 years and 25 and 30 years (p=0.059), between males and females (p=0.058), between white and non-white participants (p=0.123). There were significant

differences in distribution between participants in full time employment or not (p=0.000), and between participants who had received higher education or not (p=0.000). In terms of deprivation, there were significant differences in distribution between the most and 2nd most deprived, and the 3rd, 4th and least deprived participants (p=0.012). In terms of financial security and stability, there were significant differences in distribution between participants who reported being comfortable or coping on present income, and participants who reported finding it difficult or very difficult (p=0.000). In terms of community there were significant differences in distribution between participants who felt a sense of community belonging and those that did not (p=0.000). In terms of behavioural strategies, there were significant differences in distribution between altruistic and less altruistic participants (p=0.000), and between participants who were averagely trusting or trusting, and untrusting participants (p=0.000).

Table 51. Cross tabulations of adult well-being: Percentage participants who reported low adult well-being (1SD below the mean)

	All	Total	N	%	χ^2	Sig
Demographics	**Age group**	2047				
	18-24	975	140	14.4		
	25-30	1072	182	17.0	2.641	0.059
	Sex	2047				
	Female	1197	175	14.6		
	Male	850	147	17.3	2.682	0.058
	Ethnicity	2047				
	Non-white	170	21	12.4		
	White	1877	301	16.0	1.595	0.123
	Employment	2047				
	Employed full time	739	83	11.2		
	Not employed full time	1308	239	18.3	17.659	0.000
	Education	2047				
	Higher education	316	20	6.3		
	Less than higher education	1731	302	17.4	24.915	0.000
Deprivation	**Deprivation**	2047				
	3rd, 4th and least deprived	612	79	12.9		
	Most and 2nd most deprived	1435	243	16.9	5.244	0.012
Security and stability	**Financial security**	2047				
	Comfortable/coping on present income	1532	166	10.8		
	Finding it very/difficult on present income	515	156	30.3	110.061	0.000
Community	**Feel a sense of community belonging**	2047				
	Yes	1233	142	11.5		
	No	814	180	22.1	41.531	0.000
Behavioural Strategies	**Altruism**	2047				
	Undertakes voluntary work	227	19	8.4		
	Does not undertake voluntary work	1820	303	16.6	10.434	0.000
	Trust	2047				
	Averagely trusting or trusting	1547	205	13.3		
	Untrusting	500	117	23.4	29.359	0.000

8.2.3 Regressions

Binary logistic regression was undertaken to estimate the predictive effect of behavioural strategies and lifestyle health behaviours on reporting low adult well-being, while controlling for social and demographic variables (Table 52). The overall model was significant (p=0.000, Nagelkereke R^2=0.129, overall percentage predicted 84.3%). In terms of education, compared with participants who had been in higher education, participants who had not been in higher education had adjusted odds of reporting low adult well-being of 2.296 (95% CIs 1.412-3.736). In terms of childhood experience, compared with participants who reported happy and non-violent childhoods, participants who reported unhappy and/or violent childhoods had adjusted odds of reporting low adult well-being of 2.718 (95% CIs 2.100-3.517). In terms of financial security, compared with participants who reported being comfortable or coping on present income, participants who reported finding it difficult or very difficult on present income had adjusted odds of reporting low adult well-being of 2.437 (95% CIs 1.868-3.178). In terms of developmental communities, compared with participants who felt a sense of community belonging, participants who did not had adjusted odds of reporting low adult well-being of 1.710 (95% CIs 1.326-2.206). In terms of behavioural strategies, compared with participants who undertook voluntary work, participants who were less altruistic had adjusted odds of reporting low adult well-being of 1.861 (95% CIs 1.128-3.071), and compared with participants who were averagely trusting or trusting, untrusting participants had adjusted odds of reporting low adult well-being of 1.385 (95% CIs 1.054-1.818).

Table 52. Predictors of reporting low adult well-being with demographic factors and behavioural strategies

	OR	AOR	95% Cls	Sig
Education				
Higher education (ref)				
Less than higher education	2.486	2.296	1.412 – 3.736	0.001
Childhood experience				
Happy and non-violent (ref)				
Unhappy and/or violent	2.794	2.718	2.100 – 3.517	0.000
Financial security				
Comfortable/coping on present income (ref)				
Finding it very/difficult on present income	2.555	2.437	1.868-3.178	0.000
Feel a sense of community belonging				
Yes (ref)				
No	1.706	1.710	1.326 – 2.206	0.000
Altruism				
Undertakes voluntary work (ref)				
Does not undertake voluntary work	1.840	1.861	1.128 – 3.071	0.015
Trust				
Averagely trusting or trusting (ref)				
Untrusting	1.423	1.385	1.054 – 1.818	0.019

8.3 Summary

In previous chapters, childhood experience and, to a lesser extent, adult well-being, were found to be key correlates and predictors of various health risk behaviours. This chapter considered childhood experience and adult well-being in terms of their relationship with each other, other lifestyle behaviours and evolutionary strategies. In both studies, childhood experience and adult well-being were associated, where positive childhood experiences were associated with higher adult well-being. In study 1 adverse childhood experience was found to be associated with economic instability and high financial risk taking. In study 2, increasing levels of deprivation was associated with decreasing childhood happiness, increasing childhood violence and decreasing adult well-being. In study 1, lower adult well-being was associated with financial insecurity and low health offsetting behaviour.

In study 1 regression models considering adult well-being were not found to be significant. In study 2, binary logistic regression revealed the strongest predictor of adult well-being was childhood experience, where participants who reported unhappy and/or violent childhoods were found to be 2.7 times more likely to report low adult well-being compared to those reporting happy and non-violent childhoods, independent of other variables. Other significant predictors of adult well-being included education level, financial security and sense of community belonging. In terms of behavioural strategies, levels of altruism and were also found to predict adult well-being where participants who did not undertake voluntary work (less altruistic) and were untrusting of people were significantly more likely to report low adult well-being.

9. LATENT PROFILE ANALYSIS

The analysis presented in this Chapter applied three-step Latent Profile Analysis (LPA; Vermunt, 2010; Bakk, Tekle and Vermunt, 2013), to data from study 1. Indicator variables were used to assign participants into clusters, which were first described in terms of sociodemographic characteristics, before probability means were calculated to differentiate health outcomes by cluster. The methodology for this analysis is described in section 3.2.5e.

Findings in this chapter relate to the research question which seeks to explore to what extent we can predict individuals likely to exhibit health risk behaviours, given that health risk behaviours were associated with behavioural strategies, and were predicted by demographics, developmental experiences, socioeconomics and subjective factors.

9.1 Study 1

Indicator variables used to predict class membership were developmental or behavioural strategies that were shown to be significantly associated with one or more outcome variable in Chapters 5-8. Developmental variables included the childhood experience index; whether participants grew up with both parents until the age of 16 or not; and whether participants were from communities which kept alone or where people knew each other. Behavioural strategy variables included whether participants routinely reviewed their experiences or not; whether participants planned for the future or not; whether participants believed in cooperation or not; whether participants invested in a pension or not; whether participants were trusting or not; and whether participants invested in exercise or not.

9.1.1 LPA Model

Tables 53 displays a summary of LPA for indicator/predictive variables; the first ten cluster models are displayed. The three cluster model was selected on the basis of the lowest BIC. Entropy R^2 for the 3-class model was 0.78 (approaching high entropy value of 0.80).

Table 53. LPA fit statistics and entropy for demographic variables, behavioural strategies and public health outcomes

Clusters	LL	Parameters	BIC	Wald	P-Value	Entropy	Entropy R^2
1	-4047.64	13	8172.41	-	-	-	-
2	-3824.29	27	7808.74	14.41	0.000	44.45	0.82
3	-3727.29	41	7698.07	6.18	0.046	87.11	0.80
4	-3687.39	55	7701.05	32.25	0.000	102.94	0.78
5	-3665.24	69	7739.80	58.24	0.000	122.43	0.78
6	-3635.66	83	7763.70	96.00	0.000	107.71	0.82
7	-3617.12	97	7809.67	125.30	0.000	111.01	0.83
8	-3604.59	111	7867.67	156.20	0.000	99.59	0.85
9	-3586.10	125	7913.72	169.26	0.000	125.65	0.83
10	-3568.28	139	7961.14	215.84	0.000	103.78	0.86

9.1.2 Indicator variables

Of all participants (n=377), 154 (40.0%) were categorised into cluster 1, 148 (37.5%) into cluster 2, and 78 (22.5%) into cluster 3. Table 54 describes and figures 5 and 6 show the clusters in terms of the indicator variables. ANOVA showed significant differences in mean scores between clusters for childhood experience scores (p=0.000), and reproductive strategy (p=0.000); significant differences in distribution between clusters were found for the proportion of participants that lived with both parents until the age of 16 (p=0.000), how trusting participants were (p=0.005), and the proportion of participants that were inactive (p=0.019). Of all clusters, cluster 1 scored moderately in terms of childhood experience; highest in terms of the desire to have more children, and at a younger age; moderately in terms of the proportion that reported living with both parents until the age of 16, moderately in terms of reviewing experiences; lowest in terms of planning; moderately in terms of investing behaviour; moderately in terms of trusting people; and lowest in terms of physical activity. Of all clusters, cluster 2 scored highest in terms of positive childhood experiences; moderately in terms of reproductive strategy; highest in terms of living with both parents until the age of 16; lowest in terms of routinely reviewing experiences; moderately in terms planning for the future; highest in terms of investing in a pension; highest in terms of trusting people; and moderately in terms of physical inactivity. Of all clusters, cluster 3 scored lowest in terms of positive childhood experiences; lowest in terms of the desire to have more children, and at a younger age; lowest in terms of living with both parents until the age of 16; highest in terms of reviewing their experiences; highest in terms of planning for the future; lowest in terms of investing in a pension; lowest in terms of trusting people; and highest in terms of physical activity.

Table 54. Indicator variables with mean scores and percentages by cluster

	All	Cluster 1	Cluster 2	Cluster 3	Wald	Model Sig		
N	377	154 40.0%	148 37.5%	78 22.5%				
			Means				**F**	**Sig**
Childhood experience Index: Adverse (-14.8) Positive (3.1)	0.0	0.1	3.0	-5.4	214.83	0.000	621.154	0.000
Reproductive strategy: More children at younger age (-7.14) Less at older age (15.11)	0.0	-0.5	0.0	0.9	8.46	0.015	8.573	0.000
			Percentages				**χ^2**	**Sig**
Parents lived with until 16:								
Both parents	83.6	85.2	92.6	65.6				
One parent or no parents	16.4	14.8	7.4	34.3	19.76	0.000	29.703	0.000
Reviewing								
I review my experiences	67.6	66.1	65.7	73.7				
I rarely review my experiences	32.4	33.9	34.3	26.3	1.32	0.520	1.387	0.500
Planning								
Plan for the future	57.6	53.6	59.7	61.0				
Wait and see	42.4	46.4	40.3	39.0	1.13	0.570	1.502	0.472
Investing								
Pay a pension	44.8	41.3	51.4	40.2				
Do not pay a pension	55.2	58.7	48.6	59.8	3.63	0.160	3.373	0.185
Trust								
Most people can be trusted	61.0	63.0	67.8	46.1				
Most people cannot be trusted	39.0	37.0	32.2	53.9	8.21	0.017	10.538	0.005
Physical activity								
Inactive	18.6	24.5	18.6	7.9				
Averagely or highly active	81.4	75.5	81.4	92.1	5.14	0.077	7.907	0.019

Figure 5. Childhood experience and reproductive strategy mean scores (where higher score = positive experience/less children at older age by cluster)

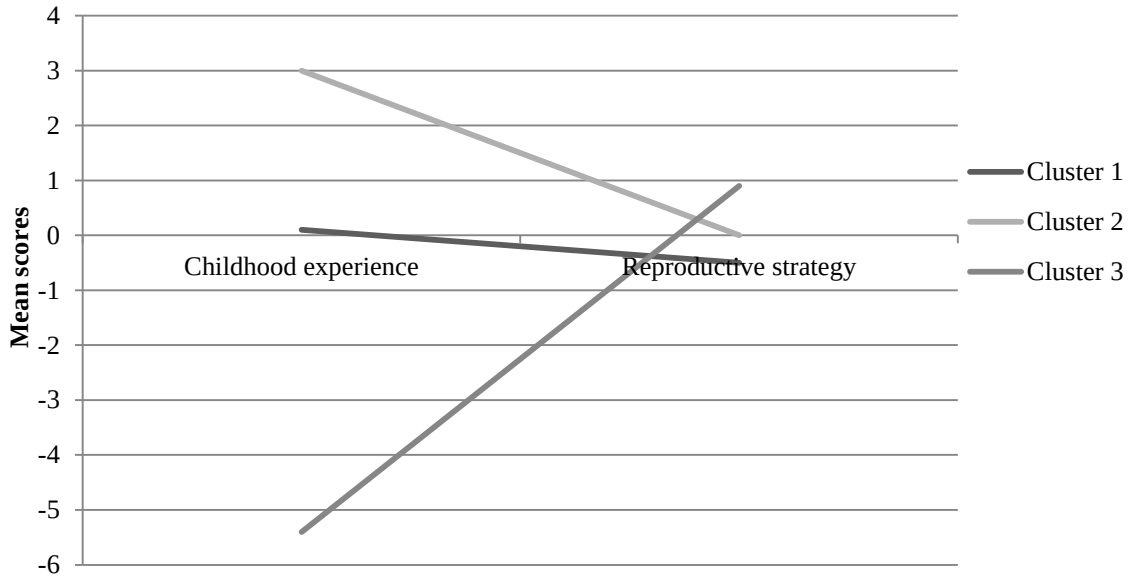
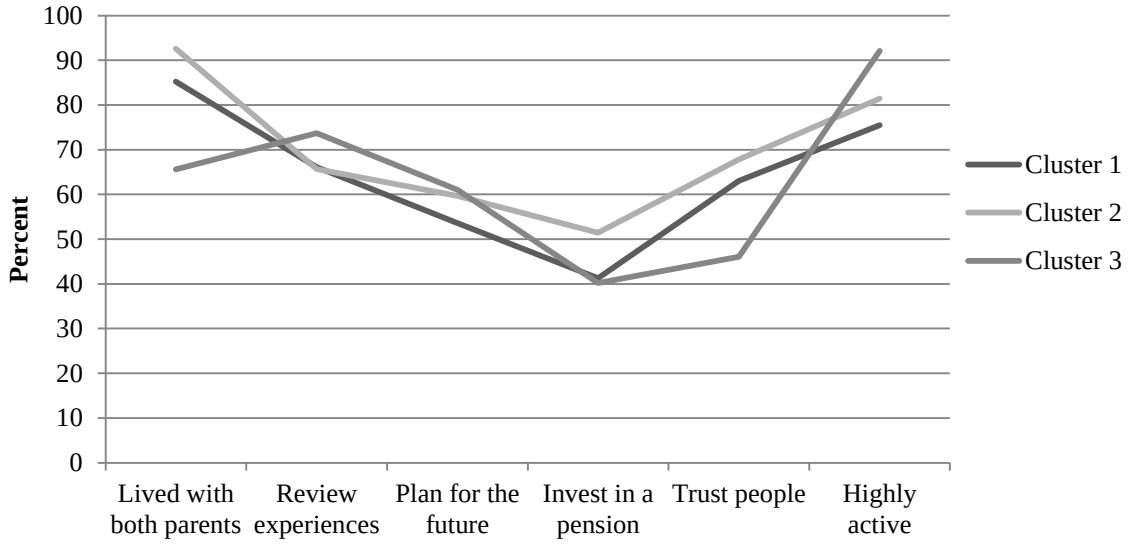


Figure 6. Behavioural strategy percentage scores by cluster



To summarise clusters using behavioural strategies that were significantly different in terms of their variance or distributions between clusters:

- Cluster 1 participants had a desire for many children, and were the most physically inactive;
- Cluster 2 participants had positive and stable childhoods, and were the most trusting of other people;
- Cluster 3 participants had adverse and unstable childhoods, with a desire for few children, were the least trusting of other people and were the most physically active.

9.1.3 Proximal variables

In terms of the overall model, significant proximal, sociodemographic variables were sex (p=0.000), ethnicity (p=0.004), and employment (p=0.008). Table 55 describes and figure 7 shows the clusters in terms of the proximal, sociodemographic variables. Significant differences in distribution between clusters were found for the proportion of males and females (p=0.000), white and non-white participants (p=0.000), and the proportion of participants that were in full time employment or not (p=0.001). Compared to other clusters, cluster 1 had the lowest proportion of participants aged between 18 and 24 years; had a moderate proportion of males; had the highest proportion of white participants; the highest proportion of university educated participants; had a moderate proportion in full time employment; and had the lowest proportion reporting high weekly income. Compared to other clusters, cluster 2 had a moderate proportion of participants aged between 18 and 24 years; had the lowest proportion of males; had a moderate proportion of white participants; had the lowest proportion of university educated participants; had the lowest proportion of participants in full time employment; and a moderate proportion of participants reporting high weekly income. Compared to other clusters, cluster 3 had the highest proportion of participants aged between 18 and 24 years; had the highest proportion of males; had the lowest proportion of white participants; had a moderate proportion of university educated participants; had the highest proportion of participants in full time employment; and had the highest proportion of participants reporting high weekly income.

Table 55. Descriptives of proximal variables by cluster, cluster 3 model

	All	Cluster 1	Cluster 2	Cluster 3	Wald	Model Sig		
N	377	154	148	78				
		40.0%	37.5%	22.5%				
	Percentages						χ^2	**Sig**
Age								
18-24	47.2	39.7	48.4	57.8				
25-30	52.8	60.3	51.6	42.3	3.975	0.140	5.660	0.059
Sex								
Male	43.0	41.8	32.0	65.6				
Female	57.0	57.3	66.9	31.9	18.295	0.000	16.739	0.000
Ethnicity								
White	87.3	95.4	90.3	68.1				
Non-white	12.7	4.6	9.7	31.9	10.834	0.004	16.371	0.000
Education								
Secondary school	21.3	16.0	25.1	22.5				
University	78.7	83.5	74.2	77.4	2.076	0.350	2.619	0.270
Employment								
Not in full time employment	64.2	67.1	72.7	45.9				
In full time employment	35.8	32.9	27.3	54.1	9.524	0.008	14.288	0.001
Income								
High	62.2	54.8	56.2	72.3				
Low	37.8	41.9	39.2	25.0	0.669	0.720	2.817	0.245

Figure 7. Sociodemographic percentage scores by cluster

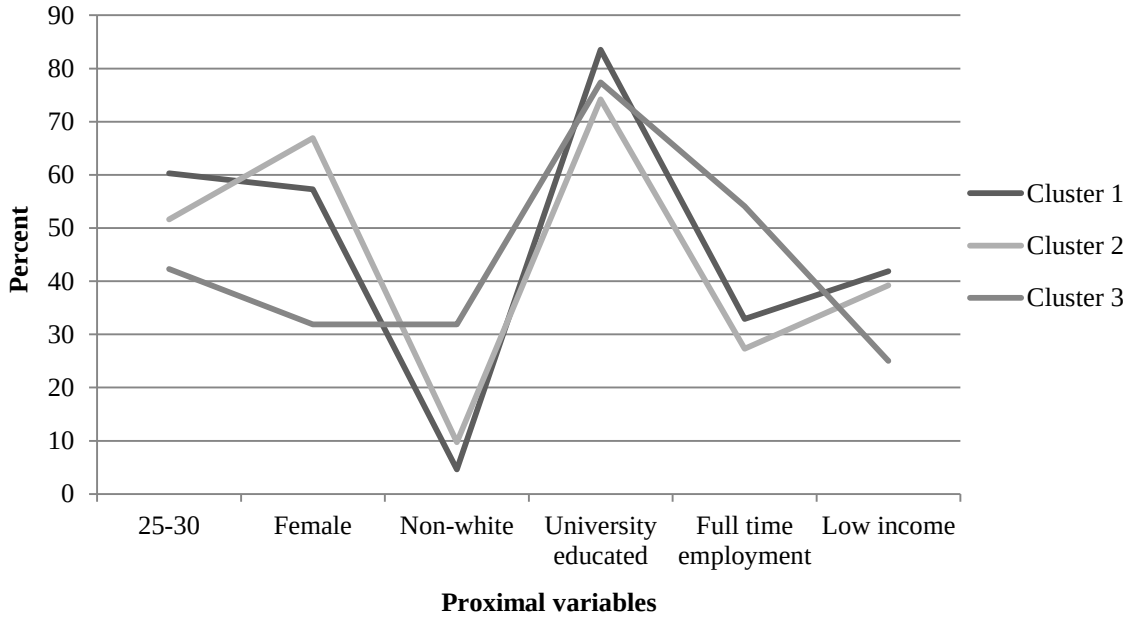


Table 56 displays the relationships between sociodemographic variables and cluster membership. Compared with males, females were more likely to be in cluster 2 (0.5) than cluster 1 (reference group for all analyses) and less likely to be in cluster 3 (-1.1) than cluster 1; compared with white participants, non-white participants were more likely to be in cluster 2 (2.2) and cluster 3 (10.8)

than cluster 1; and compared with participants who were not in full time employment, participants in full time employment were less likely to be in cluster 2 (-0.8), and more likely to be in cluster 3 (0.3) than cluster 1.

Table 56. Proximal relationships between clusters, cluster 3 model

	Cluster 1	Cluster 2	Cluster 3	Wald	Model Sig
Intercept	0.00	0.69	-0.63	1.202	0.55
Age					
18-24					
25-30	0.0	-0.588	-0.300	3.975	0.140
Sex					
Male					
Female	0.0	0.451	-1.080	18.295	0.000
Ethnicity					
White					
Non-white	0.0	0.963	2.187	10.834	0.004
Education					
Secondary school					
University	0.0	-0.485	-0.443	2.076	0.350
Employment					
Not in full time employment					
In full time employment	0.0	-0.769	0.277	9.524	0.009
Income					
High					
Low	0.0	-0.150	-0.335	0.669	0.720

To summarise clusters using behavioural strategies and sociodemographic proximal variables that were significantly different in terms of their distributions:

- Cluster 1 participants had a desire for many children and were the most physically inactive; and, in terms of sociodemographic variables, had a relatively even proportion of males and females, had the highest proportion of whites, and had a moderate proportion in full time employment.
- Cluster 2 participants had positive and stable childhoods, and were the most trusting of other people; and, in terms of sociodemographic variables, had the highest proportion of females, had a moderate proportion of non-white participants and had the lowest proportion in full time employment.
- Cluster 3 participants had adverse and unstable childhoods, with a desire for few children, were trusting of other people and were physically active; and, in terms of sociodemographic variables, had the highest proportion of males, the lowest proportion of white participants and the highest proportion in full time employment.

9.1.4 Distal variables

Latent class membership was then used to predict distal outcomes. In terms of the overall model, significant distal health behaviour variables were eating for pleasure or health (p=0.015), health risk taking (p=0.034), binge drinking (p=0.050), current daily smoking (p=0.000), sexual risk taking (p=0.014), and willingness to engage in violence (p=0.000). Table 57 describes and figure 8 shows the clusters in terms of prediction of distal health outcome variables. Significant differences in distribution between clusters were found for the proportion of participants who reported eating mainly for pleasure or health (p=0.014), risk taking and risk averse participants (p=0.029), current daily smokers and non-current daily smokers (p=0.000), participants that thought unprotected sex was worth the risk or only to conceive (p=0.011), and participants who had fought in the last 12 months and those that had not (p=0.001). Compared to other clusters, cluster 1 had the highest proportion of overweight or obese participants; had a moderate proportion of participants who reported eating for pleasure; had the highest proportion of participants who consumed low daily fruit and vegetable portions; had a moderate proportion of health risk-taking participants; had a moderate proportion of participants who reported high binge drinking; a moderate proportion who reported current daily smoking; a moderate proportion who thought unprotected sex was worth the risk, and a moderate proportion who had fought in the last 12 months. Compared to other clusters, cluster 2 had the lowest proportion of overweight or obese participants; the lowest proportion of participants who reported eating for pleasure; the lowest proportion of participants who consumed low daily fruit and vegetable portions; the lowest proportion of health risk-takers; the lowest proportion who reported high binge drinking; the lowest proportion who reported current daily smoking; the lowest proportion who thought unprotected sex was worth the risk; and the lowest proportion who had fought in the last 12 months. Compared to other clusters, cluster 3 had a moderate proportion of overweight or obese participants; the highest proportion who reported eating for pleasure; a moderate proportion who consumed low daily fruit and vegetable portions; the highest proportion of health risk-takers; the highest proportion of high binge drinkers; the highest proportion of current daily smokers; the highest proportion who thought unprotected sex was worth the risk; and the highest proportion who had fought in the last 12 months.

Table 57. Descriptives of distal variables by cluster, cluster 3 model

	All	Cluster 1	Cluster 2	Cluster 3	Wald	Model Sig		
N	377	154	148	78				
		40.0%	37.5%	22.5%				
	Percentages						χ^2	**Sig**
BMI								
Normal or underweight	81.2	78.5	85.7	78.9				
Overweight or obese	18.8	21.5	14.3	20.1	1.894	0.390	2.440	0.295
Eating for pleasure or health								
Health	17.0	13.6	24.3	9.9				
Pleasure	83.0	86.4	75.7	90.1	8.452	0.015	8.574	0.014
Daily portions of fruit and vegetables								
High	78.6	75.6	82.6	78.6				
Low	21.4	24.4	17.5	21.4	1.726	0.42	1.646	0.439
Health risk taking								
Risk averse	83.8	82.4	90.4	77.1				
Risk taking	16.2	17.6	9.6	22.9	6.790	0.034	7.112	0.029
Binge drinking								
Low	74.7	72.5	81.1	65.5				
High	25.4	27.5	18.9	34.5	5.921	0.050	5.459	0.065
Smoking								
Non-current daily smoker	74.7	80.4	85.9	50.1				
Current daily smoker	28.0	19.6	14.1	49.9	26.421	0.000	32.256	0.000
Unprotected sex								
Only to conceive	72.0	68.3	81.1	63.5				
Worth the risk	28.0	31.7	18.9	36.5	8.566	0.014	8.981	0.011
Violence								
Not fought in last 12 months	86.4	87.4	94.6	72.4				
Fought in last 12 months	13.6	12.6	5.4	27.6	15.784	0.000	14.825	0.001

Figure 8. Sociodemographic percentage scores by cluster

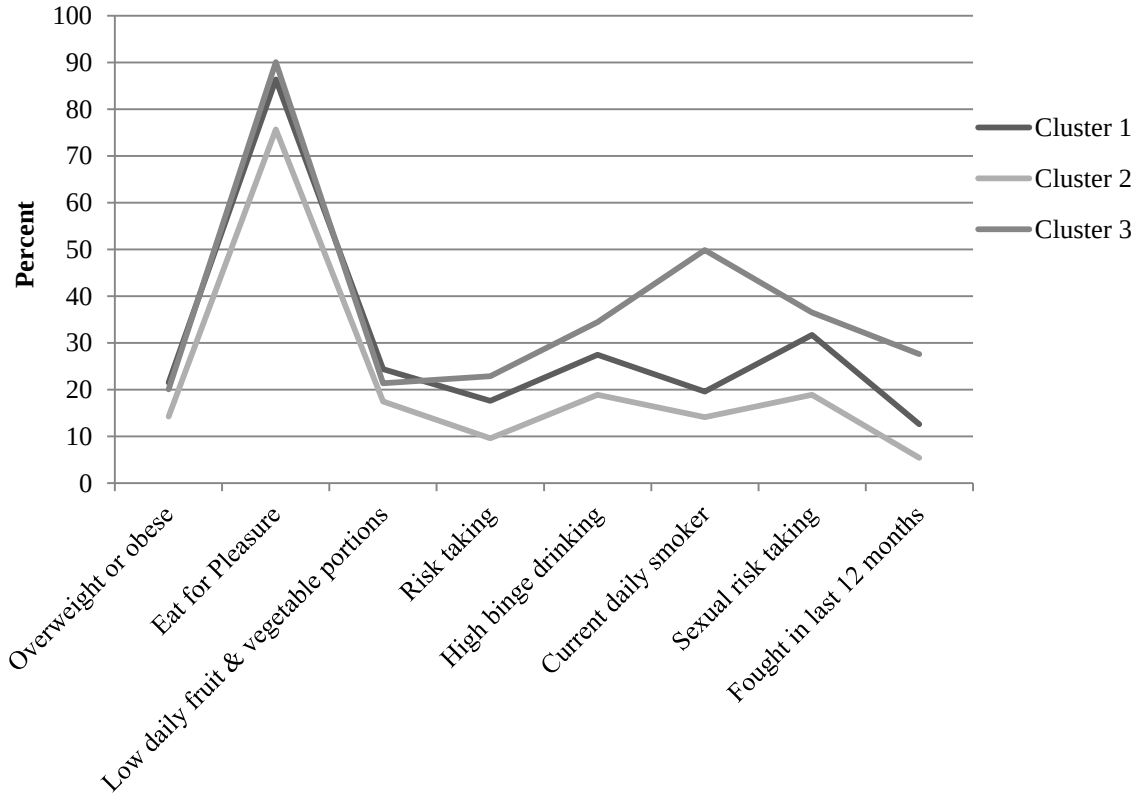


Table 58 displays the relationship between cluster membership and distal variables. Participants who ate mostly for health and participants who ate mostly for pleasure were less likely to be in cluster 2 (-0.711) and more likely to be in cluster 3 (0.358) than cluster 1 (reference category); compared with participants who were risk averse, participants who were risk taking, were less likely to be in cluster 2 (-0.701) and more likely to be in cluster 3 (0.331) than cluster 1; compared with participants who reported low binge drinking, participants who reported high binge drinking, were less likely to be in cluster 2 (-0.489) and more likely to be in cluster 3 (0.328) than cluster 1; compared with participants who were non-current daily smokers, participants who were current daily smokers, were less likely to be in cluster 2 (-0.398) and more likely to be in cluster 3 (1.410) than cluster 1; compared with participants who thought unprotected sex should be only to conceive, participants who thought unprotected sex was worth the risk, were less likely to be in cluster 2 (-0.691) and more likely to be in cluster 3 (0.211) than cluster 1; and, compared to participants who had not fought in the last 12 months, participants who had engaged in a violent fight in the last 12 months were less likely to be in cluster 2 (-0.925) and more likely to be in cluster 3 (0.973) than cluster 1.

Table 58. Distal relationships between clusters, cluster 3 model

	Cluster 1	Cluster 2	Cluster 3	Wald	Model Sig
Intercept	0.00	0.69	-0.63	1.202	0.55
BMI					
Normal or underweight					
Overweight or obese	0.0	-0.495	-0.088	1.894	0.390
Eating for pleasure or health					
Health					
Pleasure	0.0	-0.711	0.358	8.452	0.015
Daily portions of fruit and vegetables					
High					
Low	0.0	-0.421	-0.168	1.726	0.42
Health risk taking					
Risk averse					
Risk taking	0.0	-0.701	0.331	6.790	0.034
Binge drinking					
Low					
High	0.0	-0.489	0.328	5.921	0.050
Smoking					
Non-current daily smoker					
Current daily smoker	0.0	-0.398	1.410	26.421	0.000
Unprotected sex					
Only to conceive					
Worth the risk	0.0	-0.691	0.211	8.566	0.014
Violence					
Not fought in last 12 months					
Fought in last 12 months	0.0	-0.925	0.973	15.784	0.000

Membership of cluster predicted eating for pleasure or health, health risk taking, current daily smoking, sexual risk taking and violence. In terms of overall descriptions, including behavioural strategies, sociodemographic variables and health outcomes:

- Cluster 1 participants had a desire for many children and were physically inactive; in terms of sociodemographic variables, had a relatively even proportion of males and females, had the highest proportion of white participants, and had a moderate proportion in full time employment; and, in terms of health outcomes, had a moderate score for eating for pleasure or health, a moderate score for health risk taking, were moderate in terms of current daily smoking, willingness to engage in unprotected sex, and engage in violence.
- Cluster 2 participants had positive and stable childhoods, and were the most trusting of other people; in terms of sociodemographic variables, had the highest proportion of female participants, had moderate proportion of non-white participants and the lowest

proportion in full time employment; and, in terms of health outcomes, were least likely to eat for pleasure, least likely to be health risk takers, current daily smokers, engage in unprotected sex, and engage in violence.

- Cluster 3 participants had adverse and unstable childhoods, with a desire for few children, were the least trusting of other people and were physically active; in terms of sociodemographic variables, had the highest proportion of males, the lowest proportion of white participants and had the highest proportion in full time employment; and, in terms of health outcomes, were most likely to eat for pleasure, most likely to be health risk takers, current daily smokers, engage in unprotected sex, and engage in violence.

9.2 Summary

Study 2 did not include sufficient behavioural strategies to define distinct clusters; therefore latent profile analysis was conducted for study 1 data only. The 3-cluster model was selected on the basis of the lowest BIC; entropy R^2 for this model was 0.78 (approaching high entropy value of 0.80). Individuals were assigned to clusters based on probability classification and, despite overall clusters being definable in terms behavioural characteristics, there were individuals within clusters that did not conform. Cluster 1 contained the highest proportion of white participants, individuals from cluster 1 had a desire for many children at a young age, were the most physically inactive, and were moderate in terms of their health risk behaviours. Cluster 2 contained the highest proportion of females and people not in full time employment, individuals in cluster 2 reported the most positive childhoods and were the most trusting of other people, and in terms of health behaviours, were the healthiest and most risk averse for all measures. Cluster 3 contained the highest proportion of males, the lowest proportion of white participants and the highest proportion in full time employment, individuals in cluster 3 had the most adverse childhoods, desired the fewest children, were the least trusting of other people and were the most physical active, and were the least healthy and the most health risk taking for all measures.

Profiling can be a useful tool in supporting the development and targeting of interventions through population segmentation but care must be taken from these analyses as results are not representative of a given population. However, based on these analysis white and BME males who report adverse childhoods and are working full time could be targeted for interventions which seek to educate and raise awareness about diet choice, smoking, sexual health and violence.

10. DISCUSSION

10.1 Introduction

Overconsumption of food and drink, poor quality diets, low physical activity, harmful alcohol use and smoking, cause or greatly increase the risk of NCDs, which account for almost two-thirds of global deaths each year (WHO, 2017). The focus of many health promotion interventions has shifted from altering environments to attempting to change behaviours (Taylor and Repetti, 1997). However, since strategies to control or prevent obesity are required to account for complex behavioural patterns and environmental determinants, this shift has produced limited success (Gortmaker et al., 2011). Alternative strategies, including policy changes to taxation or marketing restrictions have not been widely implemented (Cornelsen and Carriedo, 2015). The public health response to address behaviours, such as overeating, drinking alcohol, smoking cigarettes and physical inactivity, may be improved by developing our understanding of the root causes of health risk behaviours. The principle aim of this research was to improve our understanding of the obesity problem and other public health issues, including harmful drinking, smoking cigarettes, risky sexual practices and violence, by applying an evolutionary interpretation to everyday choices and behaviours. The application of evolutionary principles to health behaviours may be meaningful since environment-specific health decisions result in fitness benefits, whether directly to reproduction or indirectly to health and survival (Demetrius and Ziehe, 2007). Seemingly irrational decisions which reduce health or increase the risk of pathology or disease may demonstrate rationality at an evolutionary level (Kenrick et al., 2009). Behavioural choices relating to health, including those which may result in pathology, were considered in terms of their adaptive value in modern environments. Behavioural strategies were contextualised in terms of formative conditions, particularly developmental, subjective and sociodemographic variables. The results are discussed in terms of how preventative or reactive public health interventions may be informed by these findings.

10.2 Key concepts

From 200,000 years ago until the advent of agriculture approximately 10,000 years ago, humans lived as hunter gatherers who ate lean protein and high fibre diets (Oppenheimer, 2003; Eshed, Gopherm and Hershkovitz, 2006; Speth, 1982). Hunter gatherers spent considerable time resting and being sedentary but when foraging attempted to maximise their net energy acquisition rate (Winterhalder, 1986b). In addition to fundamental models of energy acquisition, humans have been found to prefer energy rich foods, which have increased palatability and stimulate pleasure associated areas of the brain (Manabe, Matsumura and Fushiki, 2010; Dallman et al., 2005). Individuals have also been found to eat in response to food-related stimuli irrespective of internal

drivers or hunger states (Schachter, Goldman and Gordon, 1968). The availability and cost of food sources in modern societies have been found to influence eating; good access to supermarkets has been associated with lower rates of obesity and access to fast food and takeaway outlets has been linked to weight gain and obesity (Morland, Diez-Roux and Wing, 2006; Cummins and Macintyre, 2006). The increase in food supply, marketing strategies and lifestyle changes (including increasing sedentary time and decreasing home cooking) have also contributed to an increased propensity for weight gain (Swinburn, Sacks and Ravussin, 2009; Nq and Popkin, 2013; Robinson, 1998). In modern and developed societies with constantly available, rich food, selective pressures, both in terms of energy acquisition and food preference, have created conditions in which chronic energy imbalances, resulting in overweight or obesity, have increasingly occurred (DoH, 2011; Flegal et al., 2010).

Physiological and psychological drivers urge individuals to eat pleasurable foods but there is variation; individuals who are sensation seeking have been found to prefer foods rich in sugars and fats (Terasaki and Imada, 1988). Sensation seeking is also linked to various other health risk behaviours, including substance use and risky sexual practices (King et al., 2012), which implies that the psychological mechanisms involved in diet choice also influence other pleasurable health risk behaviours (Philipson and Posner, 1999). Regulation of diet and health risk behaviour requires higher cognitive control but sensation seeking and rational conscious decision making can be conflicting (Carver, 2005; Schwarzer, 2008). Greater conscious decision making has been found to be associated with lower health risk behaviours and greater impulsivity and sensation seeking has been associated with higher health risk behaviours (Bogg and Roberts, 2004; Grano et al., 2004). Health risk behaviours and other forms of risk taking, which are likely to be moderated by the same psychological mechanisms, have been found not to be modality specific but to cluster and covary in adolescents and adults (Norburya and Husainb, 2015; King et al., 2012). When undertaken together, the resulting consequences and harms of multiple health risk behaviours are likely to combine; for example, overeating is often accompanied by reduced physical activity (Joseph et al., 2011).

Psychological mechanisms which direct behavioural traits are influenced by innate genetic factors, demographic factors (such as age and sex), environmental factors (such as socioeconomic conditions), developmental factors (such as childhood experience), and subjective factors (such as adult well-being; Gangestad, 1997; Byrnes, Miller and Schafer, 1999; Tymula et al., 2013 ; Nettle, 2010; Anda et al., 2006; Felitti et al., 1998). Behavioural traits contribute to individuals' phenotypes, or observable characteristics, which are suited to a lesser or greater degree to a set of environmental conditions (Lewontin, 1968). Since behaviour and phenotypes can be changed,

natural selection can be said to act on behavioural choices, whether conscious or not; therefore, behaviour can be considered in adaptive terms (Tomasello, 1997).

While direct evolutionary success is measured by the number of offspring and grandchildren an individual produces, public health success is measured by good health and longevity; while evolutionary and public health success are not mutually exclusive, they may be contradictory. Therefore, when an individual acts in a way that may reduce health and longevity, their choices could make sense, or be optimal and adaptive from an evolutionary perspective.

10.3 The contribution of an evolutionary approach

One of the central ideas of this thesis was to explore health risk behaviours and the key determinants of them using an evolutionary approach. In section 2.2, key determinants and approaches to risk prevention and health promotion were outlined which individually or in combination shape the public health approach to overeating and other health risk behaviours. The idea of this research was not to displace these established themes and approaches but to supplement them and tie key elements together with the overarching aim of improving health promotion programmes and risk prevention interventions. Within each identified theme, an evolutionary interpretation can be applied; throughout this work, an evolutionary approach has particularly been used to explore hypotheses around cognitive processes of health behaviour and socioeconomic determinants.

The cognitive processes and psychological mechanisms which govern behaviour, and the phenotypes which result, are subject to the forces of selection; similarly, socioeconomic conditions themselves exert a specific set of selection pressures. It is relevant to consider cognitive processes and socioeconomic conditions from an evolutionary perspective, particularly when seemingly maladaptive health risk behaviours are undertaken to the point of pathology and morbidity. Health risk behaviour has been suggested to be adaptive in instances of adverse developmental experiences, poor mental health, or in unfavourable environmental conditions. Modifications in cognitive processes in individuals who suffer adverse childhoods have been found to be adaptive (Danese and McEwen, 2012) and lower investments in health behaviour (or health risk behaviour) have been suggested to be adaptive given circumstances of deprivation or poverty (Nettle, 2010). The understanding of these determinants of health risk behaviour are enhanced by applying an evolutionary understanding; seemingly maladaptive behaviour can be contextualised as potentially optimal and adaptive. A key benefit of applying an evolutionary approach to health risk behaviour is the ability to link key determinants together and to enhance our understanding of the causal mechanisms driving such behaviour; such determinants do not operate in isolation but the causal links between them are not always clear. As discussed further

in section 10.5, this enhanced understanding may also enable policy makers to put evidence into practice in an increasingly effective way.

10.4 Discussion of findings

Do dietary health risks lead to overweight or obesity among young adults?

In the context of this work, it was important to explore whether height and weight was reported reliably enough for inferences to be drawn and, if so, whether overeating predicted overweight and obesity among this sample of young adults. This exploration related to the overarching aim of the research as it contextualised findings related to BMI. The lack of associations between BMI and risky eating behaviours suggested that the relationship between behavioural strategies and risky eating behaviours was of greater relevance than the relationship between behavioural strategies and outcomes of overeating, namely overweight and obesity.

Height and weight data were not recorded in study 2; and so the discussion below relates to study 1. BMI was not found to be significantly associated with various dietary behaviours (section 5.1.1), which was not consistent with the literature. Evidence suggests overeating, especially of 'pleasurable' fatty foods (Golay and Bobbioni, 1997) and foods which are high on the glycemic index (Bjorck et al., 1994) can lead to increased overeating and obesity (Ludwig et al., 1998). Evidence also suggests that home prepared meals are healthier and more nutritional than ready meals, meals with chips and takeaway meals (Gillman et al., 2000). BMI was not found to be significantly associated with the index for physical activity but there is clear evidence of the association between inactivity and overweight or obesity (U.S. Department of Health and Human Services, 1996). BMI was also not found to be significantly associated with the total number of reported weekly meals. The evidence around total weekly meals is less clear; individuals who regularly eat breakfast have been found to have better micronutrient intake (Siega-Riz, Popkin and Carson, 1998), implying it is not the number of meals which affects overweight and obesity but nutrient quality and portion size (Rolls, Engell and Birch, 2000).

BMI was found to be negatively associated with increasing pleasure of eating fruit. Assuming pleasure derived from eating fruit equates to consumption of fruit, this is consistent with the literature where higher fruit consumption is linked with lower BMI (Lin and Morrison, 2002). BMI was found to be positively associated with increasing frequency of binge drinking. While the literature around alcohol consumption and obesity is complex, alcohol is one of the most energy dense macronutrients consumed (Prentice, 1995) and is known to reduce the oxidation of fat (Zurlo et al., 1990). There is also evidence that heavy or risky drinking can lead to, or be a risk factor for obesity (Lukasiewicz et al., 2007). A binary logistic regression revealed that food and

satiation preferences were significant predictors of BMI. These findings were consistent with the literature; 'feel good' foods tend to be physiologically and psychologically 'pleasurable' and are often higher in sugar and fat than healthier foods (Dallman et al., 2005). Evidence also suggests that individuals consistently consume more food when presented with larger portion sizes (Holland et al., 2015). Consuming foods which are high in sugar and fat, and eating larger quantities of food at meals times are likely to lead to an energy imbalance and weight gain.

The link between health risk behaviours and pathology was not assessed in this sample population of young adults as the only measure of pathology was BMI, although there were a range of indicators of health risk eating behaviours and preferences. There were inconsistent links between BMI and the health behaviours which have been evidenced to increase the risk of being overweight or obese. The lack of clear associations between risky eating behaviours and BMI may be partly explained by low inter-rater reliability of self-reported height and weight, the latter of which has been found to be typically underestimated (Brener et al., 2003). While it is also acknowledged that alcohol consumption and unhealthy eating may also be underreported in health surveys, the underreporting is suggested to be slight (Boniface, Kneale and Shelton, 2014; Cook, Pryer and Shetty, 2000). Of the sample in study 1 who reported height and weight, 33.1% of males and 6.9% of females reported being overweight or obese, which is lower than in the general population, substantially for females; this finding is consistent with research which indicates that the value and direction of the discrepancy between self-reported and measured BMI varies by sex (Gildner et al., 2015). These findings were independent of potential socioeconomic effects; there were no significant associations between BMI and income, employment status or financial security. The sensitivity and specificity of BMI is also acknowledged to be poor as body shape can vary between individuals and body shapes can be associated with certain health conditions (Wells, Treleaven and Cole, 2007); muscle mass is not accounted when calculating BMI (Rush et al., 2007); the relationship between BMI and body fat is not linear (Rothman, 2008); there are sex and ethnic differences which affect the consistency of BMI (Wang et al., 1994); and, the amount of fat stored abdominally or viscerally rather than subcutaneously is not considered (Price et al., 2006). Height and weight were presented as optional questions for study 1 and were completed by 81.7% of participants; this response rate was relatively high compared to other studies (Gildner et al., 2015).

Are dietary health risks associated with other health risks?

Supplementing existing evidence that health risk behaviours were related was important in meeting the key aims of this work. That health risk behaviours were found to be related allowed for an exploration of whether evolutionary behavioural strategies predicted health risk behaviours

in a general or a nuanced way. Health risk behaviours were found to be significantly associated with other health risk behaviours (sections 6.1.1 and 6.2.2). Health risk taking behaviours were indicated using actual or preferred behaviours, namely eating for pleasure, binge drinking frequency, smoking cigarettes, violent fights and risky sexual practices. Physical activity is also discussed here, since inactivity or lack of exercise is associated with increased health risks and chronic diseases (Paffenbarger et al., 1986). The health risk taking index in study 1 is not discussed as it included the individual measures of binge drinking, cigarette smoking and risky sexual practice. Findings from study 1 and 2 are consistent with evidence which shows health risk behaviours to be clustered, particularly eating unhealthy foods, drinking risky levels of alcohol and smoking cigarettes (Gottlieb and Baker, 1986; Best et al., 2009; Leon et al., 2007; Sonneville et al., 2013). Health risk behaviours have been found to predict one another independent of sociodemographic factors (DuRant et al., 1999). Despite the general associations, representative research in England has revealed nuanced relationships between health behaviours; for example, associations and risk factors for drug use and unsafe sex were found to be comparable while associations with alcohol were weaker and risk factors were found to differ (Hale and Vinor, 2016).

In social terms, there are two broad theories which seek to explain why health risk behaviours are associated with one another; gateway theory, which suggests that one health risk behaviour may lead to another (Pudney, 2003), and 'problem behaviour theory' which suggests health risk behaviours demonstrate independence and maturity, and is often cited as a key explanation for risk behaviours in adolescents (Jessor, Turbin and Costa, 1998). While social mechanisms may be debated, in cognitive terms health risk behaviours are directed by two models of behaviour, impulsive, sensation seeking influences and rational, conscious decision making (Carver, 2005; Hartmann et al., 2010). Conscious decision making has been found to be associated with lower risky health behaviours, while impulsive decision making has been found to be associated with risky health behaviours (Bogg and Roberts, 2004; Grano et al., 2004). The evidence around these dual influences on health behaviour is complex and the extent to which one model is employed over another is influenced by developmental experiences, environmental factors and subjective states (Gerrard et al., 2008; Bergman and Scott, 2001; discussed further in sections 10.3.4). Individuals who are susceptible to one health risk behaviour may be susceptible to many and, in some cases, health risk behaviours may reinforce one another (Lesieur and Heineman, 1988).

The comorbidity among health risk behaviours may suggest a common liability which underlies their expression; environmental and genetic relationships between health risk behaviours support this idea (Markon and Krueger, 2005; Kendler et al., 2003; Kruger et al., 2002). These patterns of comorbidity have been found cross-sectionally, longitudinally and across different cultures

(Vollebergh et al., 2001; Krueger et al., 2003). The expressions, or phenotypic variations, of health risk behaviours may be continuous or categorical; however, since environmental relationships (particularly developmental factors and socioeconomic conditions) are known to affect health risk behaviours, it seems likely that their expression is graded (Hettema et al., 2005). The extent to which health behaviours are determined by impulsive or conscious decision making is liable to change based on the environmental context which implies that phenotypic variations of health behaviour are continuous. Health behaviours are associated, may reinforce one another, and are likely to be underpinned by a continuous common liability model. The extent to which a given behavioural phenotype, created by impulsive and/or rational decision making, is adaptive will be discussed further in section 10.3.14-17.

In studies 1 and 2 physical activity was found have limited associations with other health risk behaviours. It is likely that physical inactivity does not represent immediate health risk in the same way as eating unhealthy foods, binge drinking, smoking cigarettes and fighting. Physical inactivity in adults is related to an increased risk of chronic diseases (U.S. Department of Health and Human Services, 1996) and is reported to be influenced by adolescent participation in sport, educational attainment, social class and urban or rural living (Engström, 1986; King et al., 1992; Crespo et al., 1999; and Yang et al., 1999). However, physical inactivity is not a hedonistic undertaking, and refraining from exercise does not present immediate health risks; undertaking exercise is, to a greater extent than other health risk behaviours, an investment in good health for later years (Duda and Tappe, 1988).

Higher proportions of overweight and obese participants showed tolerance or acceptance of violence compared to normal or underweight participants. These findings may be the result of exposure to violence; evidence suggests that exposure to interpersonal violence is associated with engagement in violence in later life, and with risky or disordered eating and obesity (Lansford et al., 2007; Midei and Matthews, 2011).

Based on the findings from these studies and existing evidence, health risk behaviours are associated, may reinforce one another and are likely to be guided by the same psychological mechanisms and decision making models. In contrast to rational decision making, the idea that impulsive models of decision making are not rational may be challenged. Models have been proposed that individuals are rational in terms of 'forward-looking' maximisation of utility, when exhibiting health risk behaviours, even to the point of addiction (Becker and Murphy, 1988). Decision making with regard to immediate or delayed outcomes has been found to be highly sensitive to situational manipulations (Mischel, Ebbesen and Zeiss, 1972) such as sociodemographic factors. Strategic differences in temporal decision making has been suggested

to be adaptive in terms of food foraging choices (Rosati et al., 2007), but it may also be that such decisions are also adaptive, at least up to a point, for other health risk behaviours. If common liability models underpin risky behavioural phenotypes, and such models are influenced by environmental factors, there may be sets of circumstances in which a general model for risk taking behaviour is adaptive.

Do demographic variables or ethnic group influence health risk behaviours?

The demographic influences of health behaviour were important to explore in terms of the central aims of this work. Evidence suggests variance in behavioural strategies between demographic groups, particularly males and female, and age groups, and failing to explore and control for these effects would have placed limitations on the implications of other findings relating to evolutionary behavioural strategies. In study 1, significantly more males than females reported being overweight or obese (section 5.1.2); logistic regression revealed males to be 6.3 times more likely to be overweight or obese compared to females. While slightly more adult males in the UK report overweight or obesity (65.3% compared to 58.1%; PHE, 2016), the difference is not as large as found in this research. One reason for the degree of difference (33.1% of males compared to 6.9% of females) may be that females participants underreported their weight to a greater degree than males (Brener et al., 2003; Krul, Daanen and Choi, 2009). This underreporting by females may be particularly pronounced among young adults, and especially young women who may be more conscious of their body image than young men; women have been found to be more self-critical, less satisfied with their image and more likely to perceive a distorted image of themselves than men (Grogan, 2007). Research found that approximately 40.0% of women expressed moderate or strong negative feelings about their bodies, and wanted to be smaller than their actual sizes, but that the same women also underreported their body sizes (Monteath and McCabe, 1996).

Males were found to be more health risk taking than females for all indicators of health risk behaviour across both studies (sections 6.1.2 and 6.2.2). This is consistent with the literature, where females have been reported to be generally more risk averse than males (Tymula et al., 2013). In terms of evolutionary theory, these findings are consistent with evidence suggesting that males were likely to have taken more health risks than females, in terms of hunting for example, which would have benefitted survival and reproductive output, and would also have improved desirability among potential mates, creating sexual selection on the risk-taking trade-off (Bliege-Bird, Smith and Bird, 2001). Status competition is suggested to further drive risk taking among males in the modern world (Wilson and Daly, 1985). While status competition and the relics of risk taking in males are likely to remain to some extent, the modern world also poses social values about maleness and what it entails (Kraemer, 2000). Advantages required for hunting, such as physical strength and spatial awareness, are less useful now compared to the past and competition

for females may have been replaced by competition with females in modern public life, (Kraemer, 1991), which may include riskless expressions of behaviours including emotional control and sensitivity. That older forms of masculinity might have been displaced by new ones has not excluded risk taking behaviour by males (Connell, 2005). Contemporary studies still find that masculinity is linked to risky and criminal behaviour, including violence, rape, murder, hooliganism and white collar crime (Messerschmidt 1993; Newburn and Stanko 1994).

In terms of physical activity and exercise, males in study 1 and 2 were more active and exercised more compared to females. These findings are consistent with evidence which suggests that males exercise more than females for various reasons (Nomaguchi and Bianchi, 2004). While evidence suggest that health risk behaviours, including physical inactivity, are predicted by similar determinants (Allison, et al., 1999), findings from this research suggest that exercise and physical activity may not be cognitively governed in the same way as other health risk behaviours.

Age group was considered in both studies, despite being limited to late teenagers and young adults (people aged between 18 and 24 years) and slightly older adults (aged between 25 and 30 years). Despite both age groups being young adults, there was value in the comparison since cognitive maturity (particularly development of the frontal lobes, which are involved in critical thinking and decisions making) is not reached until the mid-20s (Johnson, Blum and Giedd, 2009).

Both studies found significantly higher proportions of participants aged between 18 and 24 years reported dietary health risk taking behaviours and various other measures of health risk taking compared to participants aged between 25 to 30 years (sections 6.1.2 and 6.2.2). These findings are consistent with evidence in the literature which shows that people get more risk averse as they get older (Byrnes, Miller and Schafer, 1999). Findings here also indicate elevated risk taking behaviour among students, which comprised 31.6% of the sample for study 1 (83.1% of which were aged between 18 and 24 years), especially in terms of binge drinking and the associated risks (Kypri, Cronin and Wright, 2005). In terms of demographics, the combined findings of age and gender revealed younger males to be the most likely to engage in health risk behaviours.

In study 1, participants aged between 18 and 24 years reported higher levels of physical activity compared to participants aged between 25 to 30 years (section 7.1.3). While there may be a distinction between general physical activity and proactively engaging in exercise, these findings are consistent with the literature, which suggests that 55.8% of people aged 16 to 25 years in England play sport, compared to 32.4% of adults aged 26 years and over; evidence also suggests that the difference in exercise levels between the sexes declines as age increases (Sport England, 2016).

In terms of ethnicity, the distribution of overweight and obese participants was found to be significantly different between white and non-white participants, where higher proportions of overweight and obese people were white. This is consistent with existing evidence; in 2005, a higher percentage of white males in England were found to be obese (23.0%) compared to all non-white ethnic groups (Black African 17.0%, Indian 14.0%, Pakistani 15.0%, Bangladeshi 6.0% and Chinese 6.0%), except Black Caribbean males (25.0%; NOO, 2011). The evidence for females in England was less clear, 23.0% of white females were obese in 2005, which was a higher proportion that Indian (20.0%), Bangladeshi (17.0%) and Chinese (8.0%) females but lower than Black Caribbean (32.0%), Black African (38.0%) and Pakistani (28.0%) females (*ibid*). In this sample, only 6.9% of females were found to be overweight or obese; therefore, the difference in distribution is likely to be largely due to males, which is consistent with the literature. This finding illustrates that grouping non-white participants has limited usefulness, discussed further in section 10.7.4.

Both studies found white participants reported higher levels of dietary health risk behaviours compared to non-white participants. These findings were not consistent with the literature; while there are differences in food and nutrient intake by ethnicity (Xie, et al., 2003), there is no evidence to suggesting minority ethnic groups generally make healthier food choices or consume more fruit and vegetable portions each day (Devine, et al., 1999). However, there is well established evidence that some non-white minority ethnic groups in the UK have poorer health outcomes than whites (Leung and Stanner, 2011). Such health outcomes include type-2 diabetes, which is almost entirely the result of poor dietary choices, and cardiovascular disease, risk factors for which are increased with poor dietary choices (Leung and Stanner, 2011). Health outcomes in ethnic minority groups in the UK are shaped by temporal, social and cultural factors (Devine, 2005), in addition to individual factors and the socioeconomic environment. Given the complexities of these associations in the literature, findings relating to non-white participants were not explored in sufficient depth for meaningful conclusions to be drawn.

Findings relating to physical activity and exercise were contradictory between study 1 and 2, where white participants in study 1 reported a higher proportion of participants who were physically inactive, while non-white participants in study 2 reported a higher proportion with low weekly exercise frequency. Neither finding is supported by the literature which suggests that, while certain sports have different ethnic compositions, there are no differences overall between whites and non-whites in terms of activity and exercise (DCMS, 2011). For study 1, this is likely to be due to the relatively high proportion of non-white participants who reported being a student (60.0% compared to 27.4% of white participants), and participation in sport has been found to be

higher among students (*ibid*). For study 2, this finding is likely to be due to socioeconomic status; 80.0% of non-white participants in study 2 were from the most and 2nd most deprived quintiles and people of lower socioeconomic status have been found to exercise less and play and less sport (*ibid*).

Do family or socioeconomic variables influence health risk behaviours?

Family and socioeconomic variables have been previously evidenced to influence health risk behaviours. Exploring elements of these known determinants using an evolutionary interpretation had the potential to provide a better understanding of the causal factors in established relationships. Stating behaviour in terms of costs and benefits over time contributed to the overarching aim of the work by highlighting how risky behaviour may be optimal considering the circumstances in which they arise. In public health generally and in this research, there is a particular focus on the effects of socioeconomic deprivation, which is established as a key determinant of health risk behaviour. However, the resulting risky behaviours which arise from adverse socioeconomic circumstances are discussed as public health failures; a consistent objective of this work was to understand public health failures as potentially optimal evolutionary choices. Considering an evolutionary approach also provided a nuanced understanding of deprivation where mitigating factors, such as family and childhood experience could be accounted. Evolutionary behavioural strategies which arise form a range of formative determinants and conditions may be quantitatively better predictors of health risk behaviour than the determinants themselves.

Study 1 found that the number of siblings participants had and the number of times participants reported seeing close friends per month were not associated with BMI or indicators of eating behaviours (section 5.1.1). In terms of the number of siblings, this finding is inconsistent with some evidence which suggests increasing number of siblings can influence diet quality and lead to increased health risk behaviours (Blane, Davey and Hart, 1999; Hart and Davey Smith, 2002). Study 1 did not record birth order, which has been found to be associated with evolutionary emotions and with food apportioning by parents (Buunk, 1997; Ernst and Angst, 1983).

In study 1, the number of times close friends were seen per month was positively associated with various health risk taking behaviours (section 6.1.1). Evidence suggests that increased social support is linked with improved health outcomes (Uchino, 2006). Social support has also been found to improve educational outcomes for adolescents of low but not high socioeconomic status, and increased social contact is associated with higher adult well-being in older adults (Malecki and Demaray, 2006; Pinquart and Sörensen, 2000). The finding from this research is likely to be indicative of high levels of socialising among university students, which may be accompanied by increased alcohol consumption and associated risk behaviours (Kypri, Cronin and Wright, 2005).

Both study 1 and 2 recorded information relating to educational attainment; however, there were substantial differences between the samples; 79.0% from study 1 had been educated to university level compared to 15.5% from study 2, this is discussed further in section 10.7.3. Study 2 data was more similar to figures for England (participation among 18 year olds, the largest age group, in 2014/15 was 26.0%; DoE, 2016).

In study 2, participants who had not received higher education reported dietary health risk behaviours compared to participants who had received higher education (section 5.2.2). Evidence suggests there are disparities in prevalence of childhood obesity and overweight for parental education, which is associated with household poverty status (Singh, Siahpush and Kogan 2010). Individuals with higher education have also been found to consume a greater amount of fruit and vegetables than those with lower education (Johansson and Andersen, 1998). Study 2 found higher proportions of other health risk indicators among non-higher education participants (section 6.2.2). While spending time and money on higher education can be interpreted as investment behaviour with the view to gaining longer term benefits, educational attainment is considered here as a socioeconomic factor; there are large differences in the likelihood of acquiring qualifications, and a large gap in higher education participation based on socioeconomic status (Blanden and Macmillan, 2014; Crawford, 2014). There is also a strong association between education and health, to the extent that increasing years in education are associated with increasingly improved health behaviours and health status (Cutler and Lleras-Muney, 2006). Findings in study 2 in relation to education are consistent with this evidence.

Study 1 used whether participants who grew up until the age of 16 with both parents as a measure of developmental conditions, in addition to whether participants grew up in communities where people knew each other or kept alone. Evidence suggests parental behaviours and patterns of family interaction, which alter dramatically following divorce, mediate cognitive and social development (Hetherington, Cox and Cox, 1979). Strong social support, which is likely to be higher in closer communities, also created better development conditions and improved health outcomes (Uchino, 2006). There were no significant differences in distribution between participants who grew up with both parents and those that did not in terms of the proportion of overweight and obese participants or indicators of dietary health risk behaviour. However, there were significant differences in terms of other health behaviours and these findings were consistent with evidence which suggests parent-child relationships are a strong influence of health risk behaviours (Chartier, Walker and Naimark, 2009). Single parenthood has been found to be a cofactor of low socioeconomic status but the relative impact of each cofactor can change over

time and both be related to third factors, including family conflict and adverse experiences (Bradley and Corwyn, 2002).

In study 1, there were significant differences in terms of BMI and food preference in terms of community support (section 5.1.2); study 2 supplemented these findings (section 5.2.2), a significantly higher proportion of participants who reported not feeling a sense of community belonging reported dietary and other health risk behaviours compared to those who did feel a sense of community belonging. While there is evidence that increasing certain types of social support among adolescents may exacerbate multiple risk taking behaviour (Fitzgerald-Yau, N. Hale, D.R. and Viner, M), these findings are consistent with broad evidence in the literature which suggests that good social support can lead to improved health outcomes (Uchino, 2006).

Owing to the relatively high proportion of current students in study 1, analyses involving current employment status were not meaningful and were omitted from results. Graduates who have invested in higher education have been found to receive substantial long term economic and health benefits (Abel, Deitz, and Su, 2014; Kimbro et al., 2008), meaning that despite low income and lack of employment, full time students in higher education may be likely to behave differently to other low income or unemployed individuals.

In study 2, there were significantly differences in dietary health risk behaviours in terms of employment status (section 5.2.2), where participants not in full time employment reported riskier dietary choices compared to participants in full time education. A higher proportion of participants who were not in full time employment also reported current daily smoking and low weekly exercise frequency compared to those in full time employment (section 6.2.2). In study 2, of the participants not in full time employment, 56.3% were unemployed and it is likely that this majority, to a greater extent than full time students, or participants employed part time, accounted for the differences in health behaviours found in this study. The literature suggests that unemployment is associated with various health risk behaviours and poorer health outcomes (Dooley, Fielding and Levi, 1996; Jin, Shah and Svoboda, 1995); findings here are consistent with that evidence. However, there are many factors which confound the causative nature of this association, whether social or economic (Jin, Shah and Svoboda, 1995). Unemployment has been found to lead to poverty and social isolation which reinforces the risk of long term unemployment (Gallie, Paugam and Jacobs, 2003). The links between low socioeconomic status and poverty are discussed in section 10.3.11.

Associated with employment and likely to be similarly formative of behavioural strategies, whether short or long term, is income, which was measured in terms of weekly household income

in study 1, and in terms of participant perception of comfort on present income in study 2. In study 1, income was not associated with BMI or dietary health risk behaviours; however, lower income participants did report higher general health risk taking, current daily smoking and low levels of physical inactivity compared to higher income participants (section 6.2.2). Study 2 revealed participants who reported finding it difficult/very difficult on present income, reported higher levels of dietary health risk taking behaviour, binge drinking and daily smoking. Income is a key contributor to socioeconomic status; however, income has also been found to determine delay discounting which is the willingness to postpone an immediate reward in order to gain additional benefits in the future (Daugherty and Brase, 2009). Lower income is likely to decrease tolerance for delayed rewards with immediate payoffs being favoured, such as binge drinking or smoking cigarettes, despite the risk of long term health costs.

For study 1, the security and stability index (including employment status and income) was created to provide an indicator of general participant perception of financial security. The index was not associated with BMI but was negatively associated with increasing preference to eat for pleasure rather than health, with increasing cigarette consumption and increasing frequency of violent fights in the past 12 months.

Although neighbourhood deprivation is a particularly meaningful measure of socioeconomic condition, data were only available for study 2. Participants from the most deprived quintiles reported higher health risk behaviours including preference for 'feel good' foods, low daily portions of fruit and vegetables, higher frequency of binge drinking, higher proportion of current daily smokers, and lower weekly exercise (sections 5.2.2 and 6.2.2).

Education, employment, income and deprivation combine to determine financial security and contribute greatly to socioeconomic condition. People from lower socioeconomic groups have been found to have poorer diets, exercise less, smoke more, ignore health advice more and be less health conscious overall, than people from more affluent social groups (Qi, Phillips and Hopman, 2006; Relton, et al., 2005; Goldman and Smith, 2002; Pill, Peters and Robling, 1995; Lowry et al., 1996; Lantz et al., 1998; Lynch, Kaplan and Salonen, 1997; Lahelma et al., 2009; Wardle and Steptoe, 2003). While some of these health behaviours may be related to income disparity, the health gradient exists even when health behaviours are free (Nettle, 2010); however, people from less affluent groups in the UK have reported lower access to healthcare for some dimensions (Campbell, Ramsay and Green, 2001). These gradients imply psychological or strategic differences; individuals from lower socioeconomic groups have been reported to give greater importance to present over future benefits (Guthrie, Butler and Ward, 2009; Adams, 2009; Adams and White, 2009) and feel less empowered to control their health outcomes (Wardle and Steptoe,

2003). The close association of health risk behaviours to one another, particularly eating pleasurable foods which are high in sugar and fat, drinking alcohol and smoking cigarettes, all of which give an immediate pleasure but increase the risk of suffering longer term health costs, implies they are governed by the same decision making strategy.

Given the circumstances of socioeconomic deprivation, lower investment in health behaviour may be adaptive (Nettle, 2010). The strategy or strategies which lead to engagement in health risk behaviour is suboptimal in terms of public health objectives but may be adaptive given the conditions from which they arise. When the value of the benefit of acting for good health is perceived to be lower than the value of the pleasure given from a behaviour, it would make sense from an evolutionary perspective to act for short term gains. Stated in terms of costs, when the perceived cost of waiting for a benefit exceeds the cost of the health risk, it would make sense to pay the cost of the health risk. This equation involves complex interactions of time, pleasure and health currencies and it is difficult to demonstrate empirically, especially since decisions are influenced by impulsive and rational elements. A principle of delay discounting, which is an adaptive trade-off (Rosati et al., 2007), suggests that conscious and reflective decision making is associated with lower health risk behaviours (Bogg and Roberts, 2004) and impulsivity is increasingly associated with health risk behaviours (Grano et al., 2004). A hypothesis of this research is that adverse environments, particularly relating to socioeconomic condition, would lead an individual towards impulsive pleasure seeking and short termism, and that this may be an adaptive choice, assuming the conditions have been accurately 'appraised'.

Where costs and benefits are 'perceived' or 'appraised', the implication is not necessarily that the process is conscious. Effort and reward decision making has been shown to occur in at least three regions in the brain, the anterior cingulate cortex (which is located in the prefrontal cortex), the ventral striatum, and a region incorporating the dopaminergic midbrain system (Croxson et al., 2009). This system is similarly connected in primate species and rats (Croxson et al., 2009), implying that cost benefit decision making is largely unconscious. Contrary research highlights that value-based decisions are predominantly organised in the prefrontal cortex, where conscious choice occurs (Grabenhorst and Roll, 2011). Like many cognitive processes, value-based decision making cannot be confined to one discrete region of the brain; consciousness itself is famously difficult to describe in neurobiological terms and integrates information from a range of cognitive systems (Tononi, 2004). Despite the prefrontal cortex being involved in value based decision making, increasingly research has highlighted that even 'conscious' choices may be determined before entering awareness (Soon et al., 2008); and that consciousness is the reporting of a decision that has been predetermined by unconscious processes (Soon et al., 2013). However, reasoned and planned behaviour models have been shown to explain between 19.0% and 38.0%

of the variance in behaviour, which demonstrates that conscious choices do drive behaviour to some extent (Sutton, 1998). There is clearly dualism in terms of conscious and unconscious decision making; self-control may override unconscious impulses in the context of health risk behaviours (Hare, Camerer and Rangel, 2009). Functional systems of behaviour are built by genes, molecules and neurons, facilitated by conscious and unconscious neural pathways in the brain, and shaped by multi-stage factors but regardless of the conscious/unconscious nature of behaviour or the cognitive and sociodemographic influences, the outcome can still be judged in terms of its adaptive value (Bechara, Damasio and Damasio, 2000).

Does childhood experience influence adult well-being?

The relevance of the research questions relating to childhood experience and adult well-being to the overall aims of the work was to establish whether childhood experience and adult well-being were independent determinants of health risk behaviours; and to define the nature of the relationship between childhood experience, in particular, and health risk behaviours. Given that childhood experience is an established and key determinant of health behaviours and outcomes, it was important to quantify the direction and extent of its effect in the context of this work. By applying an evolutionary interpretation, the health risk behaviours reported by individuals who also reported adverse childhood experiences, or low adult well-being, could be understood as adaptive, or once adaptive at the time that they arose. They may also be understood as qualitatively different from strategies arising from poor environmental conditions as they may be underpinned by past cognitive disruption rather than current cost-benefit evaluation. An evolutionary interpretation may allow individuals exhibiting similar behaviours to be better categorised and understood in terms of the varying formative influences of their behaviour.

Childhood experience and adult well-being were found to be significantly associated with one another in studies 1 and 2 (sections 8.1 and 8.2). Increasingly positive childhoods were positively associated with higher adult well-being in study 1; and increasing childhood happiness and decreasing childhood violence were positively associated with higher adult well-being in study 2. Logistic regression in study 2 found that participants who reported unhappy and/or violent childhoods were 2.7 time more likely to report low adult well-being. Psychological development continues throughout childhood and adolescence; cognitive maturity is not reached until an adult's 20s (Johnson, Blum and Giedd, 2009). Adverse childhood experiences have been associated with modifications in cognitive, nervous, endocrine and immune systems (Danese and McEwen, 2012). Adverse childhood experiences can irreversibly shape development of cognitive and other integrated systems, all of which combine to govern behaviour. Childhood experience is a key determinant of adult well-being and other health outcomes (Kiernan and Huerta, 2008; Anda et al., 2005; Chartier, Walker and Naimark, 2010; Bellis et al., 2013) and negative moods and

emotional distress, such as depression, anxiety and stress, have been found to influence health behaviours and strategies (Felitti et al., 1998; Marsheb, 2006). Findings here are consistent with the evidence that adverse childhood experiences lead to poorer states of adult well-being.

Does childhood experience influence health risk behaviours?

In study 1, positive childhood experiences were found to be associated with increasingly eating for health, and was found to be a significant predictor of eating behaviour (section 5.1.3). Study 2 found that increasing childhood happiness and decreasing childhood violence was positively associated with increasing daily fruit and vegetable portions consumed (section 5.2.1). There was also a significantly higher proportion of participants from unhappy and/or violent childhoods that reported dietary health risk behaviours compared to those from happy, non-violent childhoods. Children who suffer from neglect, abuse, stress and other adverse experiences are substantially more likely to suffer from childhood and adult obesity (Ebbeling, Dorota and Ludwig, 2002); the contribution of adverse childhoods in the creation of problem eating behaviours has been found to persist into adulthood (Johnson et al., 2002).

Both studies revealed adverse childhoods to be associated with various health risk behaviours. These findings are consistent with evidence that shows risky eating behaviours, binge drinking and smoking cigarettes are associated with adverse childhood experiences, particularly parent-child relationship factors (Bobo and Husten, 2000). A higher proportion of participants reporting adverse compared to positive childhoods in study 1, also reported physical inactivity, which is consistent with existing literature that highlights the association between adverse childhood experience and physical inactivity in adulthood (Ebbeling, Dorota and Ludwig, 2002).

There is clear evidence that adverse childhoods change neurobiological pathways which shape individual psychology and governs behaviour. The modifications in individuals who have suffered adverse childhoods have been demonstrated to be adaptive (Danese and McEwen, 2012); adverse childhoods are often accompanied by inconsistent and unreliable food supplies; binge eating and heightened attraction to energy rich foods may emerge as an adaptive response to these conditions (Ulijaszek, 1996; Moore, 2000). Such strategies may persist into adulthood, even if food becomes readily available (Johnson et al., 2002). Modifications in the development of neural pathways may also inhibit the development of higher order, complex cognitive and affective functions associated with brain regions which undergo protracted postnatal development (Pechtel and Pizzagalli, 2010), meaning cognitive control which resists engaging in health risk behaviours is less in such individuals. These findings do not suggest that all adverse experiences will result in altered neurobiology and riskier behavioural outcomes; individuals vary in their resilience to adverse circumstances. Research has shown that higher rates of resilience can ameliorate the

impact of adverse experiences and individuals with higher levels of resilience have better educational outcomes than those who did not demonstrate resilience (Bethell et al., 2014).

Does adult well-being influence health risk behaviours?

In study 1 adult well-being was not found to be associated with BMI or dietary health risk behaviours (section 5.1.1). In contrast, study 2 found low adult well-being to be significantly associated with low daily fruit and vegetable consumption and a preference for 'feel good' foods, compared to participants with average or high adult well-being (section 5.2.1). The findings from study 2 are consistent with existing evidence which suggests that negative moods and emotional distress have been found to influence health behaviours and strategies, particularly relating to diet choice and physical activity (Felitti et al., 1998; Marsheb, 2006). Childhood experience has been identified as a key determinant of adult well-being, meaning these relationships may be underpinned by the consequences of adverse childhood experiences. Adult well-being was not a significant predictor of preference for 'feel good' foods or daily fruit and vegetable portions, but childhood experience was a significant predictor. Adults may also report low adult well-being despite happy and non-violent childhoods. In such cases, poor health behaviours and outcomes may be expected; however, whether low adult well-being causes an individual to engage in health risk behaviours, or health risk behaviour causes low adult well-being is unclear.

Adult well-being is determined by a range of distal and proximal factors, particularly developmental experiences, emotional distress and unemployment (Kiernan and Huerta, 2008; Costa, McCrae and Zonderman, 1987). Well-being has been found to remain relatively stable from young adults throughout adulthood, regardless of demographics or changes in income (Costa, McCrae and Zonderman, 1987). In addition to childhood experience, social status and autonomy have been identified as key determinants of well-being (Gardner and Oswald, 2006); stability in these terms would be likely to ensure stable adult well-being despite changes in wealth or income.

A healthy diet has been found to prevent mental disorders and maintain good mental health (Mental Health Foundation, 2014), and adult obesity has been found to create or exacerbate depression or low self-esteem; these associations are likely to create cyclical effects between comfort eating (or engagement in other health risk behaviours) and mental disorders (Wardle, 2005). However, health risk behaviours, particularly eating of sugar and fat, have been demonstrated to reduce stress (Dallman et al., 2003), which could be interpreted as an adaptive behaviour since disproportionate stress responses are linked to a variety of medical, psychological and behavioural health problems (Quick, Horn and Quick, 1987).

In study 1 adult well-being was not found to be associated with other indicators of health risk taking; however, study 2 found increasing adult well-being to be negatively associated with decreasing weekly alcohol consumption, and a higher proportion of participants with low adult well-being reported daily smoking (sections 6.2.1 and 6.2.2). While the relationships between these variables are complex, alcohol consumption and smoking cigarettes have been found to be associated with mental well-being (Crocq, 2003); findings from study 2 support this evidence.

Studies 1 and 2 both found increasing adult well-being to be positively associated with increasing physical activity and exercise (sections 7.1.1 and 7.2.1). Findings here are consistent with substantial evidence which associates physical exercise with adult well-being (Penedo and Dahn, 2005). Adult well-being was not found to be a significant predictor but childhood experience was found to be a significant predictor of physical activity or exercise in both studies (sections 7.1.3 and 7.2.3). Poor states of well-being, such as depression, can lead to physical inactivity (Weyerer, 1992), and physical activity and exercise improve mental health and adult well-being (Penedo and Dahn, 2005). While physical activity and exercise have been demonstrated to improve adult well-being, many determinants have been evidenced to affect well-being, such as physical health, childhood experience and socioeconomic factors (Kiernan and Huerta, 2008; Anda et al., 2005; Chartier, Walker and Naimark, 2010; Bellis et al., 2013). Well-being itself is a complex concept, and can be considered a positive affect, rather than being the absence of mental disorder (Ostir et al., 2000). Owing to the complexities of well-being, the definitions and determinants, the significant findings from these data should be interpreted with caution.

Can evolutionary strategies be identified and quantified in contemporary contexts?

Natural selection acts when there is variation among traits, variation in reproductive success, and there is heritability of traits (Stearns and Koella, 2007). Behaviours in modern contexts are highly variable, may be plastic or fixed, innate or learned, and unconscious or conscious. Combined behavioural strategies contribute to an individual's phenotype and, for any given set of environmental conditions (including social, economic and demographic), there are optimal behavioural strategies. However, a key trait of evolutionary success for human beings is behavioural plasticity; the ability to modify behaviour to compensate for environmental change is likely to have been a selective advantage for our ancestors, and remains so in modern contexts (Bateson and Gluckman, 2011). Not only does selection act on a set of behaviours but on the ability to modify those behaviours in response to change (Palumbi, 2001).

Behavioural strategies contribute to reproduction and survival, or evolutionary fitness (Robson, 1995; Snell-Rood, 2013). Genes are the accepted unit of selection but the extent to which our genes shape our behaviour is unclear, especially in light of substantial evidence which shows the

determining effects of development, subjective factors and environmental conditions on behaviour (sections 2.5; 2.6.2; 2.6.3). Our genes provide us with generalised predispositions which are built upon and shaped by stages of development and changeable circumstances.

Behavioural strategies affect fitness, reproduction and the reproduction of children (Fieder and Huber, 2007). Choices and behaviours contribute to partner choice, age of reproduction, the number of children we choose to have, and investments and opportunities afforded to our children (Turke, 1989). Survival is also crucial to reproductive output, we must live long enough to reproduce and beyond in order to raise and support our children (Mace, 2007). Many factors contribute to survival, particularly health and resources, or wealth in modern societies. In addition to health and wealth there are additional currencies which contribute to evolutionary fitness, including familial and social relationships, for which behaviours such as trust, cooperation and altruism are determined as context specific trade-offs (Post, 2005; Killingback, Bieri and Flatt, 2006). It could also be argued that happiness is adaptive, or at least that pathological mental health disorders are maladaptive (Cohen, Janicki-Deverts and Miller, 2007). Success in health, wealth and reproductive terms is impeded by pathological mental health conditions. Behavioural choices and strategies are variable and contribute directly or indirectly to reproduction, survival and health in a multitude of ways.

The assertion that behaviour must be heritable in order for natural selection to act upon it may be incorrect; unlike genetic expression, behaviour can be changed depending on developmental conditions, subjective factors or the environmental context. Behaviour is still likely to be adaptive, despite being shaped by external and subjective factors. The literature recognises this distinction; strategic behaviour is importantly influenced by non-genetic mechanisms, which remain analogous to biological inheritance (Robson, 1995).

Behavioural strategies which are subject to forces of selection in modern societies were identified in this research by applying evolutionary theory and principles to actual and hypothetical behaviours. Behavioural strategies identified including those relating to reproduction, risk taking, altruism, cooperation, trust, offsetting, investing, reviewing decisions, planning for the future and achievement striving. The identification of behavioural strategies using evolutionary theory and evidence derived from historical and contemporary societies was relatively uncomplicated; the quantification of these behaviours was more challenging. Unless otherwise stated, the following descriptions of how behavioural strategies were quantified relate to study 1; study 2 included limited variables which could be interpreted as behavioural strategies.

Reproductive strategy or output could not be directly measured in terms of the number of children or grandchildren participants had owing to the age of the sample (18 to 30 years); while some participants reported having children, the average age of all mothers and fathers is over 30 years in the UK (33.1 and 30.2 years respectively in 2014; ONS, 2016). Reproductive strategy is determined by a trade-off between reproductive potential and reproductive effort (Stearns, 1992; Low, Simon and Anderson, 2002). The investment in somatic growth (reproductive potential) takes time and the index created to quantify this strategy assumed that later production (and higher somatic growth and potential) would be associated with lower fertility and fewer children (Low, Simon and Anderson, 2002), while higher reproductive effort with lower potential was associated with younger age. The index created included variables relating to the number of children and grandchildren participants wanted and the ideal age of reproduction; the index was found to have a questionable but acceptable level of internal consistency.

Financial and health risk taking were relatively uncomplicated to measure. Financial risk taking was measured using actual and hypothetical economic and gambling questions, which were combined to give a reliable and internally consistent index. Indicators of health risk behaviours were also uncomplicated for studies 1 and 2 where, risky eating, drinking alcohol, smoking cigarettes, risky sexual practices and engaging in violence were identified and quantified. For study 1 these indicators were combined to give a health risk index for some analyses. There were confounding factors identified in terms of physical inactivity as a health risk indicator, primarily because inactivity does not have hedonic properties (discussed in section 10.4.1).

Questions written and identified to indicate altruistic tendencies were behaviours between non-kin relationships which incurred a cost to the giver and a benefit to the receiver. Confounding factors were likely to apply; for example, whether an individual would help ‘someone lying on a pavement in the night time’ may depend more on context-specific factors, such as the area in which participants lived, the apparent state of the individual (e.g. intoxicated) or other variable circumstances. Questions were also interpreted where perceived risks, whether health and safety risks or time investments, were confounded. The index for altruism was not found to have good internal consistency reliability; therefore, a single indicator was used which represented the most straight forward form of altruism, whether a participant would donate a kidney to a non-kin child. This question, while theoretically representing altruism, may have been answered with a lack of awareness by young adults; the reality of donating an organ may not have been fully considered when responding to a questionnaire. A question from study 2 relating to voluntary work was used as an indicator for altruism for the NWMWBS. While voluntary work may be undertaken to enhance career opportunities or improve work experience, this indicator was considered to be a good indicator of altruistic behaviour (Haski-Leventhal, 2009).

Related to altruism were cooperation and trust; the difference being that cooperation (which depends on trust) yield a mutual benefit for the actor and recipient (West, Griffin and Gardner, 2007). Actual cooperation was not quantified; generalised attitudes were taken as indicators, including whether friends and families were relied upon for support, whether participants grew up in communities where people knew each other or not, or whether we are 'all in life together' or whether life was 'every man/woman for themselves' (this item used as a single indicator for cooperation). Again confounding factors, particularly subjective and inter-relational, may have influenced how participants answered these questions; the index created was not found to be internally consistent. For study 1, trust was measured using a single item indicator, whether most people in life can be trusted or not; for study 2 a similar single item indicator was used, a 10 point scale of trustworthiness of others.

Health offsetting involves the delay of gratification for the sake of better outcomes later in life (Benzion, Rapoport and Yagil, 1989) and was quantified using both general measures and those specific to eating behaviour. The index was found to have a poor but acceptable level of internal consistency. Questions relating to eating behaviour may not have accurately measured health offsetting; for example, an individual may avoid pleasurable foods because they do not want to put on weight and are concerned with their appearance, rather than offsetting for good health in later life. Similarly, questions relating to length of life compared to quality of life could have been interpreted differently between participants; quality of life could have been interpreted as a life with good heath or as life with many hedonistic pleasures. There was also a lack of mutual exclusivity with questions such as these and they were open to varying interpretation; a long life may be healthy and happy.

Unlike health offsetting, rather than foregoing an immediate benefit of pleasure, investing is paying an immediate cost with the hope of accruing a benefit at a later time (Maehr and Braskamp, 1986). Questions used in the index included whether participants were inclined to save money, whether investments in education were worthwhile, and, in health and eating terms, whether participants were willing to pay more for better quality food. There were confounding factors and assumption associated with these questions, an individual may want to save money but be unable to on their present income, or an individual may not believe that good quality food (in nutrient terms) costs more money than poor quality food. These questions did not combine to create a reliable index; instead two single item measures were used relating to financial investments for older age.

Reviewing past behaviour and planning for the future were considered together since both involve spending time reflectively in order to make better choices; the alternative is a more impulsive decision making process (Bogg and Roberts, 2004). Relatively uncomplicated, generalised indicators were used to quantify these behaviours, which related to time spent reviewing decisions, impulsive versus calculating decision making, and the extent to which participants planned for the future. Single item measures were used as the combined index did not have strong internal consistency.

Finally, measures of achievement striving were created since ambition is a constructive characteristic and is the result of internalised goals (Hogan and Schroeder, 1981; Hansson et al., 1983); therefore, is likely to be more pronounced among individuals with higher conscious control of their behaviours. Since the sample was comprised of young adults, ambition/achievement striving was measured using past ambition; for example, whether they were currently doing what they had hoped to do when they were in school. These questions were confounded by external factors which may have been outside of the participants' control; participants may have been highly ambitious in school but were not afforded the opportunities to fulfil their ambition. The index was found to have a poor but acceptable level of internal consistency.

Creating quantitative measures for behaviours which represented evolutionary strategies was challenging and was achieved with limited success. Creating measures with strong construct validity was difficult since virtually all behaviours in modern environments have subjective and context-specific variables which are likely to influence them. Participants may also have answered questions with response bias based on idealised rather than actual behaviours, especially when questions related to sensitive topics such as health behaviour. This sample of people aged between 18 and 30 years may also have contained participants who were not cognitively mature; a substantial proportion of study 1 was current full time students who may not have been psychologically or socially equipped to represent the behavioural strategies of a cognitively mature adult. The challenge of reducing complex behavioural choices into binary and multiple choice questions was identified as a key limitation of this work and is discussed in further detail in section 10.7.1. Whether single item questions were used or indices from summed Z-scores, the refined indicators were based in evolutionary theory and evidence from the literature, the identified confounds were accepted as limitations but were not thought to undermine the findings across the samples.

Are evolutionary strategies adaptive in contemporary contexts?

It was not within the scope of this research to empirically test whether behavioural strategies were adaptive. However, using evolutionary principles and evidence from the literature, directional and

exploratory research questions were formulated. Where there was sufficient evidence, directional questions were created. For example, whether socioeconomic factors or childhood experience influenced health risk behaviours; in both cases there was sufficient existing evidence to give directionality to the relevant research questions. While there was evidence to support directionality for some exploratory questions, the evidence was either incomplete, contested or the directionality was implied. For example, whether there were strategic differences in health behaviour for sociodemographic groups. The evidence demonstrates differences in health behaviour between sociodemographic groups, for example sex or income groups, but whether these differences are strategic could not be stated with any certainty. In all discussed examples, behaviours are suggested to be potentially adaptive if they are consistent with expected directionality; this is not interpreted as clear evidence that behaviours are adaptive, since survival, reproduction and pathology have not been measured. The following questions consider the influence of demographic, socioeconomic, subjective and developmental factors on behaviour outcomes.

Are there strategic differences between age and sex groups?

In study 1, a higher proportion of females reported cooperative and reviewing behaviour compared to males (section 4.1.6). In study 2 a higher proportion of females were found to be altruistic and trusting of others compared to males (section 4.2.4). Between studies, these findings are consistent since altruism and cooperation are associated (altruism almost certainly evolved from reciprocity; Lee and DeVore, 1968) and cooperation depends on trust that a benefit will be repaid. While evidence in the literature is contested, females have been reported to be kinder and more agreeable with their friends (Oswald, Clark, & Kelly, 2004) and are less likely to lose trust in relationships (Haselhuhn et al., 2015). Females have also been found to generally donate more of their money and time than males (Simmons and Emanuele, 2007).

Across both studies, males were found to be higher health risk takers for various indicators compared to females. These findings represent a strategic difference between the sexes in terms of willingness to engage in health risk behaviours, and are consistent with existing evidence which shows females to be more risk averse (Tymula et al., 2013). There is also evidence that impulsivity in males can drive pathological behaviour to a great extent than females (Lightsey Jr and Hulsey, 2002), which is consistent with findings that a higher proportion of females compared to males were reflective and reviewed their behaviour.

In study 1, younger participants (aged 18 to 24 years) had significantly higher proportions of participants who reported a preference for having more children and at a younger age than older participants (aged 25 to 30 years). This finding may be explained by variance of socioeconomic

factors between the age groups (discussed in section 10.3.11) but may also be due to older participants (aged 25 to 30) having passed the age range and the opportunity to have children at a younger age. A continued investment in reproductive potential may be the sensible and optimal choice for adults who have been through their education and early career years. Whether participants had children was not used as a control for this finding but 89.8% of participants did not have children (83.5% of those were aged 25 to 30).

Across both studies younger participants were found to be consistently more health risk taking than older participants. While older people have been found to be more risk-averse (Byrnes, Miller and Schafer, 1999), these findings may be the result of the substantial student population of the younger age group. Health risk behaviours have consistently been found to be higher among students than among the general population (Patrick et al., 1997).

A significantly higher proportion of older participants in study 1 were found to be more trusting of other people than younger participants but this finding was not replicated in study 2. These findings reflect inconsistent evidence in the literature; some studies have found trust to increase as adults age, while others find no age-related differences (Bailey et al., 2015). There were no other significant differences between age groups for behavioural strategies in studies 1 or 2.

Health risk taking behaviour showed significant generalised differences in strategy between age and gender groups; however, the effect for sex was found to be stronger and predictive of multiple behaviours. These findings have implications for other behavioural strategies, such as reviewing behaviour and planning for the future. Findings here suggest that there are no consistent, generalised and predictive strategic differences between age and gender groups, except for risk taking behaviour among males.

Do environmental conditions affect evolutionary strategies?

Indicators of socioeconomic status identified in study 1 were income and employment status, which were combined with other variables to create the security and stability index. Significantly more participants who were not employed full time reported a preference for having more children at a younger age, compared to participants who were employed full time. Significantly more participants who reported a lower income also reported a preference for having more children at a younger age compared to those not on a high income. The security and stability index was created using income, employment and questions relating to participants' perceptions of their standard of living, life stability and life predictability. Participants who felt more financial secure were associated with having fewer children at an older age. These findings support the hypothesis that participants of higher socioeconomic status (employed full time, earning a higher income and

feeling financially secure) were more inclined to invest in reproductive potential rather than reproductive output.

Increases in income and changing gender roles have led to decreases in fertility in the western world; while early reproduction is thought to be advantageous, waiting until older ages is becoming more common (Ventura et al., 2001). Individuals who have attained higher levels of education have been found to delay reproduction (Fieder and Huber, 2007) and socioeconomic advantages have been found to compensate for delayed births and lower lifetime fertility (Low, Simon and Anderson, 2002). Findings from study 1 support the theory that it may be adaptive for those with better resource-acquiring potential to delay reproduction and have fewer children but invest relatively more in them. Whether consciously or not, individuals who have the opportunity to do so may be redefining their strategic objectives, from maximising reproduction at an early age to gaining material resources and investing in the training required to acquire them (Goodman and Koupil, 2009; Fieder and Huber, 2007).

In study 1 statistically more participants who were employed full time were trusting of others, compared to participants who were not employed full time and a higher proportion of higher income participants reported planning for the future, compared to lower income participants. Study 2 revealed that less deprived participants were more altruistic and trusting than more deprived participants. Planning for the future, trusting others and showing altruistic behaviour are theoretically associated; each depend on trust (either on others or that the circumstances of life will not change to a great extent) and each involve a cost that will be repaid with interest in one currency or another. Participants who were in secure employment, who were earning a relatively high income and who felt more stable in their lives were significantly more likely to make these investments for future benefits, which is likely to be the optimal or adaptive behaviour given their circumstances. Participants who did not feel secure and stable in their lives did not make these choices, such an investment may not be adaptive if the future is less certain; it may be a cost that never yields a return.

In study 1 increasing security and stability was found to be negatively associated with dietary and other health risk behaviours; study 2 also revealed more deprived participants and participants who were finding it difficult on present income to engage more in health risk behaviours than less deprived and more financially comfortable participants. These findings add to the substantial evidence which associates lower socioeconomic status with health risk behaviours (section 2.5.1). Unlike reproductive, economic or social choices, health risk behaviours can increase the possibility of suffering pathology, which can accrue to cause disease and death; can strategies which increase the risk of disease and death be adaptive?

The typical risk factors associated with virtually any health risk behaviour are, adverse childhood experiences, mental illness, poverty, social exclusion, unemployment and insecure housing. In both studies, participants who reported worse socioeconomic circumstances also reported poorer health choices. The key to understanding these choices as adaptive is to consider the currencies of mental health, happiness and coping mechanisms. Health risk behaviours are likely to be undertaken if the benefit they provide to enable good mental health (or enable the avoidance of worse mental health) is perceived to outweigh the costs incurred to physical health.

Do perceived environmental conditions affect evolutionary strategies in a similar way to actual conditions?

A distinction cannot be drawn between perceived environmental circumstance and actual environmental circumstance using these data. Childhood experience itself may be remembered more or less favourably given an individual's mental health, well-being or current emotional state. However, these data show childhood experience and adult well-being, like adverse environmental conditions such as socioeconomic disadvantage, are associated and predictive of various health risk behaviours.

Across both studies, adverse childhood experience was associated with and predictive of dietary and other health risk behaviours independent of demographic and socioeconomic factors. Study 1 found adult well-being to be associated with health offsetting; study 2 found adult well-being to be associated with various health risk behaviours. A higher proportion of participants who reported adverse childhoods and low adult well-being also reported growing up with one parent or less until the age of 16. Participants who reported adverse childhood experiences or low adult well-being were also found to be less trusting of other people and to feel a lower sense of community belonging compared to participants who reported positive childhoods and high adult well-being.

Study 2 data revealed participants who reported adverse childhoods and low adult well-being also reported lower financial security, live in more deprived areas, and reported being educated to a lower level than participants who reported positive childhoods and high adult well-being. Adverse childhood experiences were also found to be associated with financial risk taking, while low adult well-being was associated with financial insecurity; low adult well-being was also associated with low achievement striving. Whether low adult well-being was the cause of financial insecurity (owing to the association with low achievement striving), whether low adult well-being was a

consequence of financial insecurity, or whether the association was not causative in either direction is difficult to discern.

These data suggest that while childhood experience and adult well-being were associated with various demographic, socioeconomic and health risk behaviour variables, childhood experience was found to be a stronger predictor of health risk behaviours. Childhood experience was also found to be the strongest predictor of adult well-being; in study 2 participants who reported unhappy and/or violent childhoods were more likely to report low adult well-being than participants who reported happy and non-violent childhoods.

Adverse childhood experiences were quantified in study 1 using measures of how happy, loving, violent, lonely and strict childhoods were perceived to be; in study 2, indicators related to happiness and violence. These general indicators are direct measures or indirect consequences of one or more forms of neglect (physical, emotional, medical or educational) or abuse (physical, sexual or psychological; Centers for Disease Control and Prevention, 2016). The mechanisms by which adverse childhood experiences affect adults are conceptualised by a pyramid where adverse experiences lead to disrupted neurodevelopment, social, emotional and cognitive impairments, and finally the adoption of health risk behaviours, which can lead to pathology and potentially early death (*ibid*). Increased activation of the nervous, endocrine and immune systems, which are integral to the regulation of emotions and stress, may also characterise an underlying biological platform from which depression, stress and anxiety may arise and continue into adulthood (Heim and Nemeroff, 2001; Gustafson, 2004).

In addition to the biological explanation for the association between adverse childhood and problem health behaviours, there is likely to be an adaptive advantage, particularly in terms of eating behaviours. Availability of food is a primary determinant of quality and quantity of food eaten by humans (Mela, 1996) and a dominant driver of obesity (Swinburn, Sacks and Ravussin, 2009). Adverse childhood experiences often arise from unstable or insecure environments that are likely to coincide with inconsistent and unreliable food supplies; binge eating and attraction to high calorie foods may emerge as a response to defend the body from energy deficits (Ulijaszek, 1996; Moore, 2000). The employment of such strategies during formative periods of development may persist into adulthood independent of mental well-being and current level of deprivation, and crucially, independent of whether food becomes readily available (Russell, Hughes and Bellis, 2016). Behavioural strategies can become inflexible if the affective functions which govern them have not developed properly (Johnson et al., 2002); the same affective functions which govern other health risk behaviours, drinking of alcohol and smoking of cigarettes for example. If costs and benefits are accurately ‘appraised’, engaging in a health risk behaviour may be adaptive,

given the environmental circumstances; however, if an individual's psychological mechanisms which 'appraise' these costs and benefits are malfunctioning, behavioural strategies which lead to pathology may be maladaptive, and may persist regardless of the environmental context.

Does temporal perception determine evolutionary strategies and health behaviour?

Temporal perception is shaped by compartmentalising experiences into past, present and future frames (Zimbardo and Boyd, 1999) and is formed and modified by personal experiences and environmental conditions. Temporal perception has important implications for cognitive systems and therefore health behaviours (Carstensen, Isaacowitz and Charles, 1999). In study 1 temporal perception was measured using multiple choice questions which indicated variation between participants in terms of the emphasis of their thinking, whether on reviewing past experiences, anticipating future events, or thinking in terms of the present moment. This research aimed to explore whether there was an optimum amount of time to spend reflecting on choices as evidenced by indicators for temporal perception; too little reflection and an individual would constantly act on impulse and often exhibit health risk behaviours, too much reflection and an individual may obsess or become anxious about their choices. This trade-off could be quantified as costs and benefits, consciously or unconsciously, in the minds of participants who may or may not invest an adaptive amount of time reflecting on their choices.

While temporal perception is relevant to health behaviours and there is likely to be an optimal temporal trade-off when reflectively making choices, there are many complexities and confounding factors which influence this mechanism. For example, impulsivity is associated with 'living in the moment' and making hedonistic but unhealthy choices (Grano et al., 2004); however, there is also evidence to suggest that 'living in the moment' is crucial to happiness and productivity in modern societies (Killingsworth and Gilbert, 2010). There were also limitations with these measures, the recall of past events may be remembered with inaccuracies, individuals can think nostalgically, ruminatively, positively or aversively (Zimbardo and Boyd, 1999); variation can also be affected by mood and well-being. In study 1, there were two simplified indicators of temporal perception; however, based on the evidence discussed, these measures were inadequate to measure a complex psychological construct. The indicators were also open to varying participant interpretation and may not have elicited consistent or reliable responses. For the various confounding variables, complexities in the literature and the inadequacies of the indicators, this research question could not be answered.

Is reproductive strategy predictive of health risk behaviours?

In study 1, the reproductive index was found to have good internal consistency between measures for the number of children participants ideally wanted and participants' perceptions of ideal age

for males and females to have children. Having children at a younger age was associated with having more children; the association was found to be stronger for females. This finding is consistent with evidence previously discussed which suggests later production of children is associated with lower fertility and fewer children (Low, Simon and Anderson, 2002). In study 1, reproductive strategy was not found to be associated with health risk behaviours but individuals who reported a preference for having more children and at a younger age were found to be more likely to be overweight or obese, compared to participants who reported a preference for having less children and at an older age. This finding is unusual since reproductive strategy was not associated with risky eating behaviours, and BMI itself was found to have limited associations with risky eating behaviours. Life history theory may predict that reproductive output at a younger age is favoured when the opportunity for somatic growth is reduced, fertility also decreases meaning output would begin at younger ages; consistently high fertility and reproduction at younger ages are evidenced in sub-Saharan Africa (Caldwell and Calwell, 1990), where income, parental investment in offspring and education levels are low. In developed, westernised societies, where infant mortality is low and parental investment (and earning potential) is high, fertility and reproductive rates have continued to fall. Within western societies this trend has also been evidenced; in the USA pregnancy rates of teenagers and adolescents is much higher in deprived populations (Singh, Darroch and Frost, 2001).

There was no strong evidence to create a directional hypothesis regarding reproductive strategy and health risk behaviours but it could be suggested that adverse environments create shorter term strategies in terms of reproduction and health behaviours, primarily because future benefits, yielded from somatic growth and health investments, are less certain. The lack of associations between reproductive strategy and health behaviours may indicate that developmental and socioeconomic factors govern these strategic choices in different ways; it may be that familial and economic variables are important in determining reproductive strategy (Hill and Kaplan, 1999), while childhood experience, deprivation and social factors are the primary determinants of health risk behaviours (Centers for Disease Control and Prevention, 2016; Nettle, 2010; Marmot, 2005).

Are financial behavioural strategies associated with health risk behaviours?

The health offsetting index was comprised of health behaviour indicators but also life philosophy preferences including quality and length of life questions. Intuitively, participants who reported low health offsetting were more likely to eat for pleasure, more likely to report low daily fruit and vegetable consumption, and more likely to report physical inactivity compared to health offsetting participants. Food, like other substances, can be immediately gratifying but can incur long term costs including increased health risks and pathology; the payoff for delaying gratification is good

health but cognitive control is required to delay gratification. Impulsive individuals are suggested to have less self-control and have been found to be more likely to suffer the adverse consequences of substance use and obesity (Michaelson et al., 2013; Casey et al., 2011). Like other behavioural strategies, offsetting behaviour has been found to be linked to childhood environments and social factors (Robinson, 1996; Michaelson et al., 2013).

In study 1, a single item was used to measure financial investment behaviours, whether participants generally preferred to spend or save extra money. Significantly more participants who preferred to spend extra money were found to be overweight or obese, reported dietary health risk and other health risk behaviours, compared to participants who preferred to save extra money. These results link financial strategies with health behaviours, adding evidence to the hypothesis that financial and health behaviour strategies are governed by similar psychological mechanisms. This is an important finding since there is substantial evidence that time and resource decision making is adaptive (Hill and Kaplan, 1999), given personal and environmental parameters, and the relationship between financial and health behaviours indicates health decision making is also likely to be adaptive.

In study 1, the indices for financial and health risk taking were found to be significantly associated, and both were associated with eating for pleasure rather than health; financial risk taking was also found to be associated with various other indicators of health risk behaviours. These findings suggest strategies which govern risk taking, whether financial or health-related, are shaped by similar developmental and environmental factors. There are a range of personality traits involved in financial decision making such as extraversion, neuroticism, agreeableness, conscientiousness and impulsive sensation seeking (often cited as the most important determinant of risk taking behaviour; Nicholson et al., 2005; Zuckerman and Kuhlman, 2000). Sensation seeking is governed by cognitive executive functioning (Noël et al., 2011), which is shaped by genetics and developmental experiences. However, evidence also suggests that individuals from adverse environments are more likely to take greater health and financial risks (Griskevicius et al., 2011). Individuals from poorer environments may be more likely to have experienced adverse developmental conditions (Lupien, et al., 2000), but in addition individuals may be responding to their current environmental circumstances with short term oriented behaviours, in this case sensation seeking behaviour. Findings here add evidence to the hypothesis that adverse current environments may increase the perceived costs of waiting for a future benefit and lead an individual to act for more short term, sensation seeking, and immediately beneficial behaviours.

The neurological correlates of conscious or unconscious decision making were discussed in section 10.3.4. While the influence of conscious decision making may be overstated (Soon et al.,

2013), there is clearly some influence, meaning a dualist system of behaviour decision making is likely to be employed (Hare, Camerer and Rangel, 2009). Various theories have attempted to describe the psychological models which govern health behaviour. Assuming we operate in a dualist way, a multi-stage model of behaviour seems more likely than models which focus on motivations or intentions which drive behaviour; for example, motivational or behavioural enaction models (Armitage and Conner, 2000). Multi-stage models identify that cognitive (as shaped by genetic and developmental variables) and sociodemographic factors affect behaviour at various stages and that these influences lead individual to behave in qualitatively different ways (Sutton, 2000). Multiple stages have been identified in various models (precontemplation, contemplation, preparation, action and maintenance) but there is no clear evidence at which point expected costs and benefits are considered, which components are conscious or unconscious, or how cognitive and sociodemographic factors affect the process of determining health behaviour (Armitage and Conner, 2000).

Are altruistic and cooperative tendencies associated with health risk behaviours?

In study 2, a higher proportion of participants who reported undertaking voluntary work in the last 12 months (used as an indicator of altruism) and participants who reported feeling a sense of community belonging reported a preference for 'feel good' rather than healthy foods, compared to those who had not undertaken voluntary work and those that did not feel a sense of community belonging; study 2 also revealed a lower proportion of altruistic and trusting participants reported low daily fruit and vegetable consumption. In study 1, a higher proportion of participants who were not generally trusting of others and who were less cooperative reported general health risk taking and higher levels of other health risk behaviours. In study 2, a higher proportion of participants who did not feel a sense of community belonging and less altruistic participants reported higher levels of health risk taking behaviours.

Cooperation requires trust and yields mutual benefits for the recipient and actor (West, Griffin and Gardner, 2007). Cooperation in modern societies requires community engagement and an assumption of this research is that a sense of belonging would be stronger in a cooperative community. Cooperative action is determined by community structure, cost and benefit payoff appraisals, subjective or perceptual factors, contextual factors such as the socioeconomic situation and individual differences, particular cognitive variations (Kopelman, Weber and Messick, 2002). Strategies which favour cooperation, trust and altruism were associated with, and predictive of, healthier choices. Developmental, subjective factors and socioeconomic factors shape both cooperative and health behaviour strategies; better cognitive control, higher adult well-being and opportune and safe environments are likely to be conducive to cooperative and healthier strategies. The long term benefits of cooperation outweigh the immediate costs, or in health terms, the costs

of investing or offsetting pleasurable behaviours are perceived to be less than the future benefits. While behaviours determined by innate or inflexible cognitive factors may be difficult to change, an individual may improve their health behaviours by improving controllable factors within their environment. For example, increasing social support and community engagement could be an important way to improve intended choices and create healthier lifestyles (Kelly and Melnyk, 2011).

Are reviewing, planning, and achievement striving associated with health risk behaviours?

In study 1 a higher proportion of participants who reported not planning for the future were found to be overweight or obese, reported dietary risk taking and other health risk behaviours compared to participants who reported planning for the future. Planning future choices and reviewing experiences are important components of reflective decision making (Bogg and Roberts, 2004). Evidence suggests reflective processes lead to better health choices since outcome behaviours are closely related to reasoned preferences (Paternoster and Pogarsky, 2009). This evidence was supported with findings in this research where investments in time reviewing experiences and planning choices were associated with healthier behaviours. Favourable developmental and environmental circumstances may facilitate greater investments of time in reflective decision making, and provide a framework from which healthier choices can be made.

The index for achievement striving was not found to be associated with, or predictive of health behaviours. It may be that achievement striving is not governed in a similar way to health or other behavioural strategies; however, there is evidence that achievement striving and impulsivity are associated (Glass, 1977). There may not have been substantial variation in study 1 in terms of achievement striving since a large proportion of the sample were involved with, or had received, university education, which could be an indicator of high achievement striving across the sample.

To what extent can we predict health risk behaviours from behavioural strategies?

Latent profile analysis was conducted for study 1 data; study 2 did not include sufficient behavioural strategy indicators to define distinct clusters. Three-step modelling was used where the model was estimated using behavioural strategies, individuals were assigned profiles using their class membership, before the associations between class memberships and external variables were examined. The 3-class model was selected. In terms of development and behaviour, there were significant differences between clusters for childhood experience, reproductive strategy, parental circumstance (living with both or less than both parents until the age of 16), how trusting participants were of other people, and physical activity. In terms of sociodemographics there were significant differences in distribution between clusters for sex, ethnicity and employment status. In terms of health behaviours, there were significant differences in distributions between clusters

for eating for pleasure or health, general health risk taking, current daily smoking, sexual risk taking and violence in the last 12 months. Cluster 1 contained the highest proportion of white participants, individuals from cluster 1 had a desire for many children at a young age, were the most physically inactive, and were moderate in terms of their health risk behaviours. Cluster 2 contained the highest proportion of females and people not in full time employment, individuals in cluster 2 reported the most positive childhoods and were the most trusting of other people, and in terms of health behaviours, were the healthiest and most risk averse for all measures. Cluster 3 contained the highest proportion of males, the lowest proportion of white participants and the highest proportion in full time employment, individuals in cluster 3 had the most adverse childhoods, desired the fewest children, were the least trusting of other people and were the most physical active, and were the least healthy and most health risk taking for all measures.

There were some inconsistencies within the profiling analysis compared to other research. For example, existing evidence and findings from study 2 indicated that less financially secure individuals could be expected to be more willing to take health risks, yet cluster 2 was found to have the lowest proportion in full time employment and be the most health risk averse. The likely explanation is that cluster 2 had the highest proportion of females, who are generally more risk averse than males, and that sex is a more powerful predictor of health risk taking that an indicator for financial security, such as employment status. Profiling can be useful in predicting health risk behaviours for populations of known demographic, socioeconomic and developmental variables and can be a useful tool in supporting the development and targeting of interventions through population segmentation. However, care must be taken from these analyses as data from study 1 was generated from a convenience sample. The likely sampling bias may produce results that are not representative of the wider population and, for profiling of this kind to predict health risk behaviour among the general population, a representative sample would be required.

Another limitation is that individuals were assigned to clusters based on probability classification and, despite overall clusters being definable in terms behavioural characteristics, there was heterogeneity within clusters and individuals that did not conform. For example, cluster three was the most risk taking cluster overall but just under one-third of the cluster were female, who were found to be generally risk averse.

10.5 Implications for policy and practice

There is a clear need for evidence-based public health action to attempt to reduce the risk factors for non-communicable diseases, which include heart disease, type-2 diabetes, stroke and various cancers. Non-communicable diseases are preventable and are most commonly caused by poor diets or overeating, problematic alcohol use, smoking cigarettes and lack of exercise (Rosner and Fried, 2010; Daar et al., 2007). The primary focus of this research was risky eating behaviours

and choices relating to diet but various other health risk behaviours were considered, including harmful drinking, smoking, risky sexual practices and violence. There is some evidence that preventative interventions can be effective for a range of health risk behaviours (Hale, Fitzgerald-Yau and Viner, 2014.), but implications for practice discussed here will focus on existing and potential interventions to improve eating behaviours, diet choice and physical activity. It is beyond the scope of this discussion to focus on implications for practice for all health risk behaviours, but the findings of this research suggest that eating and other health risk behaviours are linked, and that general strategies which drive behaviour may be governed by similar developmental, subjective and environmental factors. Therefore, findings from this research may be used to supplement evidence to inform preventative interventions or secondary treatments which may be appropriate for a range of health risk behaviours. This section will also be limited to consideration of strategies which govern health risk behaviour, while it is acknowledged that changes in global food systems, particularly the introduction of mass-produced and low-cost foods, along with pervasive marketing campaigns have enacted a powerful effect on food choices and dietary patterns.

Effective treatments for overweight and obesity are often limited to lifestyle factors, namely food intake and physical activity (Shaw et al., 2009). However, weight loss by any means has proved difficult to achieve and prevention efforts have rarely been sustained (Gortmaker et al., 2011). Findings here add evidence to the existing knowledge base around the circumstances of weight gain. High consumption of takeaways, ready meals and alcohol were found to be associated with pleasurable and unhealthy eating (eating out of the home is associated with fatness and energy intake respectively; McCrory, Fuss, McCallum et al., 1999; Jeffery and French, 1998), while eating fresh vegetables and fruit were associated with healthy eating. Home prepared meals were associated with increasing fruit and vegetable consumption, while eating chips, takeaways and ready meals were associated with decreasing fruit and vegetable consumption. Home prepared meals have been found to contain a better nutrient composition, lower sugar and fat content and are conducive to healthier lifestyles than restaurant and takeaway food, which contain approximately 65.0% more energy (Prentice and Jebb, 2003).

The Eatwell Guide provides a framework for eating behaviours and diet choice, recommending a diet with reduced fat and sugar, wholegrain foods, five daily portions of fruit and vegetables and healthy sources of protein (NHS Choices, 2016); there are also clear guidelines around low risk consumption of alcohol (Drinkaware, 2016). There is also a particular emphasis on schools to provide high quality protein, fruit and vegetables, and carbohydrates, and to limit the availability of sugary drinks, crisps, chocolate, sweets and fried products, so that children have healthy, balanced diets (Department of Health, 2016). Owing to the evidence that parents have

considerable influence on children and adolescent eating behaviours, which may persist into adulthood (Savage, Fisher and Birch, 2007), there are clear recommendations for parents to help prevent childhood overweight and obesity, and how to reduce the rate of weight gain for overweight and obese children (Centers for Disease Control and Prevention, 2016). Local schools also offer general skills for life, some with designated departments (The Observatory School, Wirral, 2016), which provide particular advice and teaching around shopping for healthy foods and cooking.

In the face of clear and accessible advice for adults, schools and parents regarding eating and drinking choices, there remains variation in eating and lifestyle behaviours, and childhood and adult weight. National and international policy makers have tended to favour interventions which require high levels of independent action using personal resources, or individual agency (Adams et al, 2016). Most interventions focus on advice and guidance in order to educate and encourage healthier lifestyles at a population level (Rose, 1992). The emphasis of these approaches require individuals to have high levels of agency and, since the elevated risk factors that some individuals face are not accounted, the effectiveness of these approaches requires close scrutiny (McLaren, McIntyre and Kirkpatrick, 2010). Alternative policies and interventions that do not require high or any levels of individual agency may be more effective; for example, creating healthier environments both at the macro and micro level, or encouraging food production companies to improve the nutrient content of their products. The health impact pyramid is a conceptual model which describes a gradient in terms of the agency required for health interventions (Frieden, 2010); interventions at the base of the pyramid, which require the least individual agency, have been demonstrated to have the most impact and effectiveness (*ibid*).

The availability and quality of food varies between socioeconomic areas (Reidpath et al., 2002), and the outlet density of fast food takeaways and restaurants has been found to increase frequency of consumption, which is linked to obesity and weight gain (Cummins and Macintyre, 2006; Thompson, 2004). Access to supermarkets has been found to be associated with lower rates of obesity and higher fruit and vegetable intake (Morland, Diez-Roux and Wing, 2006; Rose and Richards, 2004). Unhealthy diets and obesity are more common in disadvantaged socioeconomic groups (Darmon and Drewnowski, 2008) and fast food and takeaway shops are more prevalent in deprived areas (CEDAR, 2015). Findings here support this evidence; study 1 and 2 data found associations between financial insecurity or deprivation and unhealthy eating behaviours. Some local authorities have taken steps to reduce the number of takeaways in local areas; for example, the Greater London Authority took action to reduce store fronts dedicated to takeaways on busy high streets, an action supported by Public Health England, the National Institute for Health and Care Excellence, and the Academy of Medical Royal Colleges (CEDAR, 2015). Research

indicates that national policy makers should consider 'top down' interventions, which require minimal individual agency, since they are likely to be the most effective when addressing unhealthy lifestyles and inequity of food availability among different socioeconomic groups (Maguire, Burgoine and Monsivais, 2015).

This research supports other evidence which suggests physical inactivity is a risk factor for unhealthy eating (Jones et al., 2007). This research found increasing sedentary time and watching television were associated with eating for pleasure, and increasing activity was associated with increasing fruit and vegetable consumption; there appears to be an exacerbation of risk factors in consideration of diet and exercise. Similar to diet choices, there are environmental factors which influence forms of activity, such as distribution of parks and green spaces, actual and perceived safety, land use, population density, road use, local facilities and neighbourhood attractiveness (Foster et al., 2005). In response, evidence linking physical inactivity with poor health, the Department of Health published a series of guidelines for physical activity all age groups (2011), including recommendations for daily activity, vigorous activity and minimising sedentary time. The Departments for Culture Media and Sport, and Education also published a policy paper (2015) detailing initiatives to encourage participation in sport within communities and schools. Finally, the Department for Environment, Food and Rural Affairs (2015) released an initiative to introduce more green space to urban areas, in an attempt to reduce health inequalities. Findings from this research support existing evidence and these initiatives. As of 2015, participation in sport had increased substantially; a rise of 1.7 million over ten years (BBC, 2015). Women were responsible for the majority of the increase but participation of people from lower socioeconomic groups and disabled people remained low (*ibid*).

The total number of weekly meals was found to be positively associated with eating for health, while increasing consumption of snacks was associated with unhealthy eating. In terms of dietary advice, the message from this research and existing evidence is clear, nutrient composition is critical in maintaining a healthy, balanced diet rather than reducing the number or meals (Rolls, 1995). This research indicates that satiety is a critical factor in predicting eating behaviours and risk of pathology; participants who reported liking to feel full were more likely to be overweight and obese, and report a preference for pleasurable food. Consuming pleasurable foods (high in sugar and fat) can override homeostatic satiety signals meaning individuals can eat beyond the point of satiation. For this reason, meals which are highly palatable are often consumed more frequently and with greater portion sizes than less palatable foods (McCrory, Suen and Roberts, 2002). There is substantial evidence that portion size affects the amount eaten (Rolls, 1995); therefore, reducing portion size can help in stopping eating once satiation has been reached. Eating better quality meals with fewer calories also enables homeostatic satiety signals to function

and enables individuals to stop eating. Findings from this study support existing evidence, which has informed appropriate educational messages which recommend quality foods and sensible portion sizes.

As highlighted, there are many implications for practice in terms of dietary recommendations, guidelines and educational information, and in terms of built environment planning and the physical environment. However, within areas of similar socioeconomic and physical condition, which are exposed to similar national and local health advice and guidance, there are differences between individuals in terms of health behaviour strategies. This research highlights some of the associations and predictive effects of such strategies on health behaviours and likely outcomes. Generally, individuals who were found to favour strategies which yielded shorter term benefits were found to be more likely to engage in unhealthy behaviours. The implications for practice are complex since individuals may be acting for short term gains for a variety of reasons, including adverse childhood experiences, poor environmental or socioeconomic conditions, or subjective reasons. One of the key reasons why interventions and treatments which target overweight and obesity are so ineffective is that they fail to adequately account for the causal factors that underlie overeating and other health risk behaviours, and the complex systems of activity in which we live. A key objective of this research was to demonstrate that health risk behaviours may be adaptive, given adverse environmental conditions, and expected given adverse developmental environments or low adult well-being. Existing and potential interventions which address these causal factors are considered here.

Findings from both studies in this PhD, in addition to existing evidence, found associations between adverse socioeconomic conditions, particularly financial insecurity and deprivation, and a range of health risk behaviours. The English Indices of Deprivation (2015) include measures of income, employment, health, education, skills and training, crime, barriers to housing and services, and the living environment. The number of households that fall below the minimum standard of living has risen from 14.0% to 33.0% in the last 30 years, 18 million people cannot afford adequate housing, 1.5 million children live in households that cannot afford to heat their homes, half a million children live in families where their parents cannot afford to feed them, one in five children and adults were ‘poor’ at the end of 2012, those who are ‘poor’ are typically multiply deprived, and almost half of the ‘working poor’ work 40 hours a week, meaning full time wages are too low to support families (PSE, 2014). People from deprived environments have fewer opportunities in terms of education, professional development and employment, financial security is often much less, and crime is often higher. This research suggests that people from deprived areas exhibit shorter term strategies and that such strategies are likely to be adaptive; financial insecurity is not conducive to investing spare money; high crime is not conducive to trust and

cooperation; and uncertainty about the future is not conducive to long term health behaviours. For an individual living in a more deprived environment, seeking to change the outcomes of an adaptive behavioural strategy is very unlikely to succeed. To improve health inequalities of people living in poverty, better opportunities for work, housing and employment must be provided in order that the adaptive strategy is a healthy strategy.

Adverse childhood experiences often accompany deprivation; however, childhood experience has been found to influence eating behaviours independent of deprivation (Russell, Hughes and Bellis, 2016). An adaptive response to adverse conditions may be binge eating and attraction to high calorie food (Moore, 2000), since adverse conditions are likely to coincide with inconsistent and unreliable food supplies. These strategies may persist into adulthood despite situational change. Chronic stress during childhoods changes emotional regulation, cognitive responses, memory and learning (Anda et al., 2006), which potentially impedes higher cognitive and behavioural control. A key recommendation from this and other research is to prevent adverse experiences in childhoods. This may include educating and supporting parents to prevent emotional or physical neglect or abuse; and by improving social care systems for children whose parents are unable to prevent adverse circumstances. For an adult who has suffered adverse developmental conditions, specialist interventions, as described below, may be required. Higher control of behaviour may be difficult for such individuals since cognitive platforms which drive behaviour may have been malformed. However, there are a range of interventions and techniques to modify behaviour which may be taught and which account for environmental cues, such techniques may enable an individual to monitor emotional feelings and focus on specific goals for caloric intake and expenditure (Wing, 2002). Cognitive behavioural therapy (CBT) may also be useful, since it combines cognitive and behavioural factors and is based on the principle that an individual's thoughts, emotions and behaviour can be restructured (The Centre for Eating Disorders, 2016). There is some evidence that cognitive behavioural therapy can reduce binge eating in obese individuals (Ashton et al., 2007).

Finally, adult well-being has been shown to have an influence on diet choice and physical activity (Felitti et al., 1998; Marsheb, 2006). The motivation to eat foods high in fat and sugar has been found to occur more during challenging or stressful circumstances, (Zellner et al., 2006). This was likely to be a once adaptive strategy but in modern societies where there are various sources of stress, engaging in health risk behaviours during times of adverse mental health may be less about energy consumption and more about self-therapy. However, health risk behaviours may cause a decrease in adult well-being, potentially creating a cyclical effect between harmful behaviour and worsening mental health. While physical activity has also been shown to treat mild cases of clinical depression and generate moderate improvements in stress and anxiety (Fox,

1999), well-being is broadly determined by a combination of distal and proximal factors, particularly social deprivation and childhood experience (Kiernan and Huerta, 2008; Anda et al., 2005; Chartier, Walker and Naimark, 2010; Bellis et al., 2013). As the primary determinants of adult well-being, improving socioeconomic conditions and childhood experience would be likely to have a positive effect on adult well-being and health risk behaviours. Improving adult well-being via interventions has been demonstrated to be successful to some extent in improving eating behaviours (Bacon et al., 2002).

If health outcomes were thought to be the result of maladaptive behaviour, such behaviour could be treated by improving and amplifying existing interventions with greater understanding and specificity of target groups. If health outcomes were thought to be the result of adaptive behaviour, the challenge for public health would be to alter the circumstances or perceptions individuals identified to be at the greatest risk, whether through developmental, socio-economic or subjective circumstances. While public health work of this kind may be complicated, resulting interventions which seek to change the causes and drivers of behaviour are likely to be more effective than those seeking to reduce the products of behaviour. Public health work which results from an understanding of the causes of behaviour, rather than the symptoms, may also be applied to a range of problems caused by various health risk behaviours, since general strategies may underpin a range of health risk behaviours. Where behaviours are thought to be once adaptive, typically arising from disrupted neurobiological development (resulting in reduced higher control or altered perceptions of environments), harm reduction measures addressing behaviour may remain the most effective type of intervention since the causes of such behaviour may be difficult to change.

10.6 Implications for research

This research adds to evidence that adverse childhood experiences and socioeconomic deprivation are major risk factors for health risk behaviours and poorer health outcomes. However, while health risk behaviours are associated, they are expressed in different ways; individuals may have a general propensity to take health risks but the specific behaviours may vary. Further research may be beneficial which seeks to understand what shapes the type of health risk behaviours expressed, among individuals identified to be at higher risk. For example, among individuals of similar demographic characteristics, developmental experiences and socioeconomic environments, some individuals choose to eat pleasurable foods, while others choose to drink alcohol, and others choose to smoke cigarettes. This research highlights that the short term behavioural strategies which lead to health risk behaviours may be adaptive given the developmental and socioeconomic conditions, but there is no indication of the circumstances which lead to certain behaviours to be favoured. Exploratory work of this kind would be required

to control for the key determinants of childhood experiences and socioeconomic deprivation and explore peripheral variables, particularly social and cultural factors.

General effects of social networks and support, social relationships, social change and subjective social status on health behaviour have been identified (Glanz, Rimer and Viswananth, 2008; Hinkle, 1974; Singh-Manoux, Marmot and Adler, 2005). Family and peer influences have also found to be highly influential on health (The Edelman Health Barometer, 2011) and increasingly social media is being identified as a key tool in health care (Fisher and Clayton, 2012). Socio-cultural contexts have been identified to influence specific health risk behaviours, particularly substance use (Unger et al., 2009; Bisset, Markham and Aveyard, 2006) and alcohol use (Bloomfield, Gmel and Wilsnack, 2006). How these socio-cultural effects imprint specific health risk behaviours has not been examined independent of the key determinants of childhood experience and deprivation. Exploratory work of this kind would be most valuable among a cohort of higher risk individuals, particularly those who report adverse childhood experiences and live in economically deprived areas.

Since socioeconomic gradients of health are found even where health behaviours are free (Nettle, 2010), the association between deprivation and health behaviour is not likely to be simply derived from economic inequality; additionally, some health risk behaviours, such as buying alcohol or cigarettes, can be economically expensive. This research highlights that various health risk behaviours are predicted by deprivation, the interpretation being that shorter term strategies and lower delay discounting may be adaptive given such circumstances. Research which seeks to understand how this trade-off can be favourably adjusted would be valuable in reducing health risk behaviours. Research may seek to define and quantify the various circumstances that are caused by or accompany deprivation and examine their effects after controlling for demographic and developmental effects. Understanding the relative impact of factors associated with deprivation, such as lower academic attainment, reduced career opportunities, higher rates of criminality and danger, and less familial or social support, would enable researchers and public health practitioners to set clear strategies to improve specific factors, without wholescale economic and social reform. If risky health behaviours are optimal, or at least expected, given certain circumstances, public health research must present clear evidence to policy makers in order that strategic agendas attempt to create environments where healthier behaviours are the easiest choice, rather than addressing the outcomes of such choices.

Similar to deprivation, adverse childhood experience is a key determinant of health behaviours. Adverse childhood experience is an umbrella term encompassing different forms of physical, emotional, medical or educational abuse (Centers for Disease Control and Prevention, 2016) and

there would be value in research which seeks to disentangle the complicated effects of adverse childhoods on health outcomes. Physical and sexual violence have been evidenced to result in risky sexual behaviours, substance use and unhealthy eating behaviours (Black, 2011; Roberts, Klein and Fisher 2003) but less extreme forms of abuse and neglect have less overt and direct consequences on health. Emotional abuse is associated with delinquency, low academic achievement and teenage pregnancy (Kelley, Thornberry and Smith, 1997), psychological abuse is associated psychiatric disorders, such as depression and anxiety (Silverman, Reinherz and Giaconia, 1996), and emotional neglect can impact on an individual's ability to form and maintain healthy intimate relationships (Colman and Widom, 2004). A clearer understanding of how and why these consequences shape health risk behaviours is required. Associating levels of risk and types of behaviour from specific experiences may help to inform secondary treatments. Identifying the motivations for behaviour would also be valuable, particularly in distinguishing when health risk behaviour is a consequence of adverse experience, when it is self-therapy or comfort, when it is undertaken to change mind states, or when it is the product of impaired neurological development.

Parent-child relationships have a strong influence on health risk behaviours and this research highlights the impact of living with both parents compared to living with a single parent or no parents until the age of 16; health behaviours were typically worse for individuals reporting living with one parent or less until the age 16. Research highlights that there may be risks for healthy child psychomotor development following parental separation (Kacenelenbogen et al., 2016) but further research may be required to investigate the consequences of this and to identify child sensitivity and the consequences for health choices, particularly in terms of gender and age at which separation occurs. There is also evidence that the relationships between a mother and father and their child varies in unique ways (Stevenson and Crnic, 2012; Fenning and Baker, 2012) and that negative maternal or paternal behaviour can have different impacts on development (Fenning et al., 2014). How these developmental changes impact on health risk behaviour has not been clearly evidenced for single or double parent families. There is also evidence that attunement (emotional support and mutual understanding between parent and child) can impact on childhood development (Coburn, Crnic and Ross, 2015) but similarly the health consequences of this have not been fully explored.

There are existing interventions which are suggested to be essential priorities in supporting early child development and measures for preconception care, maternal health, child health, nutrition, violence prevention, environmental health and social protection (Daelmans et al, 2015). Effectiveness of these interventions has been demonstrated for children and adolescents in terms of academic performance and health, and for adults in terms of economic productivity and social

integration (Gertler et al., 2014; Grantham-McGregor et al., 2014) but effectiveness has not been demonstrated in the UK, or in terms of long term health risk behaviours. Longitudinal work of this kind would be useful in informing policy and practice by adding to the evidence base and demonstrating effectiveness and efficacy of preventative interventions which seek to foster healthier and happier parent-child and family relationships.

Various factors comprise perceived community support, but among young adults these are most often familial support, friendships and peer relationships, intimate relationships, economic hardships and habitation types (De Haan, Boljevac and Schaefer, 2010). Adult well-being is also likely to alter the perception of community support. Further work may attempt to define the relationship between perceived community support and health risk behaviours and identify the relative importance of these factors in creating or exacerbating health risk behaviours particularly poor diets and binge drinking.

Indicators of financial security and economic decision making were found to be associated with various health risk behaviours across both studies; however, gambling has been found to be less heritable than health risk taking (Zuckerman and Kuhlman, 2000). This implies that the drivers and causes of these associated behaviours may vary. Further work may seek to understand whether these associations are due to similar psychological mechanisms driving financial and health behaviours, as implied by this research, or whether they are coincidental and shaped by overlapping but different circumstantial factors. A key driver to explore in this research may be current socioeconomic environment; for example, deprivation may be associated with poverty leading to financial insecurity and risk taking, and, coincidentally, associated with less emotional or social support leading to factors, such as low adult well-being, which may lead to health risk taking.

Since investing behaviour and financial risk taking were found to be significant predictors of health risk behaviours in study 1, independent of other factors, further research may seek to identify whether interventions to address compulsive spending or gambling would also be effective if adapted to address impulsive health risk behaviours. Evidence suggests that cognitive behavioural interventions are most effective at treating compulsive gambling (Toneatto and Ladoceur, 2003), but while problem gambling is considered in similar terms as certain types of substance use, particularly cocaine and alcohol use, the effectiveness of such treatments on less problematic health risk behaviour, such as eating for pleasure, has rarely been explored. While eating for pleasure or overeating is not perceived to be as socially problematic as compulsive gambling or substance use, the extent of the obesity problem and the risk of pathology requires increasing consideration of potentially effective treatments.

The significant associations and predictive relationships of limited behavioural strategies (interpreted in evolutionary terms) on health outcomes in study 2, imply that there may be value in exploring other behavioural strategies across a larger, representative study. Further research to build on these findings using a similar methodology on a larger sample may add to the evidence that health behaviour outcomes are adaptive and can be predicted by evolutionary theory. The findings of a study from a larger representative sample may also be more generalisable and may be used to predict health behaviours for given demographic and socioeconomic parameters. Such research could be supplemented with existing data sources for a given population, and used to compare predicted health behaviours with recorded outcomes. If modelling over a larger sample is found to highlight similar relationships and predictive effects of independent variables on dependent health outcomes as this study, profiling analyses could be undertaken to identify individuals at greater risk of pathological health behaviours.

10.7 Limitations

10.7.1 Research design

The majority of questions in study 1 were original since there were no existing questions to represent specific strategic behaviours relating to health or evolutionary principles. While writing original questions allowed a higher degree of specificity to desired measures, the questions had not been tested for construct validity in previous research. A limitation of using original questions that had not been tested for construct validity (rather than standardised/validated questions) is that they may have been interpreted differently between participants; this may lead to between-participant inconsistencies. Conversely, in study 2, while an original data item was added to the questionnaire, it was not designed for the specific objectives of this research; however, the questions were reliable and had been tested in previous iterations of the NWMWBS. Questions in study 2 related to demographic and socio-economic circumstances, and health outcomes, and did not include specifically designed indicators of evolutionary strategies. A limited number of proxy measures were interpreted in adaptive terms (volunteerism for altruism and trust for cooperation), rather than designed measures which indicated evolutionary principles. For other elements of evolutionary theory, associations and predictive effects of demographic and socio-economic variables on health outcomes were used to imply, rather than measure strategic behaviour. Study 2 was valuable in highlighting the circumstances in which health risk behaviours arise, despite not quantifying the behavioural strategies which may govern them.

In study 1, demographic, socioeconomic and health behaviour questions were relatively unambiguous. For questions relating to evolutionary principles, potential ambiguity and

inaccuracies were highlighted when theoretically similar variables were combined and the resulting indices were found not to have good internal consistency. This implies that either a number of original questions did not adequately represent the identified evolutionary behavioural strategies, or that there was variability between participants' interpretation of the questions. This was not perceived to be a major limitation of this work since indices of evolutionary behaviour for reproduction, health and financial risk taking, health offsetting, and achievement striving were found to be acceptable in terms of their internal consistency. Health behaviour indices, including those relating to activity and exercise, and eating for pleasure or health were also found to have good internal consistency. Evolutionary behaviour indices that did not have good internal consistency were not used in analyses and single item measures were used to represent theoretical principles; these included measures for altruism, cooperation and trust, investing and, reviewing and planning behaviour. The single items chosen were the closest to identified principle; for example, the measure for altruism was whether an individual would donate a kidney to a non-kin person. There are limitations when using single item measures: Multiple dimensions of an identified principle are not combined, in this example an individual may be highly altruistic but not to the extent of donating a vital organ or they may have health conditions which preclude them from doing so. Construct validity is also less with single item measures. For life satisfaction models across large samples, multivariate indicators are suggested to be 16.0% more reliable than single item indicators (Lucas and Donnellan, 2011). The reduced predictive validity arising from using single item measures was an accepted limitation of this work.

There were limitations in terms of the evidence which supported the theoretical evolutionary strategies and the statistical justification for their combination. Some questions and indices were representative of well-established elements of evolutionary theory, such as the indices for reproduction, cooperation, trust and altruism. However, the questions designed to measure cooperation, trust and altruism had questionable construct validity since they did not associate with one another or have good internal consistency reliability when combined as indices. Other questions and indices were indirectly derived from theoretical principles, such as the indices for offsetting, investing, reviewing and planning, and achievement striving. There was inconsistent construct validity in capturing these principles in the original questions; questions for offsetting and achievement striving combined to give internally consistent indices, while questions for investing and, reviewing and planning did not, and single item measures were used.

Interpreting behaviour as evolutionary currencies in modern contexts was a key challenge of this research. It was an original objective of the work but an objective which was accompanied by potential limitations. It is important to acknowledge that evolutionary currencies may not extend to health behaviour in modern contexts; health behaviour may not be adaptive but may be

influenced by cultural and social cues which may have limited attachment to environmental conditions which are formative of adaptive behaviour. Where variables were associated and combined with good consistency it was assumed that they adequately represented a given evolutionary principle. However, it's possible that these variables simply represented similar behaviours which were associated to one another but did not represent evolutionary principles and were not undertaken in an adaptive way. Further work may clarify this by longitudinally measuring the variation in outcomes in terms of accepted evolutionary currencies. Assuming that questions and indices were representative of evolutionary principles, findings in this research suggest that health behaviours are likely to be adaptive, at least to some extent, owing to the directionality of the findings and the alignment with the theoretical framework. This exploratory research is not recommended to be definitive but a foundation on which further work may be built in order to further develop the evidence in support of this theory.

Many of the questions which indicated, or combined to indicate, behavioural strategies were binary or multiple choice. The idea being that complex decisions could be reduced into simple options; however, simplification along these lines is prone to missing useful information. Participants may agree with both options in a binary choice question; for example, a condom may make an individual 'feel safer during sex' and 'make sex less pleasurable'. Participants were encouraged to pick the statement they agreed with most but, assuming they understood the concept, the resulting data would not differentiate between an individual who favoured an option by 51.0% to 49.0%, or by 100% to 0%. Another limitation of questions of this type, which were written to represent behavioural strategies, is that many decision making processes are unconscious. Unconscious decision making may involve appraisals and trade-offs between evolutionary currencies, and result in adaptive behaviours, but the individual may not be aware of the decision making process. The questions in this study required conscious responses relating to a range of behaviours and may have answered questions differently to how they actually behaved. Similarly, an individual may answer questions based on ideal behaviour rather than actual behaviour, or may misperceive actual behaviour. Participants have been found to be more likely to report their conscious or ideal choices, particular when relating to health risk or hedonic behaviours, which may differ from their actual behaviours (Clark and Tifft, 1966). Participants have also been found to answer questions in line with perceived social norms, especially relating to health risk behaviour, such as drinking alcohol and smoking (Perkins and Berkowitz, 1986). Such inaccuracies or discrepancies in terms of how participants would like to behave, or how they believe their peers behave, compared to how they actually behave are difficult to quantify and potentially prone to reduced construct validity. Construct validity was also identified as an issue within the questionnaire tool. There were a number of questions which, on reflection, were not

sufficiently relevant to the research questions to be used in analyses; this issue should have been foreseen at the questionnaire design stage.

Recording indicators for health behaviour was occasionally problematic, especially for questions relating to unhealthy diets, drinking alcohol, smoking, violence and sexual health questions, some or all of which may be stigmatised behaviour. Participants may have tended to underestimate reporting of health risk behaviour, especially those relating to stigmatised practices. These questions are likely to have been underreported to a greater extent if participants were given the questionnaire by somebody they knew, as happened in 52.3% of cases, despite assurances regarding confidentiality and anonymity. The same is likely to be true in relation to the question of participants' weight; as previously discussed females may have been more likely to underreport their weight than males. The degree of measurement error arising from these limitations cannot be estimated but it is likely to have occurred at a fairly consistent rate throughout the sample. While acknowledged as a limitation, the health findings of this research were used relative to behavioural, developmental and environmental variables, and a margin of measurement error in the prevalence or extent of health risk behaviours would not undermine these relationships.

Eating preferences and behaviours were used and indicators of potential pathology rather than BMI for most analyses; these indicators may also be subject to some subjective inaccuracies which cannot be excluded. While previous piloting of the question to measure general eating preference indicated an acceptable level of construct validity, some participants might 'feel good' when they eat healthy foods or believe that their diet is healthy when it is not; similarly, participants may misunderstand what constitutes a portion of fruit or vegetables. This was accepted as a limitation and a potential margin for measurement error in the data.

In terms of lifestyle variables, one key factor was not included in the questionnaire which would have been useful in controlling for behavioural findings; whether participants were currently in a long term or stable relationship. Relationship status has been found to influence behavioural strategies and health behaviours (Winfield and Whaley, 2005; Fuller, 2010); future work using a similar methodology would benefit by controlling for current relationship status.

In terms of family and demographic variables, participants were not asked their exact age, but were asked to record their age group. Age was not perceived to be a key variable to control since this research was focussed on young adults but cognitive development continues through an adults' 20s and a continuous measure of age may have been useful for some analyses. While number of siblings and siblings' year of birth were asked, a further consequence of not recording age was that participants could not be categorised as eldest, youngest or middle siblings within their

families. Since evidence suggests birth order can influence behavioural strategies, such information would have been useful.

There were also some issues of measure validity within this questionnaire. Certain questions would not have been relevant for sub sections of the sample but these confounds were not controlled for in the analyses. For example, students would not have the opportunity to pay into a pension but would have been recorded at low investors; similarly individuals living in student houses would have typically reported low income despite having good potential to earn in the future. Whether participants were currently in long term relationships was also not recorded; a factor likely to shape behavioural strategies in various ways.

Questions relating to temporal perception were inadequate; questions which recorded how participants think 'most of the time' and what participants think when their 'mind wanders' were not sufficiently specific as single measures or combined to give a reliable indication of temporal perception. Standardised questions, or groups of questions, are available to measure temporal perception; however, there was a trade-off between gaining good quality reliable data and producing an accessible and manageable questionnaire tool which could yield a reasonably sized sample. Without including a range of specific questions relating to aspects of temporal perception, which would have substantially lengthened the questionnaire, it may have been better to omit the two questions which gave potentially unreliable data.

10.7.2 Data collection

For study 1, chain referral sampling, a variant of snowball sampling, was used to recruit participants and was considered an appropriate method of data collection. While chain referral sampling was efficient and adequate in generating meaningful public health data, the sample was potentially subject to biases that would not have been incurred via random sampling techniques. One identifiable bias was the skew of the sample in study 1 towards students and people educated to university level, which implies that the sample was not diverse in terms of the socioeconomic composition; levels of education have been associated with higher income and lower deprivation (Mayer, 2001). The representation of individuals from lower socioeconomic groups would likely have increased if the data collection period had been extended and a larger sample of participants was collected; just over half (52.7%) of participants reported knowing the person who gave them the questionnaire. Time for data collection and resources for incentives were a limitation to extending the data collection period in order to collect a larger sample with greater dispersion. While there wasn't equal participation between sociodemographic groups, the sample population

was not required to be representative of a given population and the potential skew of the sample was not considered to be a major limitation.

Study 2 used a clustered random approach of households but the majority of the questionnaires were collected during weekdays and between working hours; although an amount of sampling did occur on weekend days and until 8pm week nights. A randomised approach was likely to have reduced the potential skew of the sample but biases may still have arisen. In this case people who were out of the house and at work during conventional hours on weekdays were less likely to be sampled. This sample would have been appropriate to represent the population of the North West of England but weighted data were not used; as with study 1, it was the relationship between sociodemographic variables and health outcomes which informed the research questions.

10.7.3 Sample

There was a reasonable rate of completion for study 1 (25.1%), which was acceptable considering the comprehensive nature of the questionnaire tool. In study 2, participation was successful for 78.0% of the total visited addresses, which is a high rate of completion. The discrepancy is likely to be due to the nature of the data collection, where in study 1, participants were given the questionnaire and requested to complete and return in their own time, while in study 2 researchers visited addresses, requested immediate participation and led participants through the questionnaire.

The sex composition was similar between studies 1 and 2; both had a higher proportion of female, compared to male, participants. The difference was greater in study 2, which was comprised of 58.5% females. A slightly higher proportion of females might be expected in both samples since females have been found to donate more of their time than males (Simmons and Emanuele, 2007); whether this is also true of research participation is unclear. The secondary study may have been comprised of a higher proportion of female participants since the majority of participants were likely to have been recruited during working hours and males have higher rates of employment than women in the UK (ONS, 2013). The composition of age groups was similar between studies 1 and 2, where there were slightly fewer participants aged between 18 and 24 compared to participants age 25 to 30. Study 1 had a higher proportion of non-white participants. This is likely to be due to the larger proportion of higher education students in the sample who have a larger proportion of ethnic minority groups (21.0%; HESA, 2017) compared to the population of England and Wales (12.9%) and of the North West of England (9.8%; ONS, 2011). The differences in proportions of sex and age groups within samples, and the difference in ethnicity

between samples were not perceived to be major limitations; where there were significant differences between these groups, the effects were controlled for in predictive modelling.

Income categories were recorded in study 1, while deprivation and perception of income was recorded in study 2. These measures were useful for within study analyses but were not comparable between the two samples. The major difference between samples was in education level where 79.0% from study 1 reported being educated to university level compared to 15.5% from study 2; in 2014/15 the estimate of likelihood of a young person participating in Higher Education by age 30 in England was 48.0% (Department of Education, 2016). The relatively high proportion of well-educated participants in study 1 may be a reflection of the limited dispersal through socioeconomic and cultural groups. In study 1, the higher proportion of participants in higher education compared to the national average is likely to be a consequence of the limited dispersal of questionnaires from primary and secondary seeds, the majority of whom had worked or studied in higher education institutions. In study 2, the lower proportion of university educated participants compared to the national average may reflect the data collection methodology (the majority of which was done between working or studying hours during weekdays) and the relatively higher levels of deprivation and potentially lower participation rates in higher education in the North West of England (Department for Communities and Local Government, 2016). Owing to the extent of the difference between samples it was determined that analyses involving education would not be meaningful.

There may have been limitations in terms of the characteristics of individuals willing to participate in study 1 (study 2 recruitment was predetermined for any given household). In any research, participating individuals are likely to be above average in terms of their altruistic tendencies, since (assuming they do not get financial or other rewards) they are required to give their time for the benefit of the research; they may also be more cooperative and trusting, that research data would remain confidential. While these characteristics may not be relevant for many research projects, this research sought to group people based on evolutionary strategies. While the sample as a whole may be above average in terms of these traits, compared to the general population, there was still variation within the sample, and this limitation was not thought to undermine findings.

Sample size calculation for the exploratory study 1 was not considered to be of great value (Jones, Carley and Harrison, 2004) but the final sample size was considered to be adequate. There may have been limitations in terms of reporting of some behaviours, which may have been expressed too infrequently for some analyses. For example, questions relating to moderation of health risk behaviours may have been expressed too infrequently for meaningful analyses. Young adults may be less likely to have suffered from pathology or adverse consequences of health risk behaviour

compared to older adults, and may not have considered motivations for reducing risky behaviour, such as binge drinking. In study 2, recruitment was continued until the target sample size was reached; the sample was considered to be sufficient to provide for likely effects.

10.7.4 Analysis

Limitations associated with BMI were discussed in section 10.4.1. In addition to the likely underreporting of weight, findings from this research imply that there are further confounding factors which undermine analyses using BMI. These findings suggest that risky eating behaviour does not necessarily result in pathology in terms of overweight and obesity, at least among young adults. If BMI was an accurate measure of eating behaviour, despite being underreported, then BMI data would likely have been associated with the index for eating for pleasure or health. Body weight among risky eaters may be moderated by exercise and physical activity, and there is likely to be variation between individuals in terms of the physiological processes which store excess energy as subcutaneous fat. Even if excess food consumption does not result in an increase in body weight for some individuals, risky eating still poses potential risks to long term health, such as type-2 diabetes, malnutrition or organ damage. BMI was used in analyses (and was dichotomised using standard categorisations for overweight and obese, normal and underweight) but the index for risky eating was considered a valid indicator of potential long term pathology.

Where continuous data were dichotomised, one standard deviation above or below the mean was used. Whether below or above the mean was typically decided to group the riskiest or least healthy participants, and compare this group to the rest of the sample population. The rationale for this was that the research sought to identify the strategies and conditions which governed or underpinned health risk behaviour and, it was hoped that the greatest contrasts could be identified by comparing the highest risk individuals to the majority of the sample.

Where categorical data were dichotomised the following limitations were identified. In studies 1 and 2 ethnicity was categorised white and non-white. While there were several significant findings from analyses with ethnicity, there are limitations involved with grouping black and minority ethnic groups together. In addition to cultural variations, there are variations in behaviour and pathology (section 10.4.1) between ethnic minority groups. While combining ethnic minority groups averages these variations, the dichotomised data were useful in controlling for the broad effects of ethnicity when examining other variables.

Similarly, in studies 1 and 2, employment categories were dichotomised as participants in full time employment and those not in full time employment. Those not in full time employment

included participants who were students, unemployed and working part time. Each of these subcategories of employment status was likely to have different lifestyle and socioeconomic circumstances. The limitations arising from this categorisation were accepted since the principal purpose of analyses was to isolate participants who were financially secure owing to being employed full time. While those not employed full time were likely to have contrasting economic circumstances and potential to earn (for example full time students may have greater future earning potential compared to unemployed participants), both were likely to be relative financially insecurity at the time of the research compared to participants in full time employment.

Education was dichotomised into participants who had received, or were currently in, higher education and those that were not. While there were no obvious limitations with this categorisation, as higher education represented an investment of time and money for a future benefit, as previously discussed, the groups between samples were substantially different (and both samples were substantially different to the national average). Analyses using education were not considered to be meaningful for this reason.

In study 1, the question relating to income had questionable test validity since it related to household income; a student living alone would report a household income to be substantially less than a student living in a group, despite both having the same economic circumstances. This question was then dichotomised into high and low, high being household income over £700 per week. Similar to employment, this categorisation sought to group participants who were financially secure. Study 2 categorised deprivation so that individuals who lived in the most and the 2nd most deprived areas were grouped, while those in the 3rd, 4th and least deprived areas were grouped. There was no clear evidence to inform these categorisations. There was a also a limitation in the assignment of participants to each quintile, since individuals may have lived in a more or less deprived sub-set area for that LSOA compared to the broad deprivation rank. The questionable content validity for these measures were accepted as limitations but were not thought to have undermined findings.

In terms of development, in study 1 participants were divided into groups that had lived with both parents until the age of 16 and those that had not, this was not perceived to be a limitation since evidence suggests that health outcomes vary between single or no parent households, and two parent households. In terms of childhood experience, study 1 divided the index using 1 standard deviation below the mean, while study 2 grouped participants into those reporting happy and non-violent childhoods and those reporting unhappy and/or violent childhoods. This was not perceived to be a limitation of analyses since adverse childhood experiences, whether recognised by the

participants or not (i.e. violent but happy childhoods), were likely to have altered behavioural and health outcomes compared to happy and non-violent childhoods.

In terms of health indicators, self-perceived fitness and healthiness was dichotomised into participants who perceived themselves to be fit and healthy and those that perceived themselves to be unfit and/or unhealthy. The limitations with analyses involving this question were more likely to arise from misperceptions rather than the categorisation process, where unfit or unhealthy participants may have perceived themselves to be fit and healthy. Participants may be likely to underreport poor fitness and healthiness, or participants may have believed that a lack of pathology, such as overweight or obesity, despite an unhealthy lifestyle, may indicate fitness and healthiness. Childhood weight was also self-reported and, consistent with adult BMI, the same categorisations of overweight and healthy weight or 'skinny' were used.

In studies 1 and 2, daily fruit and vegetable intake was dichotomised as low (two or less portions per day) or high (three or more portions per day). While international and national guidance recommends 400g of fruit and vegetables per day (approximately five portions) categorisation for this question sought to identify the least healthy or highest risk taking participants.

There were accepted limitations in the categorisation of alcohol consumption in both studies. In study 1 frequency of drinking was dichotomised as low (drinking on two or less occasions per week) and high, (drinking on three or more occasion per week), and binge drinking was dichotomised as low (drinking five or more drinks on one occasion weekly or less) and high (drinking five or more drinks on five or more occasions per month). Study 2 sought to replicate these categorisations for consistency but with different indicators; weekly drinking was categorised as low (less than 25 units per week) and high (25 units or more per week), and binge drinking was dichotomised as low (drinking six or more drinks on one occasion weekly or less) and high (drinking six or more drinks on five or more occasions per month). It wasn't possible to dichotomise drinking categories according to safe drinking guidelines as question boundaries were not set to recommended limits, and since recommended limits are sex-specific. A further limitation was that questions were different between studies, particularly in terms of drinking frequency in study 1 and units consumed in study 2. The importance of these categorisations was to differentiate between health risk behaviour and reduced risk behaviour. In all categorisations the relatively more frequent or higher quantity consumers of alcohol were drinking at levels which would be likely to pose a risk to long term health, whether more than two occasions per week, binge drinking (at least five drinks) more frequently than weekly, or consuming more than 25 units per week.

In studies 1 and 2, smoking cigarettes was categorised as current daily smokers compared to non-current daily smokers. The limitation with this grouping may be that individuals may smoke but not daily, which could pose a close to equal health risk as smoking daily. This was accepted as an analytical limitation.

In study 1, violence was dichotomised as participants who reported having a violent fight in the last 12 months and those that did not. While some participants reported one fight, of which they may have been an unwilling participant and, others reported substantially more, and may have been the perpetrators of the violence, a split using one standard deviation above or below the mean would have given particularly unbalanced groups owing to the distribution of participant responses; the mean was 0.40 and the standard deviation was 2.744 (one standard deviation above the mean would have given a group of 366 and group of 11).

In terms of childhood experience, there may have been limitations owing to the relationship between childhood experience and adult well-being. The measures for childhood experience were reported retrospectively and adults suffering with low or high adult well-being may have shown recall bias; a wider range of validated questions may have assisted in reducing these inaccuracies. As with other questions, participants' emotional states may have affected responses at the time of questionnaire completion. There were no changes to the methodology which would have reduced these limitations, and they were accepted as potential measurement errors.

There was some complexity around the use of the physical activity index. It is acknowledged that this index was both theoretically a health outcome and a behavioural strategy. Since it represents investment health behaviour. Analyses considered the index for physical activity in these simultaneous terms; chapter 7 considered the associates and predictors of physical activity and exercise, while the latent profiling analysis used the index as an indicator variable. This simultaneous use of a variable was a limitation; however, theoretically the index was likely to be a valid variable in both contexts. Future work may seek to clarify and separate the data items which contributed to both the health outcome and the strategic behaviour.

There were some limitations with respect to the latent profiling analysis. The main limitation was that each cluster was defined by its predominant characteristics despite being comprised of demographically and behaviourally diverse participants. Despite being defined in terms of higher or lower proportions or behavioural scores, in some cases, proportions of individuals within each cluster were inconsistent with the defining characteristics. For example, cluster 3 was described as the most ethnically diverse cluster, despite containing 68.1% white participants. Accurate descriptive language of clusters attempted to mediate the effects of this limitation. There were

also sample limitations when conducting latent profiling analysis; samples too large yield models with unworkable numbers of distinct profiles and samples too small yield unreliable or non-significant findings. Study 2 was also limited in terms of the indicator variables required to define clusters; therefore, profiling analysis was not conducted.

10.8 Original elements of this research

There were several elements of this research which were novel and original. An important novel aspect of this work was bringing together key factors known to affect health risk behaviours, including childhood experience, demographic and socioeconomic factors. There has been extensive research on each key factor but rarely have they been considered in conjunction and for a range of health risk behaviours. This original element was important in understanding the nature and direction of each key factor in relation to other determinants. This research also interpreted contemporary behavioural choices as evolutionary strategies, which was a key original element of this exploratory research. Each strategy was logically constructed in light of existing evidence and evolutionary theory but there were limitations with this practice. Among the most pertinent of the identified limitations was the issue of conscious and unconscious decision making, and particularly whether conscious self-reporting of behaviour would reflect actual behaviour. However, considering the adaptive value of health behaviours is likely to be a useful tool in understanding and contextualising poor health choices and could be helpful in informing preventative interventions and secondary treatments. Finally, behavioural strategies have not been used to create profiles of individuals, with known sociodemographic parameters, with associated health risk behaviours. If replicated for a representative sample, profiling of this kind can be used to compare predicted health behaviours with recorded outcomes and potentially identify at-risk individuals within a given population.

10.9 Strengths of this research

In addition to the original elements, there were several key strengths of this research. This work was undertaken using established methodological procedures in order to ensure findings were reliable, high quality and could provide a robust platform upon which further research could be developed. Combining a bespoke questionnaire designed for the hypotheses of this work with a regional survey allowed for specific research questions to be addressed while providing the opportunity to contextualise findings across a larger sample. Findings across studies 1 and 2 built upon existing evidence that developmental experiences and socioeconomic conditions are key determinants behavioural strategies and health outcomes. Studies 1 and 2 also provided the opportunity to consider indicator variables or groups of theoretically similar variables as evolutionary strategies and, while findings were more nuanced, data allowed for exploratory

research questions to be adequately addressed. Evolutionary strategies and health outcomes were also used to identify behaviourally similar clusters of participants, which were described in term of their demographic and socioeconomic compositions.

Considering behavioural strategies in adaptive terms was a key strength of this work as it provided the opportunity to gain a greater understanding of why seemingly maladaptive health risk behaviours are undertaken. This work suggests that childhood experiences and socioeconomic inequality are key determinants of behavioural strategies, but crucially that such strategies are likely to be adaptive. The relationships between adaptive strategies and health risk behaviours may provide a valuable foundation for further research. Unhealthy behaviours can also carry social stigma and research that demonstrates that health risk behaviour may be optimal given an individual's subjective and environmental circumstances is likely to enable greater empathy and reduce the emphasis on individual responsibility by academics and practitioners.

Health decision making, like any contemporary human behaviour, is extremely complex and while this exploratory research cannot provide definitive recommendations for policy makers it may help to adjust the existing paradigm of the obesity problem and other health risk behaviours. Understanding the key determinants of health risk behaviours and considering behaviour in adaptive terms may enable a greater understanding for researchers, policy makers and practitioners of how and why unhealthy and pathological behaviours occur. Improving the accuracy of predicting the circumstances and experiences from which health risk behaviours arise can lead to improvements in the effectiveness of applied preventative interventions and secondary treatments.

10.10 Conclusions

Health risk behaviours cause or greatly increase the risk of NCDs, which account for almost two-thirds of global deaths each year. Public health responses to support moderate consumption of food and drink, to improve poor quality diets, to increase physical activity, and to reduce harmful consumption of alcohol and cigarettes have largely been ineffective. This research applied an evolutionary interpretation of health risk behaviours in order to better understand why pathological behaviours are undertaken despite greatly increasing the risks of morbidity and mortality. If pathological behaviour could be demonstrated to be adaptive, or optimal in evolutionary terms, a greater understanding could be reached as to why harmful behaviours are undertaken, the circumstances in which they arise and how public health responses could be improved.

Human behaviour can be innate or learned, and evolutionary science recognises that environmental pressures contribute to behavioural trait distribution. Behaviours can change over time and with changing circumstances but often remain constant in the short term; well-defined behaviours achieved through non-genetic means can become successful evolutionary strategies. Natural selection acts when there is variation among traits, variation in reproductive success and a relationship between traits and reproductive success. It has also been suggested that inheritability of traits is a key factor for natural selection to act, but human behaviour can be changed depending on developmental, subjective or environmental factors. This research, in support of existing evidence, suggests that behaviour is adaptive despite not being heritable and non-genetic mechanisms can be analogous to biological inheritance.

Findings from this research supports clear existing evidence that people from lower socioeconomic groups exhibit higher health risk behaviours and have poorer health outcomes. Behavioural strategies were identified using evolutionary principles and such strategies were found to be determined by environmental circumstance. This research demonstrated that socioeconomic environments are likely to shape strategies which govern unhealthy behaviour and are associated with, or predictive of, reproductive strategy, trust, altruism, cooperation and investing behaviour. If health behaviours could be predicted from environmental variables and strategic characteristics, they are likely to be adaptive. Risky behaviour may be optimal when the long term benefits of acting for good health is lower, or perceived to be lower, than the short term benefits derived from the behaviour.

The effect of developmental variables on health behaviour was also evidenced in this research; whether relating to parental circumstances, familial support, social support or childhood experience. There is clear evidence that adverse childhood experiences change neurobiological pathways which govern behaviour; such modifications are suggested to be adaptive (Danese and McEwen, 2012). Such strategies may persist into adulthood, implying once adaptive strategies may become maladaptive if environmental conditions change to become more favourable. Modifications in the development of neural pathways may also inhibit the development of higher order, cognitive affective functions, meaning individuals may be unable to regulate unhealthy behaviours regardless of environmental circumstance. Whether short term strategies are the products of current environmental conditions or relics of inhibited development, the resulting health risk behaviours can be discussed as adaptive or once adaptive.

Health risk behaviours were found to be associated and predictive of one another; particularly eating for pleasure, drinking alcohol and smoking cigarettes. These findings suggest health risk behaviours may be governed by the same or similar behavioural strategies. Financial risk taking

and financial investment decisions were also found to be associated and predictive of health risk behaviours, meaning the currencies of wealth (an accepted evolutionary currency) and health are highly likely to be similarly appraised and governed.

It is accepted that there are alternate explanations or causal pathways regarding the associative and predictive nature of relationships identified here; the broad determinants of developmental experience and socioeconomic conditions and the diverse range of health outcomes. It is also acknowledged that this thesis brings together two complex fields of science and that it was challenging to identify and control for all of the influencing factors of health risk behaviour; of particular relevance may be cultural factors, which were not accounted for here. However, significant findings were found for a range of theoretical and identified evolutionary strategies, relating to reproduction, risk taking, altruism, cooperation, trust, offsetting, investing, reviewing decisions, planning for the future and achievement striving. After controlling for other factors: Reproductive strategy was found to be predictive of BMI; health offsetting was found to be predictive of risky eating behaviour and physical activity; investing behaviour was found to be predictive of BMI, general health risk taking, binge drinking, current daily smoking, and violence; altruism was found to be predictive of eating preference; trust was found to be predictive of general health risk taking, current daily smoking, and physical activity; cooperation was found to be predictive of current daily smoking; community belonging was found to be predictive of binge drinking; and, planning was found to be predictive of current daily smoking, and risky sexual practices.

These findings across two independent samples suggest that health behaviours are likely to be adaptive. Health risk behaviours are likely to be adaptive when an individual is living in an adverse environment of some description, when the behaviour enables pleasure, improved mental health or avoidance of worse mental health, and when such benefit outweighs the potential long term physical health costs. Health risk behaviours are suggested to be maladaptive when an individual's psychological mechanisms are impaired or higher control diminished (whether due to adverse developmental experiences or poor adult well-being), creating an inaccurate cost-benefit 'appraisal' or misperception of environmental conditions. The exploratory nature of this work may give rise to more questions than definitive answers but this research suggests that risky health behaviours and pathological outcomes may be governed by often adaptive strategies which are largely shaped by the complex interactions of developmental experiences and environmental conditions. This research highlights that there is likely to be value in understanding the evolutionary context surrounding health behaviour.

This research strongly supports existing evidence that childhood experiences and socioeconomic inequality are the key determinants of behavioural strategies and health outcomes. Interventions which seek to reduce health risk behaviours must seek to change behavioural strategies by improving childhood experiences, and socioeconomic environments, specifically by reducing poverty and by providing equal opportunities for education, employment and personal growth.

11. REFERENCES

Abate, N. and Chandalia, M. (2003). The impact of ethnicity on type 2 diabetes. Journal of Diabetes and its Complications. 17. 39-58.

Abel, J.R., Deitz, R. and Su, Y. (2014). Are Recent College Graduates Finding Good Jobs? Current Issues in Economics and Finance. 20. 1. 1-8.

Adams, J. (2009) The mediating role of time perspective in socio-economic inequalities in smoking and physical activity in older English adults. Journal of Health Psychology. 14. 794–799.

Adams, J. and White, M. (2009) Time perspective in socioeconomic inequalities in smoking and Body Mass Index. Health Psychology. 28. 83–90.

Adams, J., Mytton, O., White, M. et al. (2016). Why Are Some Population Interventions for

Adler, N.E., Boyce, W.T., Chesney, M.A. et al. (1993). Socioeconomic inequalities in health - no easy solution. Journal of the American Medical Association. 269. 3140–3145.

Adler, N.E. and Stewart, J. (2010). The biology of disadvantage: socioeconomic status and health. New York: John Wiley & Sons. 2.3 Human history.

Agresti, A. (2002). Categorical Data Analysis. Second Edition. Wiley Interscience.

Aiello, L.C. and Wheeler, P. (1995). The expensive tissue hypothesis: the brain and the digestive system in human and primate evolution. Current Anthropology. 46. 126-170.

AIHW. (2004). The relationship between overweight, obesity and cardiovascular disease. Canberra: Australian Institute of Health and Welfare and National Heart Foundation of Australia. (Cardiovascular Disease Series No. 23).

Ainslie, G. (1975). Specious reward: A behavioral theory of impulsiveness and impulse control. Psychological Bulletin. 82. 463–496.

Akinson, R. and Flint, J. (2001). Accessing hidden and hard to reach populations: snowball research strategies. Social Research Update. 33: 33–41.

Alden-Smith, E. (2004). Why do good hunters have higher reproductive success. Human Nature. 15. 4. 343-364.

Allison, K.R., Adiaf, E.M., Ialomiteanu, A. et al. (1999). Predictors of health risk behaviours among young adults: analysis of the National Population Health Survey. Canadian Journal of Public Health. 90. 2. 85-89.

Anda, R.F., Felitti, V.J., Bremner, J.D. et al. (2006). The enduring effects of abuse and related adverse experiences in childhood: A convergence of evidence from neurobiology and epidemiology. European Archives of Pschiatry and Clinical Neuroscience. 256. 3. 174-186.

Anderson, A.S. and Morris, S.E. (2000). Changing fortunes: Changing food choices. Nutrition and Food Science. 30. 12–15.

Andersson, M. (1994). Sexual selection. Princeton, NJ: Princeton University Press.

Andreasen, C.H., Stender-Petersen, K.L., Mogensen MS, et al. (2008). Low physical activity accentuates the effect of the FTO rs9939609 polymorphism on body fat accumulation. Diabetes. 57. 1. 95-101.

Ang, S., Van Dyne, L., Koh, C. et al. (2007). Cultural Intelligence: Its Measurement and Effects on Cultural Judgment and Decision Making, Cultural Adaptation and Task Performance. Management and Organization Review. 3. 3. 335–371.

Appleton, K.M., Woodside, J.V., Yarnell, J.W. et al. (2007). Type A behaviour and consumption of an atherogenic diet: no association in the PRIME study. Appetite. 49. 3. 554-560.

Araneta, M.R.G., Wingard, D.L. and Barrett-Connor, E. (2002). Type 2 diabetes and metabolic syndrome in Filipina-American women: a high risk nonobese population. Diabetes Care. 25. 494-499.

Ashton, T.S. (1998). The Industrial Revolution, 1760-1830 (C Opus T Opus N).

Ashton, K.A., Drerip, M., Windover, A. et al. (2007). Brief, four-session group CBT reduces binge eating behaviors among bariatric surgery candidates. Surgery for Obesity and Related Diseases. 5. 2. 257–262,

Axelrod, R. and Hamilton, W.D. (1981). The Evolution of Cooperation. Science. 211. 1390–1396.

Bacon, L., Keim, N.L., Van Loan, M.D. et al. (2002). Evaluating a 'non-diet' wellness intervention for improvement of metabolic fitness, psychological well-being and eating and activity behaviors. International Journal of Obesity. 26. 854–865.

Bakk, Z., Tekle, F.B. and Vermunt, J.K. (2013). Estimating the association between latent class membership and external variables using bias-adjusted three-step approaches. Sociological Methodology. 43. 1: 272–311.

Barboza, D. (2003). Food giant puts health initiative on the table. International Herald Tribune, July 2, 2003. http://www.iht.com/articles/101495.html (Accessed 19th February 2014).

Barnes, G.M., Welte, J.W., Tidwell, M.C.O. et al. (2013). Effects of neighborhood disadvantage on problem gambling and alcohol abuse. Journal of Behavioral Addictions. 2. 2. 82–89.

Barrett, L., Dunbar, R. and Lycett, J. (2002). Human evolutionary psychology. Princeton, NJ: Princeton University Press.

Barsh, G.S., Farooqi, I.S. and O'Rahilly, S. (2000). Genetics of body-weight regulation. Nature. 404. 644–651.

Bates, B., Lennox, A. and Swan, G. (2009). National diet and nutrition survey: headline results from year 1 of the rolling programme (2008/2009). London: Food Standards Agency.

Bateson, P. and Gluckman, P. (2011). Plasticity, Robustness, Development and Evolution. Cambridge: Cambridge University Press.

Baumeister, R.F., Campbell, J.D., Krueger, J.I. et al. (2003). Does high self-esteem cause better performance, interpersonal success, happiness, or healthier lifestyles?. American Psychological Society. 4. 1. 1-44.

BBC. (2015). http://www.bbc.co.uk/sport/35061399 [Accessed 11th April 2017].

Beaglehole, R and Yach, D. (2003). Globalisation and the prevention and control of non-communicable disease: the neglected chronic diseases of adults. Lancet. 362. 903–908.

Bechara, A., Damasio, H. and Damasio, A.R. (2000). Emotion, decision making and the orbitofrontal cortex. Cerebral Cortex. 10. 295–307.

Becker, G.S. and Murphy, K.M. (1988). A Theory of Rational Addiction. Journal of Political Economy. 96. 4. 675-700.

Becker, M.H. (1993). A medical sociologist looks at health promotion. Journal of Health and Social Behavior. 34. 1–6

Bell, A.C., Ge, K. and Popkin, B.M. (2002). The road to obesity or the path to prevention: motorized transportation and obesity in China. Obesity Research. 10. 277-283.

Bellis, M.A., Hughes, K., Jones, A. et al. (2013). Childhood happiness and violence: a retrospective study of their impacts on adult well-being. BMJ Open. 3:e003427.

Bellis, M.A., Lowey, H., Hughes, K. et al. (2012). Variations in risk and protective factors for life satisfaction and mental wellbeing with deprivation: a cross-sectional study. BioMed Central Public Health. 12: 492.

Belsky, J., Steinberg, L. and Draper, P. (1991). Childhood experience, interpersonal development, and reproductive strategy: An evolutionary theory of socialization. Child Development. 62. 4. 647-670.

Bendig, A.W. (1954). Reliability and the number of rating scale categories. The Journal of Applied Psychology. 38. 38-40.

Benjamin, D.K. (2001). Where Markets Meet the Environment. Perc Reports. 19. 1. 15-17.

Benzion,U., Rapoport, A. and Yagil, J. (1989). Discount rates inferred from decisions: An experimental study. Manage. Sci. 35. 270–284.

Bereczkei, T. and Dunbar, R.I.M. (1997). Female-biased reproductive strategies in a Hungarian Gypsy population. Proceedings of the Royal Society. London. B. 264. 1378. 17-22.

Bergman, M.M. and Scott, J. (2001). Young adolescents' wellbeing and health-risk behaviours: gender and socio-economic differences. Journal of Adolescence. 24. 183–197.

Berk, E.S., Kovera, A.J., Boozer, C.N., Pi-Sunyer, F.X. and Albu, J.B. (2006). Metabolic inflexibility in substrate use is present in African-American but not Caucasian healthy, premenopausal, nondiabetic women. JCEM. 91. 4099-4106.

Berkman, L. F., Glass, T., Brissette, I., and Seeman, T. E. (2000). From social integration to health: Durkheim in the new millennium. Social Science and Medicine. 51: 843–857.

Bertéus-Forslund, H., Klingström, S., Hagberg, H. et al. (2008). Should snacks be recommended in obesity treatment? a 1-year randomized clinical trial. European Journal of Clinical Nutrition. 62. 1308–1317.

Best, D., Lehmann, P., Gossop, M. et al. (2009). Eating Too Little, Smoking and Drinking Too Much: Wider Lifestyle Problems Among Methadone Maintenance Patients. Addiction Research. 6. 6. 489-498.

Bethell, C.D., Newacheck, P., Hawes, E. et al. (2014). Adverse Childhood Experiences: Assessing The Impact On Health And School Engagement And The Mitigating Role Of Resilience. Health Affairs. 33. 12. 2106-2115.

Bisset, S., Markham, W.A. and Aveyard, P. (2006). School culture as an influencing factor on youth substance use. Journal of Epidemiology and Community Health. 61.485-490.

Bjorck, I., Granfeldt, Y., Liljeberg, H. et al. (1994). Food properties affecting the digestion and absorption of carbohydrates. American Journal of Clinical Nutrition. 59: 699S–705S.

Black, M.C. (2011). Intimate partner violence and adverse health consequences: implications for clinicians. American journal of lifestyle medicine. 5. 5. 428-439.

Blanden, J. and Macmillan, L. (2014), Education and intergenerational mobility: help or hindrance? DoQSS Working Paper No. 14-01, Institute of Education. University of London.

Blane, D., Davey, G. and Hart, C. (1999). Some social and physical correlates of intergenerational social mobility: evidence from the West of Scotland Collaborative Study. Sociology. 33: 169–183.

Bliege-Bird, R., Smith, E. A. and Bird, D.W. (2001). The hunting handicap: Costly signaling in human foraging strategies. Behavioral Ecology and Sociobiology. 50. 9-19.

Bloomfield, K., Gmel, G. and Wilsnack, S. (2006). Introduction to special issue 'gender, culture and alcohol problems: a multi-national study. Alcohol and Alcoholism. 41. 1. pp. i3–i7.

Bobo, J.K. and Husten, C. (2000). Sociocultural influences on smoking and drinking. Alcohol Research and Health. 24. 4. 225-232.

Bøckman, P. (2011). Can wild animals become overweight? By Ingrid Spilde. http://sciencenordic.com/can-wild-animals-become-overweight (Accessed 5th March 2014).

Bogg, T. and Roberts, B. W. (2004). Conscientiousness and health-related behaviors: A meta-analysis of the leading behavioral contributors to mortality. Psychological Bulletin. 130. 887-919.

Bolhuis, J. J., Brown, G. R., Richardson, R. C., and Laland, K. N. (2011). Darwin in mind: New opportunities for evolutionary psychology. PLoS Biology. 9. 7. 1-8.

Bolte, G., Tamburlini, G., Kohlhuber, M. (2010). Environmental inequalities among children in Europe-evaluation of scientific evidence and policy implications. European Journal of Public Health 20. 14-20.

Boniface, S., Kneale, J and Shelton, N. (2014). Drinking pattern is more strongly associated with under-reporting of alcohol consumption than socio-demographic factors: evidence from a mixed-methods study BMC Public Health. 14. 1297. DOI: 10.1186/1471-2458-14-1297.

Boorse, C. (1977). Health as a theoretical concept. Philosophy of Science. 44. 4. 542-573.

Borgerhoff-Mulder, M. (1998). The demographic transition: Are we any closer to an evolutionary explanation? Trends in Ecology and Evolution. 13. 266–270.

Borgerhoff-Mulder, M. and Beheim, B.A. (2011). Understanding the nature of wealth and its effect on human fitness. Philosophical Transactions of the Royal Society. B. 366. 344-356.

Bortz, W.M. (2005). Biological Basis of Determinants of Health. American Journal of Public Health. 95. 3. 389-392.

Bowling, A. (1997). Research Methods in Health: Investigating Health and Health Services. Buckingham: Open University Press.

Boyd, E.M. and Fales, A.W. (1983). Reflective learning key to learning from experience. Journal of Humanistic Psychology. 23. 2. 99-117.

Bradbury, J.W. and Vehrenkamp, S.L. (1998). Principles of animal communication. Sunderland, MA: Sinauer. ISBN 0-87893-1007.

Bradley, R.H. and Corwyn, R.F. (2002). Socioeconomic Status and Child Development. Annual Review of Psychology. 53. 371–399.

Brady, H.E. and Kaplan, C.S. (2000). Categorically wrong? Nominal versus graded measures of ethnic identity. Studies in Comparative International Development 35. 3. 56–91.

Braveman, P. and Gottlieb, L. (2014). The Social Determinants of Health: It's Time to Consider the Causes of the Causes. Public Health Reports. 129. 2. 19–31.

Brener, N.D., Mcmanus, T., Galuska, D.A. et al. (2003). Reliability and validity of self-reported height and weight among high school students. Journal of Adolescent Health. 32. 4: 281–287.

British Nutrition Foundation. (2013). What are nutrients? http://www.nutrition.org.uk/healthyliving/basics/what-are-nutrients (Accessed 19 March 2014).

Brown, G., Wilding, R.E. and Coulter, R.L. (1991). Customer evaluation of retail salespeople using the SOCO scale: A replication extension and application. Journal of the Academy of Marketing Science. 9. 347-351.

Brown, R.E. and McFarland, D.J. (1979). Animal Behaviour. 27. 887.

Brown, S.A. (1997). Revolution at the checkout counter. Cambridge: Harvard University Press.

Brownson, R.C., Chriqui, J.F. and Stamatakis, K.A. (2009). Understanding Evidence-Based Public Health Policy. American Journal of Public Health. 99. 9. 1576–1583.

Bruch, H. (1961). Psychological aspects in overeating and obesity. Psychosomatics. 5. 269-274.

Brummett, B. H., Barefoot, J. C., Siegler, I. C. et al. (2001). Characteristics of socially isolated patients with coronary artery disease who are at elevated risk for mortality. Psychosom. Med. 63: 267–272.

Bundred, P., Kitchiner, D. and Buchan, I. (2001). Prevalence of overweight and obese children between 1989 and 1998: population based series of cross-sectional studies. BMJ. 322. 1–4.

Buss, D. M. (2009). How can evolutionary psychology successfully explain personality and individual differences? Perspectives on Psychological Science. 4. 4. 359-366.

Buss, D.M. and Schmitt, D.P. (1993). Sexual strategies theory: An evolutionary perspective on human mating. Psychological Review. 100. 2. 204-232.

Butland, B., Jebb, S., Kopelman, P. et al. (2007). Foresight Report: Tackling obesities: future choices—project report. London: Government Office for Science.

Buunk, P. (1997). Personality, birth order and attachment styles as related to various types of jealousy. Personality and Individual Differences. 23. 6: 997–1006.

Byrnes, J.P., Miller, D.C. and Schafer, W.D. (1999). Gender differences in risk taking: A meta-analysis. Psychological Bulletin. 125. 3. 367-383.

Cao, J., Galinsky, A.D. and Maddux, W.W. (2013). Does Travel Broaden the Mind? Breadth of Foreign Experiences Increases Generalized Trust. Social Psychological and Personality Science. 5. 5: 517-525.

Caballero, B. (2005). A nutrition paradox - underweight and obesity in developing countries. The New England Journal of Medicine. 352. 15. 1514-1516.

Cai, G., Cole, S.A., Butte, N. et al. (200^) A quantitative trait locus on chromosome 18q for physical activity and dietary intake in Hispanic children. Obesity (Silver Spring). 14. 1596– 1604.

Caldwell, J.C. and Caldwell, P. (1990). High fertility in sub-Saharan Africa. Scientific American. 262. 5.118-125.

Calow, P. (1982). Homeostasis and Fitness. The American Naturalist. 120. 3. 416-419.

Campbell, K. L. and J. W. Wood. (1987). Fertility in traditional societies. Natural Human Fertility: Social and Biological Mechanisms, ed. P. Diggory and S. Teper. London: Macmillan. 76-90.

Carstensen, L. L., Isaacowitz, D. M. and Charles, S. T. (1999). Taking time seriously: A theory of socioemotional selectivity. American Psychologist. 54. 165-181.

Carver, C.S. (2005). Impulse and constraint: Perspectives from personality psychology, convergence with theory in other areas, and potential for integration. Personality and Social Psychology Review. 9. 312-333.

Casey, B.J., Somerville,L.H., Gotlib, I. H. et al. (2011). Behavioral and neural correlates of delay of gratification 40 years later. Proceedings of the National Academy of Sciences. U.S.A. 108. 14998–15003.

Catalano, P.M., Thomas, A., Huston-Presley, L. et al. (2007). Phenotype of infants of mothers with gestational diabetes. Diabetes Care 30 (supplement 2). S156-S160.

Cavadini, C., Siega-Riz, A.M. and Popkin, B.M. (2000). US adolescent food intake trends from 1965 to 1996. Archives of Disease in Childhood. 83. 18–24.

Centers for Disease Control and Prevention. (2016). Adverse Childhood Experiences. ACEs. https://www.cdc.gov/violenceprevention/acestudy/ [Accessed 16th December 2016].

Centers for Disease Control and Prevention. (2016). Tips for Parents – Ideas to Help Children Maintain a Healthy Weight. https://www.cdc.gov/healthyweight/children/ [Accessed 22nd December 2016].

Centre for Diet and Activity Research. (2015). The rise of the takeaway: Number of takeaways in deprived areas increases substantially over two decades. http://www.cedar.iph.cam.ac.uk/blog/the-rise-of-the-takeaway/ [Accessed 22nd December 2016].

Chandawarkar, R.Y. (2006). Body contouring following massive weight loss resulting from bariatric surgery. Advances in Psychosomatic Medicine. 27. 61-72.

Chartier, M.J., Walker, J.R. and Naimark, B. (2009). Health risk behaviors and mental health problems as mediators of the relationship between childhood abuse and adult health. American Journal of Public Health. 99. 5. 847-854.

Chartier, M.J., Walker, J.R. and Naimark, B. (2010). Separate and cumulative effects of adverse childhood experiences in predicting adult health and health care utilization. Child Abuse and Neglect Journal. 34. 454–464.

Chinn, S., Rona, R.J. (2001). Prevalence and trends in overweight and obesity in three cross-sectional studies of British children, 1974–94. BMJ. 322. 24–26.

Chiolero, A., Faeh, D., Paccaud, F., Cornuz, J. (2008). Consequences of smoking for body weight, body fat distribution, and insulin resistance. American Society for Clinical Nutrition. 87. 4: 801-809.

Clark-Carter, D. (2014). z Scores. Wiley StatsRef: Statistics Reference Online.

Clark, J.P. and Tifft, L.L. (1966). Polygraph and Interview Validation of Self-Reported Deviant Behavior. American Sociological Review. 31. 4. 516-523.

Clark, S. and Muthén, B. (2009). Relating latent class analysis results to variables not included in the analysis. https://www.statmodel.com/download/relatinglca.pdf.

Clemens, L.H., Slawson, D.L. and Klesges, R.C. (1999). The effect of eating out on quality of diet in premenopausal women. Journal of the American Dietetic Association. 99: 442–444.

Coburn, S.S., Crnic, K.A., and Ross, E.K. (2015). Mother-child dyadic state behavior: Dynamic systems in the context of risk. Infant and Child Development. 24. 274-297.

Cochran, G. and Harpending, H. (2009). The 10 000 year explosion: How civilization accelerated human evolution. Basic Books Science.

Coelho, P.S. and Esteves, S.P. (2007). The choice between a five-point and ten-point scale in the framework of customer satisfaction measurement. International Journal of Market Research. 49. 3. 313-339.

Cogan, J.C. and Ernsberger, P. (1999). Dieting, weight, and health: reconceptualising research and policy. Journal of Social Issues. 55. 187–205.

Cohen, S., Janicki-Deverts, D. and Miller, G.E. (2007). Psychological Stress and Disease. The Journal of the American Medical Association. 298. 14. 1685-1687.

Coleman, J.S. (1958-59). Relational Analysis: The Study of Social Organizations with Survey Methods. Human Organization. 17: 28–36.

Colman, R. and Widom, C. (2004). Childhood abuse and neglect and adult intimate relationships: A prospective study. Child Abuse and Neglect. 28. 11. 1133–1151.

Colquitt, J.L., Picot, J., Loveman, E. et al. (2009). Surgery for obesity. Cochrane Database of Systematic Reviews. 2: CD003641.

Committee on Integrating Primary Care and Public Health; Board on Population Health and Public Health Practice; Institute of Medicine. (2012). Primary Care and Public Health: Exploring Integration to Improve Population Health. Washington (DC): National Academies Press (US); March 28 2012.

Connell, R.W. (2005). Hegemonic Masculinity: Rethinking the Concept. Gender and Society. 19. 6. 829-859

Cook, A., Pryer, J. and Shetty, P. (2000). The problem of accuracy in dietary surveys. Analysis of the over 65 UK National Diet and Nutrition Survey. Journal of Epidemiology and Community Health. 54. 611–616

Cornelsen, L. and Carriedo, A. (2015). Health-Related Taxes on Foods and Beverages. Food Research Collaboration: London.

Corsica, J. A. and Pelchat, M. L. (2010). Food addiction: True or false? Current Opinion in Gastroenterology. 26. 165–169.

Costa, P.T., McCrae, R.R. and Zonderman, A.B. (1987). Environmental and dispositional influences on well-being : Longitudinal follow-up on an American national sample. British Journal of Psychology. 78. 299-306.

Crawford, C. (2014). Socio-economic differences in university outcomes in the UK: drop-out, degree completion and degree class. IFS Working Paper W14/31. Institute for Fiscal Studies.

Crespo, C.J. Ainsworth, B.E., Keteyian, S.J. et al. (1999). Prevalence of physical inactivity and its relation to social class in U.S. adults: results from the Third National Health and Nutrition Examination Survey, 1988–1994 Medicine & Science in Sports & Exercise. 31. 12. 1821–1827.

Cristia, J.P. (2009). Rising mortality and life expectancy differentials by lifetime earnings in the United States. Journal of Health Economics. 28. 984–995.

Crocq, M.A. (2003). Alcohol, nicotine, caffeine, and mental disorders. Dialogues in Clinical Neuroscience. 5. 2. 175–185.

Cronk, L. (1991). Wealth status and reproductive success among the Mukogodo of Kenya. American Anthropologist. 93. 345-360.

Crouse, D.L., Ross, N.A. and Goldberg, M.S. (2009). Double burden of deprivation and high concentrations of ambient air pollution at the neighbourhood scale in Montreal, Canada. Social Science and Medicine. 69. 971-981.

Croxson, P.L., Walton, M.E., O'Reilly, J.X. et al. (2009). Effort-Based Cost–Benefit Valuation and the Human Brain. The Journal of Neuroscience. 29. 14. 4531– 4541.

Cubbin, C., LeClere, F.B. and Smith, G.S. (2000). Socioeconomic status and injury mortality: individual and neighbourhood determinants. Journal of Epidemiology and Community Health. 54. 517–524.

Cummins, S. and Macintyre, S. (2006). Food environments and obesity: neighbourhood or nation? International Journal of Epidemiology. 35. 100–104.

Cutler, D.M. and Lleras-Muney, A. (2006). Education and health: Evaluating theories and evidence. National Bureau of Economic Research. Paper prepared for the conference on "The Health Effects of Non-Health Policies", organized by the National Poverty Center. http://www.nber.org/papers/w12352.pdf [Accessed 1st December 2016]

Daar1, A. S., Singer, P. A. and Persad, D. L et al. (2007). Grand challenges in chronic non-communicable diseases. Nature. 450. 494-496.

Daelmans, B., Black, M.M., Lombardi, J. et al. (2015). Effective interventions and strategies for improving early child development. doi: http://dx.doi.org/10.1136/bmj.h4029 [Accessed 12th January 2017].

Dallman, M.F., Pecararo, N. and la Fleur, S.E. (2005). Chronic stress and comfort foods: self-medication and abdominal obesity. Brain, Behaviour and Immunity. 19. 275-280.

Dallman, M.F., Pecoraro, F. and Akana, S.F. (2003). Chronic stress and obesity: A new view of ‘‘comfort food’’. Proceedings of the National Academy of Sciences. 100. 20. 11696–11701.

Daly, M. and Wilson, M. (1988). Homicide. New York. Aldine De Gruyter.

Daly, M. and Wilson, M.I. (1999). Human evolutionary psychology and animal behaviour. Animal Behaviour. 57. 509–519.

Danese, A. and McEwen, B.S. (2012). Adverse childhood experiences, allostasis, allostatic load, and age-related disease. 106. 1. 29-39. doi: 10.1016/j.physbeh.2011.08.019.

Darmon, N. and Drewnowski, A. (2008). Does social class predict diet quality? The American Journal of Clinical Nutrition. 87. 5. 1107–1117.

Data Protection Act. (1998). Office of Public Sector Information. http://www.legislation.gov.uk/ukpga/1998/29/contents

Daugherty, J.R. and Brase, G.L. (2009). Taking time to be healthy: Predicting health behaviors with delay discounting and time perspective. Personality and Individual Differences. 48 . 202–207.

Davison, K.K. and Birch, L.L. (2001). Weight status, parent reaction, and self-concept in five-year-old girls. Pediatrics. 107. 46–53.

Dawkins, R. (1976). The selfish gene. New York Coty. Oxford University Press. ISBN 0-19-286092-5.

Dawkins, R. (1980). Good strategy or evolutionarily stable strategy? In: Sociobiology: beyond nature/nurture (Silverberg GWBJ, ed). Boulder, Colorado: Westview Press. 331-367.

Day, T. and Taylor, P. D. (1996). Evolutionary stable versus fitness maximizing life histories under frequency-dependent selection. Proceedings of the Royal Society. London. B. 263. 333-338.

de Castro, J.M., Brewer, E.M., Elmore, D.K. et al. (1990). Social facilitation of the spontaneous meal size of humans occurs regardless of time, place, alcohol or snacks. Appetite. 15. 2. 89-101.

De Haan, L., Boljevac, T. and Schaefer, K. (2010). Rural Community Characteristics, Economic Hardship, and Peer and Parental Influences in Early Adolescent Alcohol Use. The Journal of Early Adolescence. 30. 5. 629-650

De Leon, J., Rendon, D.M., Baca-Garcia, E. et al. (2007). Association between smoking and alcohol use in the general population: stable and unstable odds ratios across two years in two different countries. Alcohol Alcohol. 42. 3. 252-257.

Delgado, M.R., Frank, R.H. and Phelps, E.A. (2005). Perceptions of moral character modulate the neural systems of reward during the trust game. Nature Neuroscience. 8. 1611–1618.

Demetrius, L. and Ziehe, M. (2007). Darwinian fitness. Theoretical Population Biology. 72. 323–345.

Dennis, E.A., Flack, K.D. and Davy, B.M. (2009). Beverage consumption and adult weight management: A review. Eating Behaviors. 10. 4: 237–246.

Department for Communities and Local Government (DCLG). (2011). English indices of deprivation 2010. London: Department for Communities and Local Government.

Department for Communities and Local Government. (2016). English indices of deprivation 2015. https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015. [Accessed 23rd January 2017].

Department for Culture Media and Sport. (2011). Adult participation in sport. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/137986/tp-adult-participation-sport-analysis.pdf [Accessed 2nd December 2016].

Department for Environment, Food and Rural Affairs. (2015). More green space for our towns and cities. https://www.gov.uk/government/news/more-green-space-for-our-towns-and-cities [Accessed 22nd December 2016].

Department of Education. (2016). Participation Rates In Higher Education: Academic Years 2006/2007 – 2014/2015. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/552886/HEIPR_PUBLICATION_2014-15.pdf [Accessed 1st December 2016]

Department of Education. (2016). Participation Rates In Higher Education: Academic Years 2006/2007 – 2014/2015.

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/552886/HEIPR_PUBLICATION_2014-15.pdf. [Accessed 23rd January 2017].

Department of Health. (2003). Confidentiality: NHS Code of Practice – November 2003. http://nwpho.org.uk/IG

Department of Health. (2016). School meals - healthy eating standards. https://www.gov.uk/school-meals-healthy-eating-standards. [Accessed 22nd December 2016].

Devine, C.M. (2005). , A Life Course Perspective: Understanding Food Choices in Time, Social Location, and History. Journal of Nutrition Education and Behavior. 37. 121-128.Diet and Obesity More Equitable and Effective Than Others? The Role of Individual Agency. PLoS Medicine. 13. 4. 1-7.

Devine, C.M., Wolfe, W.S., Frongillo, E.A. (1999). Life-course events and experiences: association with fruit and vegetable consumption in 3 ethnic groups. Journal of the American Dietetic Association. 99. 3. 309-314.

DoH. (2011). Healthy lives, healthy people: A call to action on obesity in England. Department of Health. www.dh.gov.uk/publications.

DoH. (2012). Statistical press notice: national diet and nutrition survey: headline results from years 1, 2 and 3 combined (2008/09 – 2010/11). Department of Health. https://www.gov.uk/government/news/statistical-press-notice-national-diet-and-nutrition-survey-headline-results-from-years-1-2-and-3-combined-2008-09-2010-11 (Accessed 15th March 2014).

Dolnicar, S. and Grün, B. (2007). How constrained a response: a comparison of binary, ordinal and metric answer formats. Journal of Retailing and Consumer Services. 14. 108-122.

Dolnicar, S., Grün, B. and Leisch, F. (2011). Quick, simple and reliable: forced binary survey questions. International Journal of Market Research. 53. 231-252.

Dooley, D., Fielding, J. and Levi, L. (1996). Health and unemployment. Annual Review of Public Health. 1. 17:449-465.

Draper, P. (1989). African marriage systems: perspectives from evolutionary ecology. Ethology and Sociobiology. 10. 1-3. 145-169.

Drewnowski, A. (2009). Obesity, diets, and social inequalities. Nutrition Reviews. 67.1: S36-S39.

Drinkaware. (2016). Alcohol limits and unit guidelines https://www.drinkaware.co.uk/alcohol-facts/alcoholic-drinks-units/alcohol-limits-unit-guidelines/ [Accessed 22nd December 2016].

Drolet, A.L. and Morrison, D.G. (2001). Do we really need multiple-item measures in service research? Journal of Service Research, 3. 3. 196-204.

Duda, J.L. and Tappe, M.K. (1988). Predictors of Personal Investment in Physical Activity among Middle-Aged and Older Adults. Perceptual and Motor Skills. 66. 2. 543-549.

Duda, J.L. and Tappe, M.K. (1988). Predictors of personal investment in physical activity among middle-aged and older adults. Perceptual and Motor Skills. 66. 543-549.

Dugdale, A.E. and Griffiths, M. (1979). Estimating fat body mass from anthropometric data. The American Journal of Clinical Nutrition. 32. 2400-2403.

Dumuid, D., Olds, T., Lewis, L.K. (2016). Health-Related Quality of Life and Lifestyle Behavior Clusters in School-Aged Children from 12 Countries. The Journal of Pediatrics. 183. 178-183.

DuRant, R.H., Smith, J.A., Kreiter, S.R. et al. (1999). The Relationship Between Early Age of Onset of Initial Substance Use and Engaging in Multiple Health Risk Behaviors Among Young Adolescents. Archives of Pediatrics and Adolescent Medicine. 153. 3. 286-291.

Ebbeling, C. B, Pawlak, D. B. and Ludwig, D.S. (2002). Childhood obesity: public-health crisis, common sense cure. Lancet. 360. 473–82.

Ebbeling, C.B. and Ludwig, L.S. (2001). Treating obesity in youth: should dietary glycaemic load be a consideration? Advances in Pediatrics. 48. 179–212.

Ebbeling, C.D., Pawlak, D.B. and Ludwig, D.S. (2002). Childhood obesity: public health crisis, common sense cure. Lancet. 360. 473–82.

Edelman, B., Engell, D., Bronstein, P. et al. (1986). Environmental effects on the intake of overweight and normal-weight men. Appetite 7: 71–83.

Engström, L.M. (1986). The process of socialization into keep-fit activities. Scandinavian Journal of Medicine & Science in Sports, 8. 3. 89–97.

Ernst, C. and Angst, J. (1983). Birth Order Its Influence on Personality. Springer-Verlag Berlin Heidelberg New York. Chap 2.

Eshed, V., Gopher, A. and Hershkovitz, I. (2006). Tooth wear and dental pathology at the advent of agriculture: new evidence from the Levant. American Journal of Physical Anthropology. 130. 145–159.

Essock-Vitale, S.M. (1984). The reproductive success of wealthy Americans. Ethology and Sociobiology. 5. 45-49.

European Food Safety Authority. (2008). Concise database summary statistics - total population. available at: http://www.efsa.europa.eu/en/datexfoodcdb/datexfooddb.htm (Accessed 8th March 2014).

Ezzati, M., Lopez, A., Rodgers, A.D. et al. (2004). Murray CJL, eds. Comparative quantification of health risks: global and regional burden of disease attributable to selected major risk factors. Geneva: World Health Organization.

Felitti, V.J. (1993). Childhood sexual abuse, depression and family dysfunction in adult obese patients: a case control study. Southern Medical Journal. 86. 732– 6.

Felitti, V.J., Anda, R.F., Nordenburg D, et al. (1998). Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults: the adverse childhood experiences (ACE) study. American Journal of Preventive Medicine. 14. 245-258.

Fenning, R.M and Baker, J.K. (2012). Mother-Child Interaction and Resilience in Children with Early Developmental Risk. J Fam Psychol. 2012 Jun; 26(3): 411–420.

Fenning, R.M., Baker, J.K., Baker, B.L. et al. (2014). Parent-child interaction over time in families of young children with borderline intellectual functioning. Journal of Family Psychology. 28. 3. 326-335.

Ferguson, M.A., Gutin, B., Owens, S. et al. (1998). Fat distribution and hemostatic measures in obese children. The American Journal of Clinical Nutrition. 67. 1136–1140.

Fessler, D.M.T, Pillsworth, E.G. and Flamson, T.J. (2003). Angry men and disgusted women: An evolutionary approach to the influence of emotions on risk taking. Organizational Behavior and Human Decision Processes. 95. 107-123.

Fieder, M. and Huber, S. (2007). The effects of sex and childlessness on the association between status and reproductive output in modern society. Evolution and Human Behaviour. 28. 392-398.

Finch, C.E. and Tanzi, R.E. (1997). Genetics of aging. Science. 278. 5337. 407-411.

Finkelstein, E.A., Fiebelkorn, I.C. and Wang, G. (2003). National medical spending attributable to overweight and obesity: how much, and who's paying? Health Affairs. Millwood. W3 supplement. 219–226.

Finkelstein, E.A., Fiebelkorn, I.C. and Wang, G. (2004). State-level estimates of annual medical expenditures attributable to obesity. Obesity Research. 12. 18–24.

Finkelstein, E.A., Trogdon, J.G., Cohen, J.W. et al. (2009). Annual medical spending attributable to obesity: payer-and service-specific estimates. Health Affairs. Millwood. 28. 822–31.

Fisher, J. and Clayton, M. (2012). Who Gives a Tweet: Assessing Patients' Interest in the Use of Social Media for Health Care. Worldviews on Evidence-Based Nursing. 9. 2. 100-108/

Fitzgerald-Yau, N., Hale, D.R. and Viner, R.M. (2013). No longer a black and white question: gender and ethnic differences in multiple health risk behaviours (mhrbs) and their associated risk and protective factors. Poster Abstracts 52. S21–S113.

Flegal, K.M., Carroll, M.D., Ogden, C.L. et al. (2010). Prevalence and trends in obesity among US adults, 1999-2008. Journal of the American Medical Association. 303. 3. 235-41.

Fong, T.W. (2005). The Biopsychosocial Consequences of Pathological Gambling. Psychiatry. 2. 3: 22–30.

Ford, E.S., Galuska, D.A., Gillespie, C. et al. (2001). C-reactive protein and body mass index in children: findings from the Third National Health and Nutrition Examination Survey, 1988–1994. Journal of Pediatrics. 138. 486–492.

Foster, C., Hillsdon, M., Cavil, N. et al (2005). Understanding participation in sport: a systematic review. London: Sport England.

Fox, K. R. (1999). The influence of physical activity on mental well-being. Public Health Nutrition: 2(3a). 411-418.

FPH. (2010). Faculty of Public Health, Registered charity 263894. http://www.fph.org.uk/healthy_weight,_healthy_lives%3A_a_toolkit_for_developing_local_strategies

FPH. (2010). Faculty of Public Health, Registered charity 263894. http://www.fph.org.uk/healthy_weight,_healthy_lives%3A_a_toolkit_for_developing_local_strategies (Accessed 9th April 2014)

Frederick, G., Loewenstein, G. and Donoghue, T. (2002). Time discounting and time preference: A critical review. Journal of Economic Literature. 40. 350–401.

Freedman, D.S., Dietz, W.H., Srinivasan, S.R. et al. (1999). The relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa Heart Study. Pediatrics. 103. 1175–1182.

Frieden, T.R. (2010). A Framework for Public Health Action: The Health Impact Pyramid. Am J Public Health. 100. 4. 590–595.

Fuller, T.D. (2010). Relationship status, health, and health behavior: an examination of cohabiters and commuters. Sociological Perspectives. 53. 2. 221-246.

Gailliot, M. T. and Baumeister, R. F. (2006). Self-regulation and sexual restraint: Dispositionally and temporarily poor self-regulatory abilities contribute to failures at restraining sexual behavior.

Gallie, D., Paugam, S. and Jacobs, S. (2003). Unemployment, Poverty and Social Isolation: Is there a vicious circle of social exclusion? European Societies. 5. 1. 1-32.

Galor, O. (2005). From stagnation to growth: Unified growth theory. Handbook of Economic Growth 1. Elsevier. 171–293.

Gangestad, S. W. and Simpson, J. A. (2000). The evolution of human mating: trade-offs and strategic pluralism. Behavioral and Brain Sciences. 23. 573–644.

Gangestad, S. W. and Thornhill, R. (1997). The evolutionary psychology of extra-pair sex: the role of fluctuating asymmetry. Evolution and Human Behavior. 18. 69-88.

Gardner, J. and Oswald, A.J. (2006). Money and Mental Wellbeing: A Longitudinal Study of Medium-Sized Lottery Wins. IZA Discussion Paper No. 2233. http://ftp.iza.org/dp2233.pdf [Accessed 7th April 2017].

Gary S. Becker and Kevin M. Murphy (1988). A Theory of Rational Addiction. Journal of Political Economy. 96. 4. 675-700.

Gertler, P., Heckman, J., Pinto, R., et al. (2014). Labor market returns to an early childhood stimulation intervention in Jamaica. Science. 344. 998-1001.

Gesta, S., Tseng, Y.H. and Kahn, C.R. (2008). Developmental origin of fat: Tracking obesity to its source. Cell. 135. 2. 242-256.

Gildner, T.E., Barrett, T.M., Lieber, M. et al. (2015). Does BMI generated by self-reported height and weight measure up in older adults from middle-income countries? Results from the study on global AGEing and adult health (SAGE). BMC Obesity. 2. 44.

Gillis, L and Gillis, A. (2005). Nutrient inadequacy in obese and non-obese youth. Canadian Journal of Dietetic Practice and Research. Winter. 66. 4. 237-242.

Gillman, M.W., Rifas-Shiman, S.L. Frazier, A.L. et al. (2000). Family Dinner and Diet Quality Among Older Children and Adolescents. Archives of Family Medicine. 9. 3. 235-240.

Gillison, F., Stathi, A., Reddy, P. et al (2015). Processes of behavior change and weight loss in a theory-based weight loss intervention program: a test of the process model for lifestyle behaviour change. International Journal of Behavioral Nutrition and Physical Activity. DOI 10.1186/s12966-014-0160-6.

Glanz, K., Rimer, B.K. and Viswananth, K. (2008). Health behavior and health education theory, research, and practice 4th edition. John Wiley & Sons.

Glass, D. (1977). Behavior patterns, stress, and coronary disease. Hillsdale, New Jersey: Erlbaum.

Gliem, J. A. and Gliem, R. R. (2003). Calculating, Interpreting, and Reporting Cronbach's Alpha Reliability Coefficient for Likert-Type Scales. Midwest Research to Practice Conference in Adult, Continuing, and Community Education.

Gluckman, P. and Hanson, M. (2006). Mismatch: The lifestyle diseases timebomb. New York: Oxford University Press.

Golay, A. and Bobbioni E. (1997). The role of dietary fat in obesity. International Journal of Obesity. 21:S2–S11.

Goldman, D.P. and Smith, J.P. (2002). Can patient self-management help explain the SES health gradient? Proceedings of the National Academy of Sciences of the United States of America. 99. 10929–10934.

Goodman, A. and Koupil, I. (2009). Social and biological determinants of reproductive success in Swedish males and females born 1915–1929. Evolution and Human Behaviour. 30. 329-341.

Gordon-Larsen, P., McMurray, R.G. and Popkin, B.M. (2000). Determinants of adolescent physical activity and inactivity patterns. Pediatrics. 105: e83.

Gortmaker, S.L., Swinburn, B.A., Levy, D et al. (2011). Changing the future of obesity: science, policy, and action. Lancet. 378. 838–47.

Gottlieb, N.H. and Baker, J.A. (1986). The relative influence of health beliefs, parental and peer behaviors and exercise program participation on smoking, alcohol use and physical activity. Social Science & Medicine. 22. 9. 915-927.

Grabenhorst, F. and Roll, E.T. (2011). Value, pleasure and choice in the ventral prefrontal cortex. Trends in Cognitive Sciences. 15. 2. 56–67.

Grammer, K. and Thornhill, R. (1994). Human (Homo sapiens) facial attractiveness and sexual selection: the role of symmetry and averageness. Journal of Comparative Psychology. 108. 233-242.

Grano, N., Virtanen, M., Vaherta, J. et al. (2004). Impulsivity as a predictor of smoking and alcohol consumption. Personality and Individual Differences. 37. 1693-1700.

Grantham-McGregor SM, Fernald LC, Kagawa RM, Walker S. Effects of integrated child development and nutrition interventions on child development and nutritional status. Ann N Y Acad Sci2014;1308:11-32.

Grassi, M., Nucera, A., Zanolin, E. et al. (2007). Performance comparison of Likert and Binary formats of SF-36 version 1.6 across ECRHS II adult populations. Value in Health, 10. 6. 478-488.

Green, P.E. and Rao, V.R. (1970). Rating scales and information recovery: How many scales and response categories to use? Journal of Marketing. 34. 33-39.

Griffiths, P., Gossop, M., Powis, B. et al. (1993). Reaching hidden populations of drug users by privileged access interviewers: methodological and practical issues. Addiction. 88: 1617-1626.

Griskevicius, V., Tybur, J.M., Delton, A.W. et al. (2011). The influence of mortality and socioeconomic status on risk and delayed rewards: A life history theory approach. Journal of Personality and Social Psychology, 100. 6. 1015-1026.

Grogan, S. (1999). Body image: Understanding body dissatisfaction in men, women and children. London: Routledge.

Grossman, M. (1972). On the Concept of Health Capital and the Demand for Health. The Journal of Political Economy. 80. 2. 223-255.

Guerin, B. and Innes, J.M. (1984). Explanations of social facilitation: A review. Current Psychology. 3. 2. 32-52.

Gulliford, M., Figueroa-Munoz, J., Morgan, M. et al. (2002). What does 'access to health care' mean? Journal of Health Services Research & Policy. 7. 3. 186-188.

Gustafson, T.B. and Sarwer, D.B. (2004). Childhood sexual abuse and obesity. Obesity Reviews. 5. 129-135.

Gustafson, T.B. and Sarwer, D.B. (2004). Childhood sexual abuse and obesity. Obesity Reviews. 5. 129–135.

Guthrie, L.C., Butler, S.C. and Ward, M.M. (2009). Time perspective and socioeconomic status: A link to socioeconomic disparities in health? Social Science and Medicine. 68. 2145–2151.

Haddix, K. (2001). When polyandry falls apart: leaving your wife and your brothers. Evolution and Human Behaviour. 22. 47-60.

Hale, D.R., Fitzgerald-Yau, N. and Viner, R.M. (2014). American Journal of Public Health. 104. 5. 19-41.

Hale, D.R. and Viner, R.M. (2016). The correlates and course of multiple health risk behaviour in adolescence. BMC Public Health. 16. 458. DOI: 10.1186/s12889-016-3120-z.

Hall, K.D., Guo, J., Dore, M. et al. (2009). The progressive increase of food waste in America and its environmental impact. PLOS ONE. 4: e7940.

Hamilton, W. D. (1964). The genetical evolution of social behavior, Journal of Theoretical Biology. 7. 1-52.

Hansson, R.O., Hogan, R., Johnson, J.A. et al. (1983). Disentangling type A behavior: The roles of ambition, insensitivity, and anxiety. Journal of Research in Personality. 17. 186-197.

Hardin, G. (1968). The tragedy of the commons. Science. 162. 1243-1248.

Harding, A.H., Wareham, N.J., Bingham, S.A. et al. (2008). Plasma vitamin C level, fruit and vegetable consumption, and the risk of new-onset type 2 diabetes mellitus: the European prospective investigation of cancer--Norfolk prospective study. Archives of Internal Medicine. 168.14. 1493-1499.

Hare, T.A., Camerer, C.F. and Rangel, A. (2009). Self-Control in Decision-Making Involves Modulation of the vmPFC Valuation System. Science. 324. 5927. 646-648.

Harley, C.B. (1981). Learning the evolutionary stable strategy. Journal of Theoretical Biology. 89. 611-633.

Harnack, L., Stang, J. and Story, M. (1999). Soft drink consumption among US children and adolescents: nutritional consequences. Journal of the American Dietetic Association. 99. 436–441.

Hart, C.L. and Davey Smith, G. (2002). Relation between number of siblings and adult mortality and stroke risk: 25 year follow up of men in the Collaborative study. Journal of Epidemiology & Community Health. 57: 385–391.

Hartmann, A.S., Czaja, J., Rief, W. et al. (2010). Personality and psychopathology in children with and without loss of control over eating. Comprehensive Psychiatry. 51. 6. 572-578

Harvard School of Public Health. (2014). Genes are not destiny. http://www.hsph.harvard.edu/obesity-prevention-source/obesity-causes/genes-and-obesity/ (Accessed 20th March 2014).

Haselhuhn, M.P., Kennedy, J.A., Kray, L.J., et al. (2015). Gender differences in trust dynamics: Women trust more than men following a trust violation. Journal of Experimental Social Psychology, 56, 104–109. doi:10.1016/j.jesp.2014.09.007

Haski-Leventhal, D. (2009). Altruism and Volunteerism: The perceptions of altruism in four disciplines and their impact on the study of volunteerism. Journal for the Theory of Social Behaviour. 39. 3. 271–299.

Hassel, S., McKinnon, M.C., Cusi, A.M. et al. (2011). An Overview of Psychological and Neurobiological Mechanisms by which Early Negative Experiences Increase Risk of Mood Disorders. Journal of the Canadian Academy of Child and Adolescent Psychiatry. 20. 4. 277–288.

Hawkes, K., Hill, K and O'Connell, J.F. (1982). Why hunters gather: Optimal foraging and the Aché of eastern Paraguay. American Ethnologist. 9. 379–398.

Hawks, J., Wang, E.T., Cochran, G.M. et al. (2007). Recent acceleration of human adaptive evolution. Proceedings of the National Academy of Sciences. 104. 52. 20753.

Health and Social Care Information Centre. (2014). Health Survey for England 2014:Health, social care and lifestyles. http://www.hscic.gov.uk/catalogue/PUB19295/HSE2014-Sum-bklet.pdf

Heatherton, T.F., Herman, C.P. and Polivy, J. (1991). Restraint, weight loss, and variability of body weight. Journal of Abnormal Psychology. 100. 78-83.

Heckathorn, D. D. (1997). Respondent-driven sampling: A new approach to the study of hidden populations. Social problems. 44. 2: 174-199.

Heckathorn, D.D. (2011). Snowball versus respondent-driven sampling. Sociological Methodology. 41. 1: 355–366.

Heim, C. and Nemeroff, C.B. (2001). The role of childhood trauma in the neurobiology of mood and anxiety disorders: Preclinical and clinical studies. Biological Psychiatry. 49. 1023-1039.

Hendry, A.P., Kinnison, M.T., Heino, M. et al. (2010). Evolutionary principles and their practical application. Evolutionary Applications. 4. 159-183.

Hendry, A.P., Kinnison, M.T., Heino, M. et al. (2010). Evolutionary principles and their practical application. Evolutionary Applications. 4. 159-183.

Henrich, J. and McElreath, R. (2007). Dual-inheritance theory: the evolution of human cultural capacities and cultural evolution. In Oxford handbook of evolutionary psychology (eds R. Dunbar & L. Barrett). Oxford. UK: Oxford University Press.

Herskind, A.M., McGue, M., Holm, N.V. et al. (1996). The heritability of human longevity: A population-based study of 2872 Danish twin pairs born 1870-1900. Human Genetics. 97. 3. 319-323.

HESA. (2017). Students by ethnicity 2014/15. https://www.hesa.ac.uk/data-and-analysis [Accessed 23rd January 2017].

Hetherington, E. M., Cox, M., and Cox, R. (1979). Family interaction and the social, emotional, and cognitive development of children following divorce. In V. Vaughn & T. Brazelton (Eds.), The family: Setting priorities (pp. 174-201). New York: Science and Medicine.

Hettema, J.M., Prescott, C.A., Myers, J.M. et al. (2005). The structure of genetic and environmental risk factors for anxiety disorders in men and women. Archives of General Psychiatry. 62. 2. 182-189.

Hill, A.J. and Silver, E.K. (1995). Fat, friendless and unhealthy: 9-year old children's perception of body shape stereotypes. International Journal of Obesity. 19. 423–430.

Hill, J.O., Thompson, H. and Wyatt, H.W. (2005). Weight Maintenance: What's Missing? Journal of the American Dietetic Association. 105. 5. 63-66.

Hill, K. and Kaplan, H. (1999). Life History Traits in Humans: Theory and Empirical Studies. Annual Review of Anthropology. 28. 397-430.

Hill, K., Kaplan, H., Hawkes, K. et al. (1987). Foraging Decisions Among Ach Hunter-Gatherers: New Data and Implications for Optimal Foraging Models. Ethology and Sociobiology. 8. 1-36

Hinkle, L.E. (1974). The effect of exposure to culture change, social change, and changes in interpersonal relationships on health. Stressful life events: Their nature and effects , Oxford, England: John Wiley & Sons, xi, 340 pp.

HMRC. (2015). Personal income by tax year. HM Revenue and Customs. 2014-01-31. Available: https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/incomeandwealth/bulletins/householddisposableincomeandinequality/financialyearending2016 Accessed 10th November 2017.

Hoffman, D.J., Wang, Z., Gallagher, D. and Heymsfield, S.B. (2005). Comparison of visceral adipose tissue mass in adult African Americans and whites. Obesity Research. 13. 66-74.

Hofmann, W., Friese, M. and Wiers, R. (2008). Impulsive versus reflective influences on health behavior: a theoretical framework and empirical review. Health Psychology Review. 2. 2. 111-137.

Hogan, R. and Schroeder, D.H. (1981). The ambiguities of achievement. Sociological Spectrum. 1. 35-45.

Hohwü, L., Lyshol, H., Gissler, M. et al. (2013). Web-Based Versus Traditional Paper Questionnaires: A Mixed-Mode Survey With a Nordic Perspective. Journal of Medical Internet Research. 15. 8: e173.

Hollands, G.J., Shemilt, I., Marteau, T.M. et al. (2015). Portion, package or tableware size for changing selection and consumption of food, alcohol and tobacco. Cochrane Database Systematic Review. 14. 9. CD011045. doi: 10.1002/14651858.CD011045.pub2.

Holm, S. (1979). A simple sequential rejective multiple test procedure. Scandinavian Journal of Statistics. 6: 65-70.

Hopcroft, R.L. (2006). Sex, status, and reproductive success in the contemporary United States. Evolution and Human Behavior. 27. 104-120. doi:10.1016/j.evolhumbehav.2005.07.004

Inglehart, R. and Baker, W.E. (2000). Modernization, cultural change, and the persistence of traditional values. American Sociological Review. 65. 1. 19-51.

Institute for Government. (2009). Going with the grain: influencing behaviour through public policy. Cabinet Office.

Institute of Medicine (US). (2006). Committee on Assessing Interactions among Social, Behavioral, and Genetic Factors in Health; Hernandez LM, Blazer DG, editors. Genes, Behavior, and the Social Environment: Moving Beyond the Nature/Nurture Debate. Washington (DC): National Academies Press (US). Genetics and Health.

Irons, W. (1979). Cultural and biological success. In evolutionary biology and human social behavior: an anthropological perspective (eds Chagnon N. A., Irons W.). North Scituate, MA: Duxbury Press.

Jaccard, J. and Wan, C.K. (1996). LISREL approaches to interaction effects in multiple regression. Thousand Oaks, CA: Sage Publications.

Jacobs, J.A. and Gerson, K. (2001). Overworked Individuals or Overworked Families? Explaining trends in work, leisure, and family time. Work and Occupations. 28. 40-63.

James, W.P.T., Nelson, M., Ralph, A. et al. (1997). Socioeconomic determinants of health: the contribution of nutrition to inequalities in health. British Medical Journal. 314. 1545–1549.

Jamieson, S. (2004). Likert scales: how to (ab)use them. Medical education. 38. 12. 1217–1218.

Jamison, D. T. et al. (2006). (eds) Priorities in health. World Bank, Washington DC. Available at http://www.dcp2.org (accessed 1st March 2014).

Janssen, I., Heymsfield, S.B., Allison, D.B. et al. (2002). Body mass index and waist circumference independently contribute to the prediction of nonabdominal, abdominal subcutaneous, and visceral fat. The American Journal of Clinical Nutrition. 75. 683–688.

Jebb, S.A. (1997). Aetiology of obesity. British Medical Bulletin. 3. 2. 264-285.

Jefferson, T., Herbst, J.H. and McCrae, R.R. (1998). Associations between Birth Order and Personality Traits: Evidence from Self-Reports and Observer Ratings. Journal of Research in Personality. 32: 498-509.

Jeffery, R.W. and French, S.A. (1998). Epidemic obesity in the United States: Are fast foods and television viewing contributing? American Journal of Public Health. 88: 277–280.

Jéquier, E. (2002). Leptin signalling, adiposity, and energy balance. Annals of the New York Academy of Sciences. 967. 379-388.

Jessor, R., Turbin, M.S. and Costa, F.M. (1998). Protective factors in adolescent health behavior. Journal of Personality and Social Psychology. 75. 3. 788–800.

Jin, R.L., Shah, C.P., and Svoboda, T.J. (1995). The impact of unemployment on health: a review of the evidence. Canadian Medical Association Journal. 153. 5. 529-540

Johansson, L. and Andersen, L.F. (1998). Who eats 5 a day?: Intake of fruits and vegetables among Norwegians in relation to gender and lifestyle. Journal of the American Dietetic Association. 98. 6. 689–691.

Johnson, J.G., Cohen, P., Kasen, S. et al. (2002). Childhood adversities associated with risk for eating disorders or weight problems during adolescence or early adulthood. American Journal of Psychiatry. 159. 394-400.

Johnson, J.G., Spitzer, R.L. and Williams, J.B.W. (2001). Health problems, impairment and illness associated with bulimia nervosa and binge eating disorder among primary care and obstetric gynaecology patients. Psychological Medicine. 31. 1455–1466.

Johnson, S.B., Blum, R.W. and Giedd, J.N. (2009). Adolescent maturity and the brain: The promise and pitfalls of neuroscience research in adolescent health policy. Journal of Adolescent Health. 45. 3. 216–221.

Jones, A., Bentham, G., Foster, C. et al. (2007). Tackling obesities: future choices, obesogenic environments, evidence review. Government Office for Science. Skills. www.dius.gov.uk DIUS/PUB/2K/10/07/NP.

Jones, S.R., Carley, S. and Harrison, M. (2004). An introduction to power and sample size estimation. Emergency Medicine Journal. 20. 5. 453-458.

Joseph, R.J., Alonso-Alonso, M., Bond, D.S. et al. (2011). The Neurocognitive Connection between Physical Activity and Eating Behavior. Obesity Reviews. 12. 10. 800–812.

Kacenelenbogen, N., Dramaix-Wilmet, M., Schetgen, M. et al. (2016). Parental separation: a risk for the psychomotor development of children aged 28 to 32 months? A cross-sectional study BMC Pediatrics. 16. 89. DOI 10.1186/s12887-016-0621-y

Kashima, Y., Gallois, C. and McCamis, M. (1993). The theory of reasoned action and cooperative behaviour: It takes two to use a condom. British Journal of Social Psychology. 32. 3. 227-239.

Kelley, B.T., Thornberry, T.P. and Smith, .C.A. (1997). In the wake of childhood maltreatment. Washington (DC): National Institute of Justice, Office of Justice Programs, Office of Juvenile Justice and Delinquency Prevention.

Kelly, S.A. and Melnyk, B.M. (2011). Correlates Among Healthy Lifestyle Cognitive Beliefs, Healthy Lifestyle Choices, Social Support, and Healthy Behaviors in Adolescents: Implications for Behavioral Change Strategies and Future Research. Journal of Pediatric Health Care. 25. 4. 216-223.

Kendler, K.S., Prescott, C.A., Myers, J. et al. (2003). The structure of genetic and environmental risk factors for common psychiatric and substance use disorders in men and women. Arch Gen Psychiatry. 60. 929-937.

Kenny, P.J. (2011a). Common cellular and molecular mechanisms in obesity and drug addiction. Nature Reviews Neuroscience. 12. 638-651.

Kenny, P. J. (2011b). Reward mechanisms in obesity: new insights and future directions. Neuron. 69. 664–679.

Kenrick, D.T, Griskevicius, V., Sundie, J.M. (2009). Deep Rationality: The Evolutionary Economics of Decision. Social Cognitive and Affective Neuroscience. 27. 5. 764–785.

Kiernan, K.E. and Huerta, M.C. (2008). Economic deprivation, maternal depression, parenting and children's cognitive and emotional development in early childhood. British Journal of Sociology. 59. 783–806.

Killingback, T., Bieri, J. and Flatt, T. (2006). Evolution in group-structured populations can resolve the tragedy of the commons. Proceedings of the Royal Society. London. B. 273. 1477-1481.

Killingsworth, M.A. and Gilbert, D.T. (2010). A Wandering Mind Is an Unhappy Mind. Science. 330. 6006. 932.

Kilpeläinen, T.O., Qi, L, Brage, S. et al. (2011). Physical activity attenuates the influence of fto variants on obesity risk: a meta-analysis of 218,166 adults and 19,268 Children. PLOS Medicine 8. 11. e1001116. doi:10.1371/journal.pmed.1001116.

Kimbro, R.T., Bzostek, S., Goldman, N. et al. (2008). Race, Ethnicity, And The Education Gradient In Health. Health Affairs. 27. 2. 361-372.

King, A.C., Blair, S.N., Bild, D.E. et al. (1992). Determinants of physical activity and interventions in adults Medicine & Science in Sports & Exercise, 24. 6. 221–236.

King, D. and Mossialos, E. (2005). The determinants of private medical insurance prevalence in England, 1997–2000. Health Services Research. 40. 1. 195-212.

King, K.M., Nguyen, H.V., Kosterman, R. et al. (2012). Co-occurrence of sexual risk behaviors and substance use across emerging adulthood: evidence for state- and trait-level associations. Addiction. 107. 1288–1296.

King, K.M., Nguyen, H.V., Kosterman, R. et al. (2012). Co-occurrence of sexual risk behaviors and substance use across emerging adulthood: evidence for state- and trait-level associations. Addiction. 107. 7. 1288–1296

Kirby, K.N. and Marakovic, N.N. (1996). Delay-discounting probabilistic rewards: Rates decrease as amounts increase. Psychonomic Bulletin and Review. 3. 100–104.

Kirk, M.A. and Rhodes, R.E. (2011). Occupation correlates of adults' participation in leisure-time physical activity: a systematic review. American Journal of Preventative Medicine. 40. 4: 476-485.

Kirkwood, T.B.L. and Rose, M.R. (1991). Evolution of Senescence: Late Survival Sacrificed for Reproduction. Philosophical Transactions of the Royal Society B. 332. 15–24.

Kitchen, P., Brignell, J., Li, T. et al. (2004). The emergence of IMC: a theoretical perspective. Journal of Advertising Research. 19–30.

Kitchenham, B.A. and Pfleeger, S.L. (2002). Principles of Survey Research Part 3: Constructing a Survey Instrument. Software Engineering Notes. 27. 2. 20-24.

Klesges, R.C., Klem, M.L., Epkins, C. et al (1991). A longitudinal evaluation of dietary restraint and its relationship to changes in body weight. Addict Behavior. 16. 363–368.

Koch, F.S., Sepa, A. and Ludvigsson, J. (2008). Psychological stress and obesity. Journal of Pediatrics. 153. 6.

Koch, F.S., Sepa, A. and Ludvigsson, J. (2008). Psychological Stress and Obesity. Journal of Pediatrics.153. 6. 839-844.

Kongsved, S.M., Basnov, M., Holm-Christensen, K. et al. (2007). Response rate and completeness of questionnaires: a randomized study of Internet versus paper-and-pencil versions. Journal of Medical Internet Research. 2007. 9. 3. e25. doi: 10.2196/jmir.9.3.e25. http://www.jmir.org/2007/3/e25/

Kopelman, S., Weber, M.J. and Messick, D.M. (2002). The Drama of the Commons. Chapter: 4 Factors Influencing Cooperation in Commons Dilemmas: A Review of Experimental Psychological Research. The National Academies Press.

Kraemer S. (1991). The origins of fatherhood; an ancient family process. Family Process. 30. 377–392.

Kraemer S. (2000). The fragile male. British Medical Journal. 321. 1609–1612.

Krebs, C.J. (1978). Ecology. The experimental analysis of distribution and abundance. Xxv (Second edition).

Krueger, R.F., Chentsova-Dutton, Y.E., Markon, K.E. et al. (2003). A cross cultural study of the structure of comorbidity among common psychopathological syndromes in the general health care setting. Journal of Abnormal Psychology. 112. 437-447.

Krueger, R.F., Hicks, B.M. Patrick, C.J. et al. (2002). Etiologic connections among substance dependence, antisocial behavior, and personality: modeling the externalizing spectrum. J Abnorm Psychol. 111. 411-424.

Krul, A.J., Daanen, H.A.M. and Choi, H. (2009). Self-reported and measured weight, height and body mass index (BMI) in Italy, the Netherlands and North America. European Journal of Public Health. 21. 4. 414-419.

Kumanyika, S., Jeffery, R.W., Morabia, A. et al. (2002). Public health approaches to the prevention of obesity working group of the international obesity taskforce. Obesity prevention: the case for action. International Journal of Obesity and Related Metabolic Disorders. 26. 425–436.

Kuzawa, C.W. (1998). Adipose tissue in human infancy and childhood: an evolutionary perspective. Yearbook of Physical Anthropology. 132. 642-649.

Kypri, K., Cronin, M., and Wright, C.S. (2005). Do university students drink more hazardously than their non-student peers? Addiction. 100. 713-714.

Lahelma, E., Lallukka, T., Laaksonen, M. et al. (2009) Social class differences in health behaviours among employees from Britain, Finland and Japan: The influence of psychosocial factors. Health and Place. 16. 61–70.

Laland, K. and Brown, G. R. (2006). Niche construction, human behaviour and the adaptive-lag hypothesis. Evolutionary Anthropology. 15. 95-104.

Lansford, J.E., Miller-Johnson, S., Berlin, L.J. (2007). Early Physical Abuse and Later Violent Delinquency: A Prospective Longitudinal Study. Child Maltreatment. 12. 3. 233–245.

Lansky, A., Abdul-Quader, A.S., Cribbin, M. et al. (2007). Developing an HIV behavioral surveillance system for injecting drug users: the National HIV Behavioral Surveillance System. Public Health Rep. 122(suppl 1): 48.

Lantz, P.M., House, J.S., Lepkowski, J.M. et al. (1998). Socioeconomic factors, health behaviours, and mortality - Results from a nationally representative prospective study of US adults. Journal of the American Medical Association. 279. 1703–1708.

Lanza, S.T., Tan, X. and Bray, B.C. (2013). Latent Class Analysis With Distal Outcomes: A Flexible Model-Based Approach. Structural Equation Modeling. 2013. 20.1: 1–26.

Laslett, B. and Brenner, J. (1989). Gender and social reproduction: historical perspectives. Annual Review of Sociology. 15. 381-404.

Lee, J.L. and Kolonel, L.N. (1984). Are body mass indices interchangeable in measuring obesity-disease associations? American Journal of Public Health. 90-36-84.

Lee, M., and Rotheram-Borus, M. J. (2001). Challenges associated with increased survival among parents living with HIV. American Journal of Public Health. 91: 1303–1309.

Lee, R. and DeVore, I. (1968). Man the hunter. Aldine, Chicago.

Lennernas, M., Fjellstrom, C., Becker, W. et al. (1997). Influences on food choice perceived to be important by nationally-representative samples of adults in the European Union. European Journal of Clinical Nutrition. 51. 2. S8-S15.

Lesieur, H.R. and Heineman, M. (1988). Pathological Gambling Among Youthful Multiple Substance Abusers in a Therapeutic Community. Addiction. 83. 7. 765-771.

Leung, G. and Stanner, S. (2011). Diets of minority ethnic groups in the UK: influence on chronic disease risk and implications for prevention. Nutrition Bulletin. 36. 2. 161-198.

Levy, A. (2002). Rational eating: can it lead to overweightness or underweightness? Journal of Health Economics. 21. 5. 887–899.

Lewontin, R. (1970). The units of selection. Annual Review of Ecology and Systematics. 1. 1-17.

Lewontin, R.C. (1968). The concept of evolution. International Encyclopedia of the Social Sciences. New York: Macmillan. 202-210.

Lightsey Jr., O.R., Hulsey, C.D. (2002). Impulsivity, coping, stress, and problem gambling among university students. Journal of Counseling Psychology, 49. 2. 202-211.

Lin, B.H. and Morrison, R.M. (2002). Higher Fruit Consumption Linked With Lower Body Mass Index. Food Review. 25. 3. 28-32.

Lissau, I. and Sorensen, T.I.A. (1994). Parental neglect during childhood and increased risk of obesity in young adulthood. Lancet. 343. 324–27.

Liver Doctor. (2014). Your Body Type and Cellulite. www.liverdoctor.com/Section3/14_bodytypes.asp (Accesses 19th March 2014).

Lopez, A. D., Mathers, C. D., Ezzati, M. et al. (2006). (eds) Global burden of disease and risk factors. Oxford University Press and World Bank. Washington DC.

Lovasi, G.S., Hutson, M.A., Guerra, M. (2009). Built Environments and Obesity in Disadvantaged Populations Epidemiologic Reviews. 31. 1. 7–20.

Low, B.S., Simon, C.P. and Anderson, K.G. (2002). An evolutionary ecological perspective on demographic transitions: modelling multiple currencies. American Journal of Human Biology. 14. 149-167.

Lowry, R., Kann, L. and Collins, J.L. (1996). The effect of socioeconomic status on chronic disease risk behaviours among US adolescents. Journal of the American Medical Association. 276. 792–797.

Lucas, R.E. and Donnellan, M.B. (2011). Estimating the Reliability of Single-Item Life Satisfaction Measures: Results from Four National Panel Studies. Social Indicators Research. 105. 3. 323–331.

Ludwig, D.S., Majzoub, J.A., Al-Zahrani, A. et al. (1999). High Glycemic Index Foods, Overeating, and Obesity. Pediatrics. 103. 3. 1-6.

Lukasiewicz, E., Mennen, L.I., Bertrais, S. et al. (2007). Alcohol intake in relation to body mass index and waist-to-hip ratio: the importance of type of alcoholic beverage. Public Health Nutrition. 8. 3. 315-320.

Lumeng, J.C. and Hillman, K.H. (2007). Eating in larger group increases food consumption. Archives of Disease in Childhood. 92. 5. 384–387.

Lupien, S.J., King, S., Meaney, M.J. et al. (2000). Child's stress hormone levels correlate with mother's socioeconomic status and depressive state. Biological Psychiatry. 48. 10. 976-980.

Luster, T. and Small, S.A. (1994). Factors Associated with Sexual Risk-Taking Behaviors among Adolescents. Journal of Marriage and Family. 56. 3: 622-632.

Lycett, J.E. and Dunbar, R.I.M. (1999). Abortion rates reflect the optimization of parental investment strategies. Proceedings of the Royal Society. London. B. 266. 2355-2358.

Lycett, J.E., Dunbar, R.I.M. and Voland, E. (2000). Longevity and the costs of reproduction in a historical human population. Proceedings of the Royal Society. London. B. 267. 1438. 31-35.

Lynch, J.W., Kaplan, G.A. and Salonen, J.T. (1997). Why do poor people behave poorly? Variation in adult health behaviours and psychosocial characteristics by stages of the socioeconomic lifecourse. Social Science and Medicine. 44. 809–819.

Lyubomirsky, S., King, L. and Diener, E. (2005). The benefits of frequent positive affect: Does happiness lead to success? Psychological Bulletin. 131. 6. 803-855.

Mace, R. (2007) . The evolutionary ecology of human family size. In R. Dunbar, & L. Barrett (Eds.), The Oxford handbook of evolutionary psychology. Oxford: Oxford University Press. 383-396.

Maehr, M.L. and Braskamp, L.A. (1986). The motivation factor: a theory of personal investment. Lexington, MA: Lexington Press.

Maes, H.H., Neale, M.C. and Eaves, L.J. (1997). Genetic and environmental factors in relative body weight and human adiposity. Behavior Genetics. 27. 4. 325–51.

Maguire , E.R. Burgoine , T. and Monsivais, P. (2015). Area deprivation and the food environment over time: A repeated cross-sectional study on takeaway outlet density and supermarket presence in Norfolk, UK, 1990–2008. Health & Place. 33. 142–147.

Malecki, C.K. and Demaray, M.K. (2006). Social support as a buffer in the relationship between socioeconomic status and academic performance. School Psychology Quarterly. 21. 4. 375-395.

Malekinejad, M., Johnston, L.G., Kendall, C. et al. (2008). Using respondent-driven sampling methodology for HIV biological and behavioral surveillance in international settings: a systematic review. AIDS Behav. 12:105–130.

Manabe, Y., Matsumura, S. and Fushiki, T. (2010). Preference for High-Fat Food in Animals. In: Montmayeur JP, le Coutre J, editors. Fat Detection: Taste, Texture, and Post Ingestive Effects. Boca Raton (FL): CRC Press; 2010. Chapter 10.

Markon, K.E. and Krueger, R.F. (2005). Categorical and Continuous Models of Liability to Externalizing Disorders A Direct Comparison in NESARC. Arch Gen Psychiatry. 62. 12. 1352-1359.

Marmot, M. (2005). Social determinants of health inequalities. The Lancet. 365. 9464. 1099–1104.

Marmot, M.G., Kogevinas, M. and Elston, M.A. (1987). Social-economic status and disease. Annual Review of Public Health. 8. 111–135.

Marsden, R., Flynn, A. and Harrison, M. (2000). Consuming interests: the social provision of foods. London: University College Press.

Marsheb, R.M. and Grilo, C.M. (2006). Emotional overeating and its associations with eating disorder psychopathology among overweight patients with binge eating disorder. International Journal of Eating Disorders. 39. 141–146.

Martin, D. and William, H. (2008). Stewart is dead at 86; put first warnings on cigarette packs. New York Times. http://query.nytimes.com/gst/fullpage.html?res=9B0CEFD61530F93AA15757C0A96E9C8B63&sec=&spon=&pagewanted=all [Accessed 11th April 2014].

Martin, R.D. (1996). Scaling of the mammalian brain: the maternal energy hypothesis. News in Physiological Sciences. 11. 149-156.

Mattes, R.D. (2005). Fat taste and lipid metabolism in humans. Physiology and Behavior. 86. 691-697.

Mayer, S.E. (2001). How Did the Increase in Economic Inequality between 1970 and 1990 Affect Children's Educational Attainment?. American Journal of Sociology. 107. 1. 1-32.

Maynard-Smith, J. (1972). On evolution. Edinburgh University Press.

Maynard-Smith, J. (1978). Optimization theory in evolution. Annual Review of Ecology and Systematics. 9. 31-56.

Maynard-Smith, J. (1998). The origin of altruism. Nature. 393. 639-640.

McAndrew, F.T. (2002). New evolutionary perspectives on altruism: Multilevel-selection and costly-signalling theories. American Psychological Society. 11. 2. 79-82.

McClelland, J.W., Demark-Wahnefried, W., Mustian, R.D. et al. (1998). Fruit and vegetable consumption of rural African Americans: baseline survey results of the black churches united for better health 5 a day project. Nutrition and Cancer. 30. 148-157.

McCreesh N, Frost S, Seeley J, et al. Evaluation of respondent-driven sampling. Epidemiology. 2012;23:138 –147.

McCrory, M. A., Suen, V. M. and Roberts, S. B. (2002). Biobehavioral influences on energy intake and adult weight gain. Journal of Nutrition. 132. 3830S–3834S.

McCrory, M.A., Fuss, P.J., McCallum, J.E. et al. (1998). Dietary variety within food groups: Association with energy intake and body fatness in men and women. The American Journal of Clinical Nutrition. 69: 440–447.

McEwan, B.S. (1998). Stress, adaptation, and disease: allostasis and allostatic load. Annals of the New York Academy of Science 840. 33-44.

McEwan, B.S. (2000). Effects of adverse experiences for brain structure and function. Biological Psychiatry. 48. 8. 721-731.

McFarland, D.J. (1974). In: Advances in the study of behaviour. Vol 5 (D. Lehrman, J.S. Rosenblatt, R.A Hinde and E. Shaw, eds). New York Academic Press. 201-225.

McHenry, H.M. and Coffing, K. (2000). Australopithecus to Homo: transformations in body and mind. Annual Review of Anthropology. 29. 125-146.

McKee, M., Shkolnikov, V. and Leon, D. A. (2001). Alcohol is implicated in the fluctuations in cardiovascular disease in Russia since the 1980s. Annals of Epidemiology. 11. 1–6.

McLaren, L., McIntyre, L. and Kirkpatrick, S. (2010). Rose's population strategy of prevention need not increase social inequalities in health. International Journal of Epidemiology. 39. 2. 372–377.

Mealey, L. (1985). The relationship between social status and biological success: a case study of the Mormon religious hierarchy. Ethology and Sociobiology. 6. 249-257.

Mela, D. (1996). Eating behaviour, food preferences and dietary intake in relation to obesity and body-weight status. Proceedings of the Nutrition Society. 55. 803–816.

Mellbin, T. and Vuille, J-C. (1989). Further evidence of an association between psychosocial problems and increase in relative weight between 7 and 10 years of age. Acta Paediatria Scandinavica. 78. 576–580.

Mental Health Foundation. (2014). Diet and Mental Health. http://www.mentalhealth.org.uk/help-information/mental-health-a-z/D/diet/ [Accessed 26 March 2014].

Messerschmidt, J.W. (1993). Masculinities and crime: Critique and reconceptualization of theory.

Michaelson, L., de la Vega, A., Chatham, C.H. et al. (2013). Delaying gratification depends on social trust. Frontiers in Psychology. doi: 10.3389/fpsyg.2013.00355. 1-7.

Midei, A.J. and Matthews, K.A. (2011). Interpersonal violence in childhood as a risk factor for obesity: a systematic review of the literature and proposed pathways. Obesity Reviews. 12. 5. e159–e172.

Milligan, L.A. (2008). Nonhuman primate milk composition: relationship to phylogeny, ontogeny and ecology. PhD dissertation. University of Arizona.

Ministry of Agriculture, Fisheries and Food. (1999). National Food Survey 1998. London: The Stationery Office.

Mintz, S.W. (1996). Tasting food, tasting freedom: excursions in eating, culture, and the past. Boston: Beacon Press.

Mischel, W. and Ebbesen, E. B. (1970). Attention in delay of gratification. Journal of Personality and Social Psychology. 16. 329–337.

Mischel, W., Ebbesen, E. B. and Zeiss, A. R. (1972). Cognitive and attentional mechanisms in delay of gratification. Journal of Personality and Social Psychology. 21. 204–218.

Mischel, W., Shoda, Y. and Rodriguez, M.I. (1989). Delay of gratification in children. Science. 244. 4907. 933-938.

Monteath, S.A. and McCabe, M.P. (1996). The Influence of Societal Factors on Female Body Image. The Journal of Social Psychology. 137. 6. 708-727.

Moore, M.S. (2000). Interactions between physical activity and diet in the regulation of body weight. Proceedings of the Nutrition Society. 59. 193-198.

Moore, S.M. and Ohtsuka, K. (1997). Gambling Activities of Young Australians: Developing a Model of Behaviour. Journal of Gambling Studies. 13. 3: 207-236.

Morland, K., Diez-Roux, A.C.V. and Wing, S. (2006). The influence of supermarkets and other stores on obesity. American Journal of Preventive Medicine. 30. 333–339.

Muraven, M., Collins, R. L. and Neinhaus, K. (2002). Self-control and alcohol restraint: An initial application of the self-control strength model. Psychology of Addictive Behavior. 16. 113-120.

Nardo, M., Saisana, M., Saltelli, A. et al. (2005). Tools for Composite Indicators Building. http://publications.jrc.ec.europa.eu/repository/bitstream/JRC31473/EUR%2021682%20EN.pdf. [Accessed 1st June 2017].

National Obesity Observatory. (2011). Obesity and ethnicity. National Obesity Observatory. http://www.noo.org.uk/uploads/doc/vid_9851_Obesity_ethnicity.pdf. [Accessed 1st December 2016].

National Qualification Framework. (2006). Qualifications and Curriculum Authority – March 2006. QCA/06/2298.

NCHS. (1999). Prevalence of overweight among children and adolescents: United States. National Centre for Health Statistics. http://www.cdc.gov/nchs/products/pubs/pubd/hestats/overwght99.htm (Accessed 5th September 2013).

Neel, J. V. (1962). Diabetes mellitus: a "thrifty" genotype rendered detrimental by "progress"?. The American Journal of Human Genetics. 14: 353-362.

Nesse, R.M. (1999). Proximate and evolutionary studies of anxiety, stress and depression: synergy at the interface. Neuroscience and Biobehavioral Reviews. 23. 895–903.

Nettle, D. (2010). Why are there social gradients in preventative health behaviour? A perspective from behavioural ecology. PLOS ONE. 5. 10. 1-6.

Nettle, D. and Pollet, T.V. (2008). Natural selection on male wealth in humans. The American Naturalist. 172. 5. 000-000. doi: 10.1086/591690.

Newburn, T. and Stanko, E.A. (1994). Just boys doing business? Men, masculinities, and crime. New York: Routledge.

NHS Choices. (2016). Food and diet. http://www.nhs.uk/livewell/goodfood/Pages/Goodfoodhome.aspx [Accessed 22nd December 2016].

NHS. (2012). Coronary heart disease. National Health Service. http://www.nhs.uk/Conditions/Coronary-heart-disease/Pages/Introduction.aspx [Accessed 10th March 2014].

NHS. (2012). Obesity – Causes. National Health Service. http://www.nhs.uk/Conditions/Obesity/Pages/Causes.aspx (Accessed 19th March 2014).

NICE. (2014). Obesity: identification, assessment and management. The National Institute for Health and Care Excellence. https://www.nice.org.uk/guidance/CG189 [Accessed 31st May 2017].

Nichols, M.S., Silva-Sanigorski, A.D., Clearly, J.E. et al. (2011). Decreasing trends in overweight and obesity among an Australian population of preschool children. International Journal of Obesity (Lond). 35. 916–24.

Nicholson, N., Soane, E., Fenton, M. et al. (2005). Personality and domain-specific risk taking. Journal of Risk Research. 8. 2. 157-176.

Nicklas, T.A., Baranowski, T. Cullen, K.W. and Berenson, G. (2001). Eating Patterns, Dietary Quality and Obesity. Journal of the American College of Nutrition. 20. 6: 599-608.

Noël, X. Brevers, D., Bechara, A. et al. (2011). Neurocognitive determinants of novelty and sensation-seeking in individuals with alcoholism. Alcohol Alcohol. 46. 4. 407-415.

Nolte, J. (2002). The Human Brain: An Introduction to Its Functional Anatomy (15 January 2002).

Nomaguchi, K.M. and Bianchi, S.M. (2004). Exercise Time: Gender Differences in the Effects of Marriage, Parenthood, and Employment. Journal of Marriage and Family. 66. 2. 413-430.

Norburya, A. and Husainb, M. (2015). Sensation-seeking: Dopaminergic modulation and risk for psychopathology. Behavioural Brain Research. 288. 79–93.

Norris, S.L., Zhang, X., Avenell, A. et al. (2005). Long-term non-pharmacological weight loss interventions for adults with prediabetes. Cochrane Database of Systematic Reviews. 2: CD005270.

Nunnally, J. C. and Bernstein, I. H. (1994). Psychometric theory (3rd ed.). New York: McGraw-Hill.

O'Gorman, R., Wilson, D.S. and Miller, R.R. (2005). Altruistic punishing and helping differ in sensitivity to relatedness, friendship and future interactions. Evolution and Human Behavior. 26. 375-387.

Office for National Statistics. (2001). Census 2001. http://www.ons.gov.uk/ons/guide-method/census/census-2001/about-census-2001/census-2001-forms/index.html [Accessed 21st June 2013].

Office for National Statistics. (2011). https://www.ons.gov.uk/peoplepopulationandcommunity/culturalidentity/ethnicity/articles/ethnicityandnationalidentityinenglandandwales/2012-12-11 [Accessed 23rd January 2017].

Office for National Statistics. (2011). Population estimates for England and Wales, mid-2011 (2011 Census-based). http://www.ons.gov.uk/ons/publications/re-reference-ables.html?edition=tcm%3A77–262039 [Accessed 21st June 2013].

Office for National Statistics. (2015). Drug use, alcohol and smoking. Available: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/drugusealcoholandsmoking [Accessed 10th November 2017].

Office for National Statistics. (2016). Statistical bulletin: Births by Parents' Characteristics in England and Wales: 2014. http://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/livebirths/bulletins/birthsbyparentscharacteristicsinenglandandwales/2014 [Accessed 7th December 2016].

Ogden, C. L., Carroll, M. D., Kit, B.K. et al. (2014). Prevalence of childhood and adult obesity in the United States, 2011-2012. Journal of the American Medical Association. 311. 8. 806-814.

Ogden, C.L. Lamb, M.M Carroll, M.D. et al. (2010b). Obesity and socioeconomic status in adults: United States, 2005-2008. NCHS Data Brief No. 50. 1-8.

Ogden, C.L., Carroll, M.D., Curtin, L.R. et al. (2010a). Prevalence of high body mass index in US children and adolescents, 2007-2008. Journal of the American Medical Association. 303.3: 242-9.

Oppenheimer, S. (2003). Out of Eden: the peopling of the world. Constable and Robinson.

Ostir, G.V., Markides, K.S., Black, S.A. et al. (2000). Emotional Well-Being Predicts Subsequent Functional Independence and Survival. Journal of the American Geriatric Society. 48. 5. 473-478.

Oswald, D.L., Clark, E.M. and Kelly, C.M. (2004). Friendship maintenance: An analysis of individual and dyad behaviors. Journal of Social and Clinical Psychology. 23. 413–441.

Ottevaere, C., Huybrechts, I., Benser, J. et al. (2011). Clustering patterns of physical activity, sedentary and dietary behavior among European adolescents: The HELENA study. BMC Public Health. 11. 328. doi: 10.1186/1471-2458-11-328.

Padwal, R.S., Rucker, D., Li, S.K. et al. (2003). Long-term pharmacotherapy for obesity and overweight. Cochrane Database of Systematic Reviews. 4: CD004094.

Paffenbarger, R.S., Hyde, R.T., Wing, A.L. et al. (1986). Physical activity, all-cause mortality, and longevity of college alumni. The New England Journal of Medicine. 314. 10. 605-613.

Palumbi, S.R. (2001). Humans as the world's greatest evolutionary force. Science. 293. 5536. 1786-1790.

Park, Y-W., Allison, D.B., Heymsfield, S.B. and Gallagher, D. (2001). Larger amounts of visceral adipose tissue in Asian Americans. Obesity Res. 9: 381-387.

Paternoster, R. and Pogarsky, G. (2009). Rational choice, agency and thoughtfully reflective decision making: The short and long-term consequences of making good choices. Journal of Quantitative Criminology. 25. 2. 103-127.

Paxton, A. (1994). The food miles report. London: SAFE Alliance.

Pechtel, P. and Pizzagalli, D.A. (2010). Effects of early life stress on cognitive and affective function: an integrated review of human literature. Psychopharmacology. 214. 55-70.

Peeters, A., Barendregt, J.J., Willekens, F. et al. (2003). Obesity in adulthood and its consequences for life expectancy: A life-table analysis. Annals of Internal Medicine. 138. 24-32.

Penedo, F.J. and Dahn, J.R. (2005). Exercise and well-being: a review of mental and physical health benefits associated with physical activity. Current Opinion in Psychiatry.18. 2. 189-193.

Penn, D. J. and Smith, K. R. (2007). Differential fitness costs of reproduction between the sexes. Proceedings of the National Academy of Sciences. 104. 553-558.

Perkins, H.W. and Berkowitz, A.D. (1986). Perceiving the Community Norms of Alcohol Use Among

Personality and Social Psychology Bulletin. 33. 173-186.

Petridou, E., Zavitsanos, X., Dessypris, N. et al. (1997). Adolescents in High-Risk Trajectory: Clustering of Risky Behavior and the Origins of Socioeconomic Health Differentials Preventive Medicine. 26. 215-219.

PHE. (2013). Obesity and health. Public Health England http://www.noo.org.uk/NOO_about_obesity/obesity_and_health (Accessed 5th March 2014).

Philipson, T.J., Posner, R.A. (1999). The long-run growth in obesity as a function of technological change.Working Paper 7423. National Bureau of Economic Research, Cambridge, MA.

Pill, R., Peters, T.J. and Robling, M.R. (1995). Social-class and preventive health behaviour - a British example. Journal of Epidemiology and Community Health. 49. 28–32.

Pine, D.S., Goldstein, R.B., Wolk, S. et al. (2001). The association between childhood depression and adult body mass index. Pediatrics.107. 1049–1056.

Pinquart, M. and Sörensen, S. (2000). Influences of socioeconomic status, social network, and competence on subjective well-being in later life: A meta-analysis. Psychology and Aging. 15. 2. 187-224.

Polivy J. and Herman, C. P. (1993). Etiology of binge eating: Psychological mechanisms: In C. F. Fairburn & G. T. Wilson (Eds.), Binge eating: nature, assessment and treatment (pp. 173–205). New York: Guilford Press.

Post, S.G. (2005). Altruism, happiness, and health: it's good to be good. International Journal of Behavioural Medicine. 12. 2. 66-77.

Poverty and Social Exclusion. (2014). Key Findings. http://www.poverty.ac.uk/pse-research/facts-and-findings [Accessed 22nd December 2016].

Power, M. L. and Schulkin, J. (2009). The evolution of obesity. John Hopkins University Press. Baltimore.

Power, M.L. (2004). Viability as opposed to stability: an evolutionary perspective on physiological regulation. In Allostasis, Homeostasis, and the Costs of Adaptation, Schulkin, J. (ed.). Cambridge: Cambridge University Press. 343-364.

Prentice, A.M. (1995). Alcohol and obesity. International journal of obesity and related metabolic disorders. 19. 44-50.

Prentice, A.M. and Jebb, S.A. (2003). Fast foods, energy density and obesity: a possible mechanistic link. Obesity Reviews. 4. 187–194.

Prentice, T.L. and Jebb, S. (2004). Energy intake/physical activity interactions in the homeostasis of body weight regulation. Nutrition Reviews. 62. 58-67.

Preston, C.C. and Colman, A.M. (2000). Optimal number of response categories in rating scales: reliability, validity, discriminating power, and respondent preferences. Acta Psychologica. 104. 1-15.

Price, G.M., Uauy, R., Breeze, E. et al. (2006). Weight, shape, and mortality risk in older persons: elevated waist-hip ratio, not high body mass index, is associated with a greater risk of death. American Society for Clinical Nutrition. 84. 2. 449-460.

Public Health England. (2012). Obesity and alcohol: an overview. Delivered by National Obesity Observatory on behalf of the Public Health Observatories in England. http://www.noo.org.uk/uploads/doc/vid_14627_Obesity_and_alcohol.pdf

Public Health England. (2013). North West Mental Wellbeing Survey 2012/13. PHE publications gateway number: 2013240. www.gov.uk/phe [15th March 2014, date last accessed].

Public Health England. (2016). UK and Ireland prevalence and trends. https://www.noo.org.uk/NOO_about_obesity/adult_obesity/UK_prevalence_and_trends [accessed 29th November 2016].

Pudney, S. (2003). The road to ruin? Sequences of initiation to drug use and crime in Britain. The Economic Journal. 113. 486. C182–C98. doi:10.1111/1468-0297.00107.

Putnam, R.D. (1995). “Bowling Alone: America’s Declining Social Capital.” Journal of Democracy. 6. 65-78.

Qi, L. and Cho, Y.A. (2008). Gene–environment interaction and obesity. Nutrition Reviews. 66. 12. 684–94.

Qi, V., Phillips, S.P. and Hopman, W.M. (2006). Determinants of a healthy lifestyle and use of preventive screening in Canada. BMC Public Health 6. 275.

Quick, J.D., Horn, R.S. and Quick, J.C. (1987). Health Consequences of Stress. Journal

Rampersaud, E., Mitchellm B.D., Pollin, T.I. et al. (2008). Physical activity and the association of common FTO gene variants with body mass index and obesity. Archives of Internal Medicine. 168. 16. 1791–1797.

Rankinen, T., Pérusse, L., Weisnagel, S.J. et al. (2002). The human obesity gene map: the 2001 update. Obesity Research. 10. 196–243.

Rao, M., Afshin, A., Singh, G. et al. (2014). Do healthier foods and diet patterns cost more than less healthy options? A systematic review and meta-analysis. BMJ Open;3:e004277. doi:10.1136/bmjopen-2013-004277.

Rattray, J. and Jones, M.C. (2007). Essential elements of questionnaire design and development. Journal of Clinical Nursing. 16. 2. 234-343.

RCP. (2008). Type 2 diabetes: National clinical guideline for management in primary and secondary care (update). Royal College of Physicians of London.

Redd, M. and de Castro, J.M. (1992). Social facilitation of eating: effects of social instruction on food intake. Physiological Behaviour. 52. 4. 749-754.

Reicks, M., Randall, J.L. and Haynes, B.J. (1994). Factors affecting consumption of fruits and vegetables by low-income families. Journal of the American Dietetic Association. 94. 1309–1311.

Reidpath, D., Burns, C., Garrard, D., et al. (2002). An ecological study of the relationship between social and environmental determinants of obesity. Health and Place. 8. 141–145.

Relton, C.L., Hammal, D.M., Rankin, J. et al. (2005). Folic acid supplementation and social deprivation. Public Health Nutrition. 8. 338–340.

Renehan, A.G., Tyson, M., Egger, M. et al. (2008). Body-mass index and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. Lancet. 371. 569–78.

Roberts, T.A., Klein, J.D. and Fisher, S. (2003). Longitudinal effect of intimate partner abuse on high-risk behavior among adolescents. Archives of Pediatrics and Adolescent Medicine. 157. 9. 875–981.

Robinson, S.L. (1996). Trust and breach of the psychological contract. Administrative Science Quarterly. 41. 574–599.

Robinson, T.N. (1998). Does television cause childhood obesity? Journal of the American Medical Association. 279. 959–960.

Robson, A.J. (1995). The Evolution of Strategic Behaviour. The Canadian Journal of Economics. 28. 1. 17-41.

Rogers, A. R. (1995). For love or money: the evolution of reproductive and material motivations. In Human reproductive decisions (ed. R. I. M. Dunbar). London, UK: St. Martin's Press.

Rogers, A.R. (1990). Evolutionary economics of human reproduction. Ethology and Sociobiology. 11. 479-495.

Rolls, B.J. (1995). Not Eating Enough: Overcoming Under-consumption of Military Operational Rations. The National Academies Press.

Rolls, B.J., Engell, D. and Birch, L.L. (2000). Serving portion size influences 5-year-old but not 3-year-old children's food intake. Journal of the American Dietetic Association. 100. 232–234.

Rosati, A.G., Stevens, J.R., Hare, B et al. (2007). The Evolutionary Origins of Human Patience: Temporal Preferences in Chimpanzees, Bonobos, and Human Adults. Current Biology. 17. 19. 1663-1668.

Rose, D. and Richards, R. (2004). Food store access and household fruit and vegetable use among participants in the us food stamp program. Public Health and Nutrition. 7.1081–1088.

Rose, G. (1992). The strategy of preventive medicine. Guildford: Oxford University Press; 1992.

Rosner, D. and Fried, L.P. (2010).Traditions, transitions, and transfats: New directions for public health. Public Health Reports. 125. 3-7.

Rothman, K.J. (2008). BMI-related errors in the measurement of obesity. International Journal of Obesity. 32. S56–S59.

Rush, E.C., Goedecke, J.H., Jennings, C. et al. (2007). BMI, fat and muscle differences in urban women of five ethnicities from two countries. International Journal of Obesity. 31. 1232–1239.

Russell, S.J., Hughes, K. and Bellis, M.A. (2016). Impact of childhood experience and adult well-being on eating preferences and behaviours. BMJ Open http://dx.doi.org/10.1136/bmjopen-2015-007770.

Sacks, G., Rayner, M. and Swinburn, B. (2009). Impact of front-of-pack 'traffic-light' nutrition labelling on consumer food purchases in the UK. Health Promotion International. 24. 4. 344-352.

Sassi, F. (2010). Obesity and the economics of prevention: fit not fat. Paris: OECD Publishing.

Savage, J.S., Fisher, J.O. and Birch, L.L. (2007). Parental Influence on Eating Behavior, Conception to Adolescence. The Journal of Law, Medicine & Ethics. 2007. 35. 1. 22–34.

Scarborough, P., Burg, M.R., Foster, C. et al. (2011). Increased energy intake entirely accounts for increase in body weight in women but not in men in the UK between 1986 and 2000. British Journal of Nutrition. 105. 1399-1404.

Schachter, S, Goldman, R. and Gordon, A. (1968). Effects of fear, food deprivation and obesity on eating. Journal of Personality and Social Psychology. 10. 91.

Schachter, S., Goldman, R., and Gordon, A. (1968). Effects of fear, food deprivation, and obesity on eating. Journal of Personality and Social Psychology. 10. 91-97.

Schulkin, J. (2003). Rethinking homeostasis: Allostatic regulation in physiology and pathophysiology. Cambridge: MIT Press.

Schwarzer, R. (2008). Modeling Health Behavior Change: How to Predict and Modify the Adoption and Maintenance of Health Behaviors. Applied Psychology. 57. 1. 1-29.

Seibt, B., Häfner, M. and Deutsch, R. (2007). Prepared to eat: How immediate affective and motivational responses to food cues are influenced by food deprivation. European Journal of Social Psychology. 37. 359-379.

Senf, J.H. and Price, C.Q. (1994). Young adults, alcohol and condom use: what is the connection? Journal of Adolescent Health.15. 238–244.

Shaw, K.A., Gennat, H.C., O'Rourke, P. et al. (2006). Exercise for overweight or obesity. Cochrane Database of Systematic Reviews. 4: CD003817.

Shaw, K.A., Gennat, H.C., O'Rourke, P. et al. (2009). Exercise for overweight or obesity (Review). Cochrane Database of Systematic Reviews. 4. Art. No.: CD003817

Shonkoff, J.P., Boyce, W.T. and McEwen, B.S. (2009). Neuroscience, Molecular Biology, and the Childhood Roots of Health Disparities Building a New Framework for Health Promotion and Disease Prevention. Journal of the American Medical Association. 301. 21. 2252-2259.

Siega-Riz, A.M., Popkin, B.M. and Carson, T. (1998). Trends in breakfast consumption for children in the United States from 1965–1991. The American Journal of Clinical Nutrition. 67: 748S–756S.

Silagy, C., Muir, J., Coulter, A., Thorogood, M., Roe, L. (1993). Cardiovascular risk and attitudes to lifestyle: what do patients think? British Medical Journal. 306 : 1657.

Silverman, A.B., Reinherz, H.Z. and Giaconia, R.M. (1996). The long-term sequelae of child and adolescent abuse: a longitudinal community study. Child Abuse and Neglect. 20. 8.709–723.

Simmons, W.O. and Emanuele, R. (2007). Male-female giving differentials: are women more altruistic? Journal of Economic Studies. 34. 6. 534-550.

Sindler, A.J., Wellman, N.S. and Stier, O.B. (2004). Holocaust survivors report long-term effects on attitudes toward food. Journal of Nutrition Education and Behaviour. 36. 4. 189-196.

Singh, G.K., Siahpush, M. and Kogan, M.D. (2010). Rising social inequalities in US childhood obesity, 2003–2007. Elsevier. 20. 40-52.

Singh, S., Darroch, J.E. and Frost, J.J. (2001). Socioeconomic Disadvantage and Adolescent Women's Sexual and Reproductive Behavior: The Case of Five Developed Countries. Family Planning Perspectives. 33. 6. 251-289.

Singh-Manoux, A., Marmot, M.G. and Adler, N.E. (2005). Does Subjective Social Status Predict Health and Change in Health Status Better Than Objective Status? Psychosomatic Medicine. 67. 6. 855-861.

Slobodkin, L.B. and Rapoport, A. (1974). An optimal strategy of evolution. The Quarterly Review of Biology. 49. 3. 181-200.

Smith, G.D. and Egger, M. (1993). Socioeconomic differentials in wealth and health. British Medical Journal. 307. 1085–1086.

Smith, G.D., Bartley, M. and Blane, D. (1990). The black report on socioeconomic inequalities in health 10 years on. British Medical Journal. 301. 373–377.

Smith, L.P., Nq, S.W. and Popkin, B.M. (2013). Trends in US home food preparation and consumption: analysis of national nutrition surveys and time use studies form 1965-1966 to 2007-2008. Nutrition Journal. Doi:10.1186/1475-2891-12-45.

Snell-Rood, E.C. (2013). An overview of the evolutionary causes and consequences of behavioural plasticity. Animal Behaviour. 85. 5. 1004-1011.

Sonneville, K.R., Horton, N.J., Micali, N. et al (2013). Longitudinal Associations Between Binge Eating and Overeating and Adverse Outcomes Among Adolescents and Young Adults. Does Loss of Control Matter? JAMA Pediatrics. 167. 2. 149-155.

Soon, C.S., Brass, M. Heinze, H.J. et al. (2008). Unconscious determinants of free decisions in the human brain. Unconscious determinants of free decisions in the human brain. Nature Neuroscience. 11. 543-545.

Soon, C.S., He, A.H. Bode, S. et al. (2013). Predicting free choices for abstract intentions. Proceedings of the National Academy of Science of the USA. 110. 15. 6217-6222.

Spengler, S., Mess, F., Mewes, N. et al. (2012). A cluster-analytic approach towards multidimensional health-related behaviours in adolescents: the MoMo-Study. BMC Public Health. 12. 1128.

Speth, J. D. (1983). Energy source, protein metabolism and hunter-gatherer subsistence strategies. Journal of Anthropological Archaeology. 2. 1-31.

Sport England. (2016). Sports participation continues to show an upward trend. Sport England. https://www.sportengland.org/research/who-plays-sport/national-picture/ [Accessed 2nd December 2016].

Srinivasan, S.R., Myers, L. and Berenson, G.S. (2002). Predictability of childhood adiposity and insulin for developing insulin resistance syndrome (syndrome X) in young adulthood: the Bogalusa Heart Study. Diabetes. 51. 204–09.

Stearns, S.C. (1992). The evolution of life histories. Oxford University Press.

Stearns, S.C. and Koella, J.C. (2007). Evolution in health and disease. Oxford University Press.

Stein, C.J. and Colditz, G.A. (2004). The epidemic of obesity. Journal Clinical Endocrinology Metabolism. 89.6: 2522-2525.

Stein, C.J. and Colditz, G.A. (2004). The epidemic of obesity. Journal of Clinical Endocrinology and Metabolism. 89. 6. 2522-2525.

Sterling, P. and Eyer, J. (1988). Allostasis: a new paradigm to explain arousel pathology. In Handbook of Life Stress, Cognition, and Health, Fisher S, Reason J (eds.). New York. John Wiley.

Stevenson, M. and Crnic, K. (2012). Intrusive fathering, children's self-regulation and social skills: a mediation analysis. Journal of Intellectual Disability Research. 57. 6. 500–512.

Stewart-Brown, S., Tennant, A., Tennant, R. et al. (2009). Internal construct validity of the Warwick-Edinburgh Mental Well-being Scale (WEMWBS): a Rasch analysis using data from the Scottish Health Education Population Survey. Health Quality of Life Outcomes. 7:15.

Strack, F. and Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. Personality and Social Psychology Review. 8. 220-247.

Strack, F. and Deutsch, R. (2004). Reflective and Impulsive Determinants of Social Behavior. Personality and Social Psychology Review. 8. 3. 220-247.

Strauss, R.S. and Pollack, H.A. (2001). Epidemic increase in childhood overweight, 1986–1998. Journal of the American Medical Association. 286. 2845–2548.

Strohman, R. (1993). Ancient genomes, wise bodies, and unhealthy people: limits of a genetic paradigm in biology and medicine. Perspectives in Biology and Medicine. 37. 112–145.

Students: Some Research Implications for Campus Alcohol Education Programming. International Journal of the Addictions. 21. 961-976.

Summerbell, C.D., Waters, E., Edmunds, L. et al. (2005). Interventions for preventing obesity in children. Cochrane Database of Systematic Reviews 3: CD001871.

Sutton, S. (1998). Explaining and predicting intentions and behavior: How well are we doing? Journal of Applied Social Psychology. 28. 1318-1339.

Sutton, S. (2000) Interpreting cross-sectional data on stages of change. Psychology & Health. 15. 2. 163-171.

Swinburn, B., Sacks, G. and Ravussin, E. (2009). Increased food energy supply is more than sufficient to explain the US epidemic of obesity. American Journal of Clinical Nutrition. 90. 1453–1456.

Swinburn, B., Sacks, G. and Ravussin, E. (2009). Increased food energy supply is more than sufficient to explain the US epidemic of obesity. The American Journal of Clinical Nutrition. 90. 1453–1456.

Swinburn, B.A., Sacks, G., Hall, K.D. et al. (2011). The global obesity pandemic: shaped by global drivers and local environments. Lancet. 378. 804–814.

Taylor, S.E and Repetti, R. L. (1997). Health psychology: What is an unhealthy environment and how does it get under the skin? The Annual Review of Psychology. 48. 411–447.

Taylor, S.E and Repetti, R. L. (1997). Health psychology: What is an unhealthy environment and how does it get under the skin? The Annual Review of Psychology. 48. 411–47.

Tennant, R., Hiller, L., Fishwick, R. et al. (2007). The Warwick-Edinburgh Mental Well-being Scale (WEMWBS): development and UK validation. Health Qual Life Outcomes. 5: 63.

Terasaki, M. and Imada, S. (1988). Sensation seeking and food preferences. Personality and Individual Differences. 9. 1. 87-93.

The Centre for Eating Disorders. (2016). Connecting feelings, thoughts and deeds: Cognitive Behavior Therapy and eating disorders. http://eatingdisorder.org/treatment-and-support/therapeutic-modalities/cognitive-behavioral-therapy/. [Accessed 22nd December 2016].

The Department of Health. (2011). UK physical activity guidelines. https://www.gov.uk/government/publications/uk-physical-activity-guidelines [Accessed 22nd December 2016].

The Departments for Culture Media and Sport, and Education. (2015). Policy paper: 2010 to 2015 government policy: sports participation. https://www.gov.uk/government/publications/2010-to-2015-government-policy-sports-participation/2010-to-2015-government-policy-sports-participation [Accessed 22nd December 2016].

The Edelman Health Barometer. (2011). Health activated. http://www.edelman.com/post/tag/edelman-health-barometer/ [Accessed 13th January 2017].

The Misuse of Computers Act. (1990). Office of Public Sector Information. http://www.legislation.gov.uk/ukpga/1990/18

The Observatory School, Wirral. (2016). http://www.theobservatoryschool.wirral.sch.uk/ [Accessed 22nd December 2016].

The Poverty Site. (2009). Without home contents insurance. http://www.poverty.org.uk/74/index.shtml?2 (Accessed 12th April 2014).

Thomas, D., Elliott, E.J. and Baur, L. (2007). Low glycaemic index or low glycaemic load diets for overweight and obesity. Cochrane Database of Systematic Reviews. 3: CD005105.

Thompson, R.L., Margetts, B.M., Speller, V.M. et al. (1999). The Health Education Authority's health and lifestyle survey 1993: who are the low fruit and vegetable consumers? Journal of Epidemiology and Community Health. 53. 294–299.

Thorpe, K.L., Florence, C.S., Howard, D.H. et al. (2004). The impact of obesity on rising medical spending. Health Affairs (Millwood). W4 supplement. 480–86.

Tremblay, M.S., Colley, R.C., Saunders, T.J. (2010). Physiological and health implications of a sedentary lifestyle. Applied Physiology, Nutrition, and Metabolism. 35. 6. 725-740.

TIC. (2013). Statistics on obesity, physical activity and diet, England. The Information Centre.

Tomasello, M. (1999). The Cultural Origins of Human Cognition. Harvard University. Press, Cambridge, MA.

Tomasello, M. and Call, J. (1997). Primate cognition. New York, NY: Oxford University Press.

Toneatto, T. and Ladoceur, R. (2003). Treatment of Pathological Gambling: A Critical Review of the Literature. Psychology of Addictive Behaviors. 17. 4. 284-292.

Tononi, G. (2004). An information integration theory of consciousness. BMC Neuroscience. 45. 42. 1-22.

Tooby, J. and Cosmides, L. (1990). On the universality of human nature and the uniqueness of the individual: the role of genetics and adaptation. Journal of Personality. 58. 17–67.

Tounian, P., Aggoun, Y., Dubern, B. et al. (2001). Presence of increased stiffness of the common carotid artery and endothelial dysfunction in severely obese children: a prospective study. Lancet. 358. 9291. 1400-1404.

Townsend, C.R. and Calow, P. (1981). Physiological ecology: an evolutionary approach to resource use. Blackwell scientific, Oxford.

Trivers, R.L. (1971). The evolution of reciprocal altruism. The Quarterly Review of Biology. 46. 1. 35-57.

Trogdon, J.G., Finkelstein, E.A., Hylands, T. et al. (2008). Indirect costs of obesity: a review of the current literature. Obesity Reviews. 9. 489–500.

Turke, P.W. (1989). Evolution and the Demand for Children. 15. 1. 61-90.

Turke, P.W. and Betzig, L.L. (1985). Those Who Can Do: Wealth, Status, and Reproductive Success on Ifaluk. Ethology and Sociobiology. 6. 79-87.

Tymula, A., Rosenberg-Belmaker, L.A., Ruderman, L. et al. (2013). Like cognitive function, decision making across the life span shows profound age-related changes. Proceedings of the National Academy of Sciences of the USA 110: 17143-17148.

U.S. Department of Health and Human Services. (1996). Physical activity and health: a report of the Surgeon General. Atlanta GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion.

U.S. Dept of Health and Human Services. (2010). The surgeon general's vision for a healthy and fit nation. Rockville, MD: U.S. Department of Health and Human Services, Office of the Surgeon General.

Uchino, B.N. (2006). Social Support and Health: A Review of Physiological Processes Potentially Underlying Links to Disease Outcomes. Journal of Behavioral Medicine. 29. 4: 377-387.

Ulijaszek, S. J. (2002). Human eating behaviour in an evolutionary ecological context. Proceedings of the Nutrition Society. 61. 517–526.

Ulijaszek, S.J. (1996). Energetics, adaptation, and adaptability. American Journal of Human Biology. 8. 169-182.

Ulijaszek, S.J. (2002). Human eating behaviour in an evolutionary ecological context. Proceedings of the Nutrition Society. 61. 517-526.

UN, (2011). Sixty-sixth general assembly GA/11138. United Nations. (Published September 2011) http://www.un.org/News/Press/docs/2011/ga11138.doc.htm (Accessed 23rd April 2014).

Unger, J.B., Ritt-Olson, A., Teran, L. et al. (2009). Cultural values and substance use in a multiethnic sample of California adolescents. Addiction Research & Theory. 10. 3. 257-279.

Vallejo-Torres, L., Hale, D., Morris, S. et al. (2014). Income-related inequality in health and health-related behaviour: exploring the equalisation hypothesis. Journal of Epidemiology and Community Health. 68. 615–621.

Ventura, S.J., Mosher, W.D., Curtin, S.C. et al. (2001). Trends in pregnancy rates for the United States, 1976–97: an update. National Vital Statistics Reports. 49. 4. 1–9.

Vermunt, J.K. (2010). Longitudinal research using mixture models. In: K. van Montfort, J.H.L. Oud, and A. Satorra (eds.), Longitudinal Research with Latent Variables , 119-152. Heidelberg, Germany: Springer.

Vermunt, J.K. and Magidson, J. (2013). Latent GOLD 5.0 Upgrade Manual. Belmont, MA: Statistical Innovations Inc.

Viscusi, W.K. (2006). Do smokers underestimate risks? The Journal of Political Economy. 98. 6: 1253-1269.

Vohs, K. D. and Heatherton, T. F. (2000). Self-regulatory failure: A resource-depletion approach. Psychological Science. 11. 249-254.

Vollebergh, W.A.M., Iedema, J., Bijl ,R.V. et al. (2001). The structure and stability of common mental disorders: the NEMESIS study. Archives of General Psychiatry. 58. 597-603.

Wang, H. and Hanna, S. (1997). Does Risk Tolerance Decrease With Age?. Financial Counselling and Planning. 8. 2. 27-32.

Wang, J., Thornton, J.C., Russel, M. et al. (1994). Asians have lower body mass index (BMI) but higher percent body fat than do whites: comparisons of anthropometric measurements. The American Journal of Clinical Nutrition. 60. 23-28.

Wang, J., Thornton, J.C., Russell, M. et al. (1994). Asians have lower body mass index (BMI) but higher percent body fat than do whites: comparisons of anthropometric measurements. American Society for Clinical Nutrition. 60. 1. 23-28.

Wang, Y. and Beydoun, M.A. (2007). The Obesity Epidemic in the United States—Gender, Age, Socioeconomic, Racial/Ethnic, and Geographic Characteristics: A Systematic Review and Meta-Regression Analysis. Epidemiologic Reviews. 29. 6–28.

Wang, Y. C., McPherson, K., Marsh, T. et al. (2011). Health and economic burden of the projected obesity trends in the USA and the UK. Lancet. 378. 815–25.

Wang, Y. C., McPherson, K., Marsh, T. et al. (2011). Health and economic burden of the projected obesity trends in the USA and the UK. Lancet. 378. 815–25.

Wang, Y., Beydoun, M.A., Liang, L. et al. (2008). Will all Americans become overweight or obese? Estimating the progression and cost of the US obesity epidemic. Obesity Silver Spring. 16. 2323–2330.

Wansink, B., Payne, C.R. and Chandon, P. (2007). Internal and external cues of meal cessation: the French paradox redux? Obesity. 15. 2. 2920–2924.

Wardle, H., Moody, A., Spence, S. et al. (2011). British gambling prevalence survey 2010. London: The Stationery Office.

Wardle, J. (2005). The impact of obesity on psychological well-being. Best Practice and Research Clinical Endocrinology and Metabolism. 19. 3. 421-440.

Wardle, J. and Cooke, L. (2005). The impact of obesity on psychological well-being. Best Practice and Research Clinical Endocrinology and Metabolism. 19. 3. 421-440.

Wardle, J. and Steptoe, A. (2003) Socioeconomic differences in attitudes and beliefs about healthy lifestyles. Journal of Epidemiology and Community Health. 57. 440-443.

Wärneryd, K.E. (1996). Risk attitudes and risky behavior Journal of Economic Psychology. 17. 749-770.

Waters, E., de Silva-Sanigorski, A., Hall, B.J. et al. (2011). Interventions for preventing obesity in children (Review). The Cochrane Library. Issue 12.

WCRF. (2007). Food, nutrition, physical activity, and the prevention of cancer: a global perspective. World Cancer Research Fund and American Institute for Cancer Research. Washington, DC: American Institute for Cancer Research.

Well Scotland. (2011). Resources: The Warwick-Edinburgh Mental Wellbeing Scale. http://www.wellscotland.info/guidance/How-to-measure-mental-wellbeing/How-to-start-measuring-mental-wellbeing/The-Warwick-Edinburgh-Mental-Wellbeing-Scale-

Wells, J.C.K., Treleaven, P. and Cole, T.J. (2007). BMI compared with 3-dimensional body shape: the UK National Sizing Survey. American Society for Clinical Nutrition. 85. 2. 419-425.

West, S.A., Griffin, A.S. and Gardner, A. (2007). Evolutionary explanations for cooperation: review. Current Biology. 17. 16. 661-672.

Weyerer, S. (1992). Physical Inactivity and Depression in the Community. International Journal of Sports Medicine. 13. 6. 492-496.

WHO. (2001). Innovative care for chronic conditions: building blocks for action. Geneva: World Health Organization.

WHO. (2003). Controlling the global obesity epidemic. World Health Organization. http://www.who.int/nutrition/topics/obesity/en/ (Accessed 10th March 2014).

WHO. (2005). Preventing chronic diseases a vital investment. WHO global report. World Health Organization. ISBN 92 4 156300 1.

WHO. (2008). Preventing NCDs: The role of diet and physical activity. World Health Organization (Published December 2008) http://www.afro.who.int/en/clusters-a-programmes/hpr/health-risk-factors/diseases-surveillance/highlights/1245-preventing-ncd-the-role-of-diet-and-physical-activity.html [Accessed 19th March 2014].

WHO. (2013). Obesity and overweight Fact sheet N°311. World Health Organization. Updated March 2013. http://www.who.int/mediacentre/factsheets/fs311/en/ [Accessed 11th April 2014].

WHO. (2014). Controlling the global obesity epidemic. World Health Organization. http://www.who.int/nutrition/topics/obesity/en/ [Accessed 11th April 2014].

WHO. (2017). Noncommunicable diseases and their risk factors: Major NCDs and their risk factors http://www.who.int/ncds/introduction/en/ [Accessed 28th March 2017].

Wiersma, W. (2011). The Validity of Surveys: Online and Offline. Oxford Internet Institute.

Wilke, A., Hutchinson, J.M.C., Todd, P.M. et al. (2006). Is risk taking used as a cue in mate choice? Human-nature.com/ep. 4. 367-393.

Wilkie, H.J. Standage, M., Gillison, F.B. (2016). Multiple lifestyle behaviours and overweight and obesity among children aged 9–11 years: results from the UK site of the International Study of Childhood Obesity, Lifestyle and the Environment. BMJ Open. 6:e010677.doi:10.1136/bmjopen-2015-010677.

Wilson, D. S. (1994). Adaptive genetic variation and human evolutionary psychology. Ethology and Sociobiology. 15. 219-235.

Wilson, M. and Daly, M. (1985). Competitiveness, risk taking, and violence: The young male syndrome. Ethology and Sociobiology. 6. 59-73.

Winfield, E.B. and Whaley, A.L. (2005). Relationship Status, Psychological Orientation, and Sexual Risk Taking in a Heterosexual African American College Sample. Journal of Black Psychology. 31. 2. 189-204.

Wing, R.R. (2002). Behavioral weight control. In: Wadden TA, Stunkard AJ, eds. Handbook of obesity treatment. New York: Guilford Press. 301-316.

Winslow, C. E. (1920). The untilled fields of public health. Science. 51. 1306. 23–33.

Winterhalder, B and Smith, E. A. (2000). Analyzing adaptive strategies: Human behavioral ecology at twenty-five. Evolutionary Anthropology. 9. 51-72.

Winterhalder, B. (1986a). The analysis of hunter-gatherer diet: Stalking an optimal foraging model. In Food preferences and aversions, edited by M. Harris and E. A. Ross. Temple University Press, Philadelphia.

Winterhalder, B. (1986b). Diet choice, risk, and food sharing in a stochastic environment. Journal of Anthropological Archaeology. 5. 369-392.

Winthrow, D. and Alter, D.A. (2011). The economic burden of obesity worldwide: a systematic review of the direct costs of obesity. Obesity Reviews. 12. 2. 131-141.

Wittmann, M. and Paulus, M.P. (2008). Decision making, impulsivity and time perception. 12. 1. 7-12.

World Health Organization. (2002). The world health report 2002, reducing risks, promoting health. Geneva.

World Health Organization. (2008). Diet, nutrition and the prevention of chronic diseases. report of a joint WHO/FAO expert consultation. WHO Technical Report Series No. 916. Geneva.

World Health Organization. (2013). Introduction to HIV/AIDS and sexually transmitted infection surveillance - Introduction to respondent-driven sampling. Unit 1. P19.WHO-EM/STD/134/E.

Wrong, H. D. (1980). Class fertility trends in Western nations. New York: Arno Press.

Xie, B., Gilliand, F.D., Li, Y.F. et al. (2003). Effects of Ethnicity, Family Income, and Education on Dietary Intake among Adolescents. Preventive Medicine. 36. 30–40.

Yajnik, C.S. (2004). Early life origins of insulin resistance and type 2 diabetes in India and other Asian countries. Journal of Nutrition. 134. 205-210.

Yang, X., Telama, R., Leino, M. et al. (1999). Factors explaining the physical activity of young adults: the importance of early socialization. Scandinavian Journal of Medicine & Science in Sports. 9. 2. 120–127.

Yaniv, G., Rosin, O and Tobol, Y. (2009). Junk-food, home cooking, physical activity and obesity: The effect of the fat tax and the thin subsidy. Journal of Public Economics. 93. 823–830.

Young, T.K., Bjerregaard, P., Dewailly, E. et al. (2007). Prevalence of obesity and its metabolic correlates among the circumpolar Inuit in three countries. American Journal of Public Health. 97. 691-695.

Zagami, S.E., Golmakani, N., Shandiz, F. et al. (2013). Evaluating the relationship between body size and body shape with the risk of breast cancer. Oman Medical Journal. 28. 6. 389-394.

Zahavi, A. (1975). Mate selection-a selection for a handicap. Journal of Theoretical Biology. 53. 205-214.

Zellner, D.A., Loaiza, S., Gonzalez, Z. et al. (2006). Food selection changes under stress. Physiology and Behavior. 15. 87. 789-793.

Zimbardo, P.G. and Boyd, J.N. (1999). Putting time in perspective: A valid, reliable individual-differences metric. Journal of Personality and Social Psychology. 77. 6. 1271-1288.

Zuckerman, M. and Kuhlman, M. (2000). Personality and risk taking: Common biosocial factors. Journal of Personality. 68. 6. 999-1029.

Zurlo, F., Lillioja, S., Esposito-Del Puente, A. et al. (1990). Low ratio of fat to carbohydrate oxidation as predictor of weight gain: study of 24-h RQ. American Journal of Physiology. 259. 5 part 1. 650-657.

12. APPENDICES

Appendix 1. Evolution and well-being survey

Time to Complete 24 Minutes

I have read the Participant Information Sheet and I am happy to participate: ☐ DB-1

EVOLUTION and WELL BEING

This is a questionnaire about understanding the decisions people make in their lives. Not all questions may feel relevant to you but please try to answer them all as honestly as you can. If you do not know the answer please give us your best guess. If you are unsure about how to answer a particular question please think about how you usually feel. **This is a totally anonymous questionnaire**; you will not be asked information from which you may be identified. **The information collected will remain confidential**; after the data have been examined they will be erased. We hope findings from this research will help us better understand how to help people live healthier and happier lives.

Firstly, please tell us how well you know the person who gave you this questionnaire?

Very well [ ] Quite well [ ] Not very well [ ]

---

1. What is your age? 18-24[ ] 25-30 [ ]

2. What is your sex? Male [ ] Female[ ]

3. Describe your ethnicity:

White [ ]
Arab or Middle Eastern [ ]
Asian or Asian British [ ]
Black or Black British [ ]
Chinese [ ]
Other [ ] Specify.....

4. Describe your sexuality:

Heterosexual [ ] Homosexual [ ] Bisexual [ ]

5. What is the highest level of education you reached?

None [ ] Primary school [ ]
Secondary school [ ] University [ ]

6. Describe your employment status:

Employed Full-Time [ ] Employed Part-Time [ ]
Unemployed [ ] Student [ ] Retired [ ]

7. What is the total weekly income of your household? (include partner's/family's income that live with you)

0-£200 [ ] £200-£300 [ ] £300-£400[ ]
£400-£500 [ ] £500-£700 [ ] £700+ [ ]

8. How many months/years from now do feel sure you can at least maintain your current standard of living?

[ ] months or [ ] years

9. For most of your childhood up to 16 years did you live with:

Both parents [ ] Father only [ ]
Mother only [ ] Neither [ ]

10. Please rate, by circling one number, how much you agree with the following (from 1 'Not at all' to 5 'Very')

My childhood was:	Not at all				Very
Safe	1	2	3	4	5
Happy	1	2	3	4	5
Loving	1	2	3	4	5
Violent	1	2	3	4	5
Poor (little money)	1	2	3	4	5
Lonely	1	2	3	4	5
Strict	1	2	3	4	5

11. How many brothers and sisters you *ever* had [ ]

If any, what year was the oldest born [ ]
the youngest born [ ]

12. Please indicate the current age/or age at death of these relations *(Your best guess is fine)*

Mother Age [ ] yrs or age died [ ]
Father Age [ ] yrs or age died [ ]

On Mother's side of family

Grandmother Age [ ] yrs or age died [ ]
Grandfather Age [ ] yrs or age died [ ]

On Father's side of family

Grandmother Age [ ] yrs or age died [ ]
Grandfather Age [ ] yrs or age died [ ]

13. How many children do you have? [ ]

If any, what age is the oldest [ ] years
what age is the youngest [ ] years

14. How many children would you like to have in total? [ ]

15. When thinking about how many children you have/would like to have, which of these were/are important to you in deciding your total?
Please circle one option

	Not at all Important				Very Important
Size of your home	1	2	3	4	5
Cost of raising/educating	1	2	3	4	5
Effects of child bearing on you or your partner's appearance	1	2	3	4	5
Effects of child bearing on you or your partner's health	1	2	3	4	5
Having enough time for you to do what you want to do	1	2	3	4	5
Difficulties fitting in paid work or your career	1	2	3	4	5
Uncertainty about future income and security	1	2	3	4	5

Page 1

Time to Complete 21 Minutes

	Not at all Important				Very Important
Your age	1	2	3	4	5
Partner's views	1	2	3	4	5
Having enough time for each Child	1	2	3	4	5

16. In an ideal world how many grandchildren would you like to have in total? [ ]

17. Please circle one option.

As an adult I generally:	**Not at all**				**Very**
Feel useful	1	2	3	4	5
Feel optimistic about the future	1	2	3	4	5
Feel relaxed	1	2	3	4	5
Think clearly	1	2	3	4	5
Feel close to other people	1	2	3	4	5
Make up my own mind on things	1	2	3	4	5
Deal with problems well	1	2	3	4	5

Please answer as best you can by putting a number in the space

18. In a typical 24 hour day, hours you spend:

Watching TV [ ]

In bed [ ]

Standing up or moving about [ ]

Talking with your partner (when have one) [ ]

Reading (books, magazines, websites, newspapers) [ ]

19. In a typical 24 hour day, times you

Smoke a cigarette, a pipe or a cigar [ ]

Have a cup of tea or coffee [ ]

Eat a snack other than at meal times (e.g. crisp, biscuit, chocolate, cake) [ ]

20. In a typical 24 hour day, portions (handfuls) of vegetables you eat (e.g. carrots, cabbage, ***but not potatoes*** [ ]

21. Days in a typical week you:

Have at least one alcoholic drink [ ]

Attend classes or courses [ ]

Go shopping for pleasure [ ]

Eat breakfast [ ]

Eat a midday meal (lunch) [ ]

Eat an evening meal (dinner) [ ]

Play with your children for half an hour or more (*if you have children*) [ ]

Play energetic sport or take exercise [ ]

Walk without sitting down for at least a mile/twenty minutes [ ]

Feel you have overall enjoyed the day [ ]

Have a ready meal for dinner heated up at home [ ]

Have a home prepared dinner (e.g. ingredients peeled, chopped at home) [ ]

Eat at least one piece of fruit (e.g. apple, banana, etc.) [ ]

Eat chips [ ]

Clean your teeth at least twice a day [ ]

22. Days in a typical month you

Eat at a restaurant or pub for your evening meal [ ]

Eat a takeaway for your evening meal [ ]

See close family members (mother, father, sister, brother) [ ]

Would see close friends socially (not including family) [ ]

Had five or more alcoholic drinks (small glass of wine, short, half pint beer) [ ]

23. Times in the last 12 months you

Had a violent fight with someone [ ]

Have been drunk [ ]

Have placed a bet (not the lottery) on sport, at a casino, on line, etc [ ]

Have played the lottery [ ]

Have travelled abroad [ ]

24. Since you were aged 18, how many different companies/ organisations you have worked for [ ]

years have you been both out of work and not in full-time education [ ]

25. What do you think is the best age for:

Women to start having children [ ]

Men to start having children [ ]

26. How many close friends do you have? [ ]

27. A healthy sex life means having sex about how many times a month? [ ]

28. Compared to an obese person (very overweight) how many years longer do you think a person who is a healthy weight will live? [ ] years

Time to Complete 18 Minutes

29. Compared to a person who smokes 20 cigarettes a day how many years longer do you think a person who never smokes will live? [ ] years

30. Compared to a person who does no exercise how many years longer do you think a person who does 30 minutes exercise a day will live [ ] years

31. Please indicate (by circling one number for each age range) how happy you have been and how happy you think you might be at future ages. This may not be easy but please have a guess.

Years Old	Very Unhappy									Very Happy
0<=10	1	2	3	4	5	6	7	8	9	10
10<=20	1	2	3	4	5	6	7	8	9	10
20<=30	1	2	3	4	5	6	7	8	9	10
30<=40	1	2	3	4	5	6	7	8	9	10
40<=50	1	2	3	4	5	6	7	8	9	10
50<=60	1	2	3	4	5	6	7	8	9	10
60<=70	1	2	3	4	5	6	7	8	9	10
70<=80	1	2	3	4	5	6	7	8	9	10
Over 80	1	2	3	4	5	6	7	8	9	10

32. Please circle the number on the scale how pleasurable you find the following

	Not at all Pleasurable				Very Pleasurable
Physical exercise	1	2	3	4	5
Eating chocolate, cakes or snacks	1	2	3	4	5
Having an alcoholic drink	1	2	3	4	5
Going for a walk	1	2	3	4	5
Time to yourself	1	2	3	4	5
Socialising with friends (not including family)	1	2	3	4	5
Seeing close family (mother, father, sister, brother)	1	2	3	4	5
Spending time playing with your children (if you have any)	1	2	3	4	5
Quality time with your partner (when you have one)	1	2	3	4	5
Having a takeaway for your evening meal	1	2	3	4	5
Eating out at a restaurant	1	2	3	4	5
Watching TV	1	2	3	4	5
Reading (books, magazines, Websites or newspapers)	1	2	3	4	5
Studying on a course/ night-class	1	2	3	4	5
Smoking a cigarette	1	2	3	4	5
Eating fresh vegetables	1	2	3	4	5
Eating fresh fruit	1	2	3	4	5
Having sex	1	2	3	4	5
Having a home cooked meal	1	2	3	4	5
Having a cup of tea or coffee	1	2	3	4	5

33. For the following questions you are asked to choose one of two answers. Please choose what you personally think or would do by circling either a) or b)

a)	To go up two floors in a building I would usually take the lift when available
b)	To go up two floors in a building I would usually take the stairs
a)	If I needed to lose weight I would rather increase the amount of exercise I take
b)	If I needed to lose weight I would rather reduce the amount I eat
a)	To go up six floors in a building I would usually take a lift when available
b)	To go up six floors in a building usually take the stairs
a)	During my childhood I was frequently involved in exercise (running around, sport)
b)	During my childhood I did relatively little exercise (running around, sport)
a)	I have a sweet tooth and enjoy the taste of sweet things
b)	I am more of a savoury than a sweet person
a)	I see chocolate, sweets and crisps as a treat
b)	I see chocolate, sweets and crisps as a threat to my weight
a)	I prefer foods that are good for my long-term health
b)	I prefer foods that make me feel good when I eat them
a)	I prefer a big meal that leaves me feeling full
b)	I prefer a smaller meal that has high-quality ingredients
a)	I have been a vegetarian at some point since age 18 for at least a year
b)	I have not been a vegetarian at some point since age 18 for at least a year
a)	At meal times usually I eat all the food on my plate
b)	At meal times I often leave some food on my plate
a)	I am always aiming to improve what I have
b)	I am generally happy with what I have

Time to Complete: 15 Minutes

a)	If I am not feeling hungry I will happily skip a meal
b)	I never really skip meals even if I am not feeling hungry

a)	I am careful to eat foods that do not make me put on weight
b)	I do not really think about my weight when choosing my food

a)	If I watch my diet I can stay healthy without exercising
b)	Exercising is an essential part of staying healthy

a)	I do not like the feeling of being full after a meal
b)	I like to feel full at the end of a meal

a)	The best qualities in a long-term partner are being attractive and popular
b)	The best qualities in a long-term partner are being generous and caring

a)	Having a child should always be planned
b)	Planning is not always important when having a child

a)	The best qualities in a short-term partner/one-night stand are being generous and caring
b)	The best qualities in a short-term partner/one-night stand are being attractive and popular

a)	Using a condom makes me feel safer and secure during sex
b)	Using a condom makes sex less enjoyable

a)	Sex can be a normal part of life for a 16 year old
b)	Sex at 16 years old is simply too young

a)	The best qualities in a partner to have children with are being attractive and popular
b)	The best qualities in a partner to have children with are being generous and caring

a)	Even when you are not planning a baby unprotected sex is sometimes worth the risk
b)	Unprotected sex is something you should do only when you want to conceive

a)	It is best to leave having children until later in life
b)	It is best to get having children out the way early in life

a)	I would be happy for a sexual partner of mine to have close friends of the opposite sex
b)	I would not be happy for a sexual partner of mine to have close friends of the opposite sex

a)	It is good to have a sexual partner with experience of many different lovers
b)	It is good to have a sexual partner who has chosen very few different lovers

a)	There are fundamental differences between people of different ethnicity
b)	Ethnicity is only a question of skin colour; underneath we are all the same.

a)	If I saw someone lying on the pavement in the night-time I would see if they were okay
b)	If I saw someone lying on the pavement in the night-time I would avoid them

a)	In life it is generally every man/woman for themselves
b)	We are all in life together

a)	If I saw someone lying on the pavement in the day-time I would see if they were okay
b)	If I saw someone lying on the pavement in the day-time I would avoid them

a)	I would send any children I had to private school if I could afford it
b)	I would never send any children I had to private school

a)	I find it easy to see things from other people's perspective
b)	I often find it difficult to see things from other people's perspective

a)	I would be happy to pay more for locally produced food
b)	I buy food based on value for money not where it is produced

a)	Years of low income studying at University is worthwhile and means a better job afterwards
b)	It is not worth years with very little money just to get a University qualification

a)	I would rather win £2000 in cash
b)	I would rather win a holiday for me and anyone I wish to take worth £10,000 in total

a)	There is no gain without some pain
b)	There are many ways of making gains without any pain

a)	If I get some extra money I tend to spend it
b)	If I get some extra money I tend to save it

a)	I am usually quite an impulsive person
b)	I am usually quite calculated in my decisions

a)	I grew up in a community where everyone knew each other
b)	I grew up in a community where people kept themselves to themselves

a)	Generally, I can rely on my family for support
b)	Generally, I cannot rely on my family for any support

a)	Generally, I can rely on my friends for support
b)	Generally, I cannot rely on my friends for any support

Time to Complete: 12 Minutes

a)	Hitting a child is never okay
b)	Slapping naughty children is sometimes the best way to discipline them

a)	I would donate a kidney to save someone else's child even if it meant risking my life
b)	I would not donate a kidney to save someone else's child

a)	If someone smaller, weaker and of the same sex as me hit me I would probably run
b)	If someone smaller, weaker and of the same sex as me hit me I would probably fight back

a)	There are occasions when violence is the best option
b)	There is never a time when violence is the right choice

a)	I should be able to protect my property with whatever force I feel is necessary
b)	Government should set limits to the force I can use

a)	I would sacrifice my life to save a child of mine
b)	I am not sure if I would be able to sacrifice my life to save a child of mine

a)	Violence is a natural part of the human condition
b)	Being violent is something we learn

a)	I might be violent towards a sexual partner who I found cheating on me
b)	I am sure I would not be violent to a sexual partner who I found cheating on me

a)	If someone bigger and stronger than me hit me I would probably run
b)	If someone bigger and stronger than me hit me I would probably fight back

a)	If guns and bullets could simply be bought from my local supermarket I would not buy them
b)	If guns and bullets could simply be bought from my local supermarket I would buy them

a)	I keep something in my bedroom that can be used as a weapon – just in case
b)	I do not keep anything in my bedroom that can be used as a weapon

a)	I feel I am safe from violence and rarely, if ever, worry about being assaulted
b)	Being the victim of violence is something that often concerns me

a)	I routinely review my experiences
b)	I tend to not dwell on what has happened

a)	So far in life I am doing roughly what I expected
b)	I never imagined I would be where I am now

a)	I have a good idea what my life will be like in 12 months time
b)	I am not really sure what my life will be like in 12 months time

a)	I am always planning for the future
b)	I tend to wait and see how things develop

a)	I am interested in the news and try to keep up-to-date with current events
b)	I am generally not interested in the news

a)	I have plans for when I retire
b)	I have not really thought that far ahead

a)	Most days in my life I know more or less what I will be doing
b)	Most days are unpredictable

a)	It is better to know a little about something than nothing at all
b)	A little knowledge about something is often worse than knowing nothing

a)	I consider myself to be someone who is good with numbers
b)	I am not very good with numbers

a)	I often throw out food because it has passed its sell by or eat by date
b)	I hardly ever throw out food because it has passed its sell by or eat by date

a)	I am good at hiding what I actually feel
b)	I tend to show my emotions quite openly

a)	During a lifetime most people will cheat on at least one sexual partner
b)	During a lifetime most people will never cheat on a sexual partner

a)	I probably tell at least one or two lies every day
b)	More or less I always tell the truth

a)	Most people you meet in life can be trusted
b)	Most people you meet in life cannot be trusted

a)	I am good at knowing what other people are thinking
b)	I am not very good at reading people

a)	Absence from a partner makes me miss them more
b)	Absence from a partner makes me think about them less

a)	I only laugh when I genuinely find things funny
b)	I often laugh out of politeness

a)	I think being honest is always the best thing to do
b)	I think in the real world you sometimes have to be dishonest

Time to Complete 9 Minutes

a)	I would rather die at age 70 years after having been healthy throughout life
b)	I would rather die at age 85 years after restricted movement/mild pain from age 55yrs

a)	Overall my life approach has generally been *'live fast, die young'*
b)	Overall my life approach has generally been *'live safe, die old'*

a)	On my mother's side of the family most relatives have died before age 70 years
b)	On my mother's side of the family most relatives live to at least age 70 years

a)	On my father's side of the family most relatives have died before age 70 years
b)	On my father's side of the family most relatives live to at least age 70 years

a)	Length of life is more important to me
b)	Quality of life is more important to me

a)	Dying at age 75 years means someone has had a good length life
b)	Dying at age 75 years means someone has died early

a)	I am generally a logical and scientific person
b)	I am generally an emotional and creative person

a)	I am generally good with people who are ill with a cold, flu or a fever
b)	If I can I avoid people who are ill

a)	Investing in insurance for your house, car or travel is usually a good use of money
b)	Investing in insurance is usually a waste of money

---

34. For the following questions you are asked to choose one of three or four answers. Please choose what you personally think by circling either a) b) c) or d)

a)	I would rather feel 10 years younger
b)	I would rather live 10 years longer
c)	I would rather look 10 years younger

a)	I do not smoke
b)	I would stop smoking if it extended my life by 10 years
c)	I would stop smoking if it made me look 10 years younger (now or in the future)
d)	In reality none of these would make me stop smoking

a)	As a child I was generally a healthy weight
b)	As a child I was generally a overweight
c)	As a child I was generally skinny

a)	There is a history of cancer on my father's side of the family
b)	There is a history of cancer on my mother's side of the family
c)	There is a history of cancer on my father's and mother's side of the family
d)	I am not aware of any family history of cancer on either my mother's or my father's side

a)	There is a history of heart disease on my father's side of the family
b)	There is a history of heart disease on my mother's side of the family
c)	There is a history of heart disease on my father's and mother's side of the family
d)	I am not aware of any family history of heart disease on either my mother's or father's side

a)	My health is about average for someone of my age and sex
b)	My health is worse than average for someone of my age and sex
c)	My health is better than average for someone of my age and sex

a)	In five years time I think my health will be worse than now
b)	In five years time I think my health will be the same as now
c)	In five years time I think my health will be better than now

a)	I already exercise 30 minutes a day
b)	I would take 30 minutes exercise a day if it extended my life by 5 years
c)	I would take 30 minutes exercise a day if made me look 5 years younger
d)	In reality none of these would make me do 30 minutes exercise a day

a)	I think I exercise about an average amount for someone my age and sex
b)	I think I exercise more than the average for someone my age and sex
c)	I think I exercise less than the average for someone my age and sex

a)	I enjoy taking exercise that leaves me out of breath
b)	I do not enjoy exercise that leaves me out of breath but I do it because it is good for me
c)	I do not really take exercise that leaves me out of breath

a)	I like the taste of thick butter on bread and tend to put lots on
b)	I like the taste of thick butter on bread but still spread it thinly
c)	I do not like the taste of thick butter on bread

Time to Complete: 6 Minutes

a)	My financial position is generally good – I usually have the money for what I need
b)	My financial position is generally poor - I usually find it difficult to make ends meet
c)	My financial position is unpredictable – I have some good times and some bad times

a)	I am relatively well off compared to the people I usually mix with
b)	I am relatively worse off than the people I usually mix with
c)	I am about as well of as the people I usually mix with

a)	Without stopping, I could run a mile (1.6km) with relatively ease
b)	Without stopping, I could run a mile (1.6km) but with some difficulty
c)	Without stopping, I could not run a mile (1.6km)

a)	I am good at remembering people's names and faces
b)	I am good at remembering people's names
c)	I am good at remembering people's faces
d)	I am no good at either

a)	I live a generally carbon neutral life
b)	I would like to live a carbon neutral life but at the moment I do not
c)	I do not particularly care about being carbon neutral
d)	I have no idea what it means to be carbon neutral

a)	My neighbours are good friends of mine
b)	I know neighbours but they are not close friends
c)	I do not really interact with my neighbours
d)	I do not have any neighbours

a)	I never feel like hitting anyone
b)	I sometimes feel like hitting someone and would if I thought I could get away with it
c)	I sometimes feel like hitting someone but would not even if I thought I could get away with it
d)	I sometimes feel like hitting someone and do

a)	I regularly have violent thoughts (e.g imagine hitting/hurting someone) and sometimes act on them
b)	I regularly have violent thoughts (e.g. imagine hitting, hurting someone) but rarely if ever act on them
c)	I do not really have violent thoughts (e.g. imagine hitting, hurting someone)

a)	I have a will which is up to date
b)	I have a will but it needs up dating
c)	I do not have a will

a)	I am generally a religious person
b)	I do not follow any religion but believe in a higher power
c)	I do not believe in a higher power and do not follow any religion

a)	I like the taste of fat on meat (e.g. on bacon, steak) and usually eat the fat
b)	I like the taste of fat on meat (e.g. on bacon, steak) but usually do not eat the fat
c)	I do not like the taste of fat on meat (e.g. on bacon, steak) on meat and do not eat it
d)	I do not like the taste of fat on meat (e.g. on bacon, steak) but eat it anyway

a)	I do not drink alcohol
b)	I would half the amount I drink each week if it extended my life by 5 years
c)	I would half the amount I drink each week if it made me look 10 years younger, now or in the future
d)	In reality none of these would make me half the amount I drink each week

a)	I like the taste of salt in food and usually add salt to food
b)	I like the taste of salt but tend to eat as little as possible
c)	I do not like the taste of salt in food and do not eat it
d)	I do not really think about Salt in food

a)	I like to eat chips and enjoy eating them regularly
b)	I like to eat chips but try to eat them as little as possible
c)	I do not like to eat chips and do not eat them
d)	I do not like to eat chips but will eat them if someone gives me them

a)	I do not generally get hungry between meals
b)	I get hungry between meals and usually have a snack
c)	I get hungry between meals but usually resist eating until meal time

a)	My diet is healthier than an average person of my age and sex
b)	My diet is less healthy than an average person of my age and sex
c)	My diet is about average for a person of my age and sex

a)	Most times I drink alcohol it is to help me unwind
b)	Most times I drink alcohol it is to be social
c)	I never drink alcohol

a)	I think I am fit and healthy
b)	I think I am fit but unhealthy
c)	I think I am unfit but healthy
d)	I think I am unfit and unhealthy

Time to Complete: 3 Minutes

a)	Compared to drinking nothing, drinking two alcoholic drinks a day would have no effect on how long I live
b)	Compared to drinking nothing, drinking two alcoholic drinks a day would probably make my life a little longer
c)	Compared to drinking nothing, drinking two alcoholic drinks a day would probably make my life a little shorter

a)	Being underweight is just as dangerous to your health as being overweight
b)	Being overweight is more dangerous to your health as being underweight
c)	Being underweight is more dangerous to your health as being overweight

a)	At primary school I was one of the clever children in most subjects
b)	At primary school I was an average child in most subjects
c)	At primary school I was towards the bottom of the class in most subjects

a)	I am investing in a pension/putting money aside for older age
b)	I would like to invest in a pension/putting money aside for older age but cannot afford to
c)	I do not think it is worth putting money aside for old age
d)	I do not think much about older age

a)	I am convinced that global warming is real and it concerns me
b)	I am convinced that global warming is real but it is not something I am concerned about
c)	I am not convinced about global warming

a)	I try to recycle rubbish whenever I can
b)	I generally only recycle rubbish when it is convenient
c)	I never really recycle rubbish

a)	At secondary school I was one of the clever children in most subjects
b)	At secondary school I was an average child in most subjects
c)	At secondary school I was towards the bottom of the class in most subjects

a)	As an adult, I am doing what I thought I would do when I was at school
b)	As an adult I am doing something completely different from what I thought when I was at school
c)	When I was at school I never had any idea what I would do when I was an adult

a)	So far I have had the life I always wanted
b)	So far my life has been nothing like the one I wanted
c)	I have never really known what type of life I wanted

a)	I tend to worry about what other people think of me
b)	I am interested in what other people think of me but do not worry about it
c)	I do not think much about what other people think of me

a)	Most of the time I am thinking about what is going to happen in the future
b)	Most of the time I am thinking about what has happened in the past
c)	Most of the time I am thinking about the here and now
d)	Most of the time I am day dreaming

a)	In five years time I think my quality of life will be worse than now
b)	In five years time I think my quality of life will be the same as now
c)	In five years time I think my quality of life will be better than now

a)	When my mind wanders from the present it tends to be about working through things I need to do
b)	When my mind wanders from the present it tend to be about re-living things I have done
c)	When my mind wanders from the present it is usually not really connected to my past or future

Please read carefully and decide which of the following one-time bets you would be prepared to make in real life?

35. £1 on the **toss of a coin** and if you win **you get £3**
Yes [ ] No [ ]

36. £10 on the **toss of coin** and if you win **you get £30**
Yes [ ] No [ ]

37. £100 on the **toss of coin** and if you win **you get £500**
Yes [ ] No [ ]

38. £100 on the **roll of a six-sided dice** (**you pick one number**) and if you win **you get £3000**
Yes [ ] No [ ]

39. £1000 on the **roll of a six-sided dice** (**you pick one number**) and if you win **you get £30,000**
Yes [ ] No [ ]

40. Everything you own (car+house+savings) on the **roll of six sided dice**. *If you win,* ***you double everything****. You win* ***if the numbers 1, 2, 3, 4 or 5*** *comes up* ***but lose everything you own if number 6*** *comes up*
Yes [ ] No [ ]

Optional Information, please only answer these questions if you feel comfortable doing so:

My month of birth was: [ ]

My weight is:
[ ]stone / lbs **or** [ ] kgs

My height is:
[ ] feet / inches **or** [ ] metres / cms

Appendix 2. Study 1 Participant Information Sheet

LIVERPOOL JOHN MOORES UNIVERSITY
PARTICIPANT INFORMATION SHEET

Applying evolutionary principles to the investigation of eating behaviours and other lifestyle choices

You are being invited to take part in a research study. It is important that you understand why the research is being done and what it involves. Please take time to read the following information. Please use the contact details at the bottom if you have any questions or if you would like any more information.

1. What is the purpose of the study?

Evolutionary principles have been applied to lots of areas of science, but they have not been widely applied to public health problems, such as obesity.

The purpose of this research is to better understand the health choices that people make and ultimately to improve health information for the general public.

2. Do I have to take part?

No. It is up to you to decide whether or not to take part. If you do, you will be given **a short questionnaire** and **a pre-paid envelope** to return the questionnaire. You can withdraw from the study at any time.

3. What will happen to me if I take part?

If you choose to complete the questionnaire, you will be asked questions about you, your family, your lifestyle choices (including what you eat and drink, whether you smoke or how much you exercise) and your thoughts and feelings.

The questionnaire will last about twenty-five minutes and you will not be asked for any identifiable information. The results will be written up as part of a PhD dissertation and may or may not become available in the public domain.

4. Are there any risks / benefits involved?

There are not any risks associated with this research; some questions are of a sensitive nature but you are free to leave any questions if they make you feel uncomfortable in any way.

You may find there are some benefits to completing the questionnaire; as a participant you may find the process interesting and enjoyable.

5. Will my taking part in the study be kept confidential?

Yes. The questionnaire will be anonymised and you will not be asked for any identifiable information. The responses you give will only be seen by the lead researcher and will remain completely confidential. The questionnaire will be transferred and stored securely, and will be destroyed after the study.

If you have any further questions relating to this research please contact the lead researcher: Simon Russell, Centre of Public Health, Faculty of Health and Applied Social Sciences.

Email: S.J.Russell@ljmu.ac.uk *Telephone*: 0151 231 4441

Appendix 3. Study 1 Instructions for Primary Seeds

LIVERPOOL JOHN MOORES UNIVERSITY
INFORMATION SHEET FOR PRIMARY SEEDS

Applying Evolutionary Principles to the Investigation of Eating Behaviours and other Lifestyle Choices

You are being invited to assist in the collection of data for this study. The purpose of this research is to better understand the health choices that people make. We hope that ultimately it will help to improve health information for the general public.

You have agreed to act as a **Primary Seed** and you will receive **10 bundles** to distribute among **10 People (Secondary Seeds)** of your choosing. Each **Secondary Seed** will then distribute 10 questionnaires.

Each bundle will contain:

- **1** Instruction sheet **for each Secondary Seed**
- **1** £5 gift voucher **for each Secondary Seed**
- **10** Questionnaires, **10** Participant Information Sheets and **10** pre-paid envelopes **for each Secondary Seed**.

In total you should receive **10** Instruction sheets, **10** £5 gift vouchers, **100** Questionnaires, **100** Participant Information Sheets and **100** pre-paid envelopes. (You will also be given a £10 voucher for your help!).

The questionnaire is anonymous and confidential: Neither the **Secondary Seeds** nor the **Participants** will be required to provide any identifiable information.

While **Secondary Seeds** or **Participants** will not be identifiable, questionnaires will be coded so the researcher can identify how many questionnaires were received from **Primary** and **Secondary Seeds.**

Appendix 4. Study 1 Instructions for Secondary Seeds

LIVERPOOL JOHN MOORES UNIVERSITY
INFORMATION SHEET FOR SECONDARY SEEDS

Applying Evolutionary Principles to the Investigation of Eating Behaviours and other Lifestyle Choices

You are being invited to assist in the collection of data for this study. The purpose of this research is to better understand the health choices that people make. We hope that ultimately it will help to improve health information for the general public.

You have agreed to act as a **Secondary Seed** and you should have received.

- **10** Questionnaires
- **10** Participant Information Sheets
- **10** pre-paid envelopes to return the questionnaire
    - (You should also have received a £5 high street voucher to thank you for your help).

Please choose 10 people that you know (**between the ages of 18 and 30)** and give each person **1** Participant Information Sheet, **1** Questionnaire and **1** pre-paid envelope (to return the questionnaire).

The Participant Information Sheet will tell the person everything they need to know but please remind them that:

- The questionnaire is anonymous
- They will not be asked for any identifiable information
- The responses they provide will remain completely confidential

Please encourage your **10** people to complete the questionnaire by informing them that this research may ultimately help people live healthier and happier lives!

*THANK YOU **VERY MUCH** FOR YOUR ASSISTANCE!*

If you have any further questions relating to this research please contact the lead researcher: Simon Russell, Centre of Public Health, Faculty of Health and Applied Social Sciences.

Email: S.J.Russell@ljmu.ac.uk *Telephone*: 0151 231 4441

Appendix 5. Study 2 NWMWBS Questionnaire

APPROVED BY:	Executive		Field		Analysis		Client		DATE FINAL APPROVED:	

mruk research

M22780
NWPHO Mental Wellbeing Project 2012

OFFICE USE
Serial Number

Good morning/afternoon/evening. My name is _____ from **mruk** research limited. We have been asked to conduct an independent survey of local residents in the North West to obtain their opinions with regard to health and well being. The survey is being conducted on behalf of the North West Public Health Observatory and is being fed back to your local primary care trust to help them tailor the services they provide to local people.

It should take approximately 20 minutes, and all the answers you give will be kept completely confidential.

If you are happy to do this, for reasons of confidentiality we would like you to input your answers yourself onto the keypad. In that way, no one else will be able to identify your responses.

For certain questions there are showcards to assist with providing an answer. These are given to the respondent throughout the survey.

RE-ASSURE FURTHER IF NECESSARY:
This interview has been conducted within the Code of Conduct of the Market Research Society. This guarantees your anonymity. You will not be approached to buy anything as a result of taking part in this research It is only your opinion we want to understand.

All the answers you give will be added with at least 500 others and only presented in statistical format.

1. Yes I can help / proceed with interview
2. Can I speak to... (repeat introduction)
3. Not willing / refusal to participate
4. Named person not known / moved
5. Named person decease (Apologise for contact)
6. Inconvenient / Arrange time to call back

SECTION A: YOUR LOCAL AREA

ASK ALL

Q1. How many years have you lived in this local area? **INTERVIEWER NOTE: local area is defined as area within 15-20 minutes walking distance from home**
READ OUT
*single response
Less than 1 year
1 year but less than 2 years
2 years but less than 5 years
5 years but less than 10 years
10 years or more

ASK ALL

Q2. **SHOWCARD 1:** Overall how satisfied or dissatisfied are you with your local area as a place to live? **INTERVIEWER NOTE: local area is defined as area within 15-20 minutes walking distance from home**
READ OUT
*single response
Very satisfied
Fairly satisfied
Neither satisfied nor dissatisfied
Fairly dissatisfied
Very dissatisfied

ASK ALL

Q3. **SHOWCARD 2:** How strongly do you feel you belong to your immediate neighbourhood? **INTERVIEWER NOTE: (nearer to home than previous question if need clarification)**
READ OUT
*single response
Very strongly
Fairly strongly
Not very strongly
Not at all strongly
Don't know

ASK ALL

Q4. **SHOWCARD 3:** Do you join in the activities of any of the following organisations, on a regular basis?
[- **CODE ALL MENTIONS**]
*multi response
Political parties
Trade Unions (including student unions)
Environmental group
Credit Union
Parents'/School Association
Parenting support group/mums and toddlers group
Tenants'/Residents' group or Neighbourhood Watch
Education, arts or music group/evening class
Choir, reading groups/book club
Religious group or church organisation
Support/Self-help group
Group for elderly people (eg lunch clubs)
Youth group (eg Scouts, Guides, Youth Clubs, etc)

Women's Group
Social club/working men's club
Sports club/sports group (e.g. swimming, Zumba)
Slimming Group (eg Weight Watchers, Slimming World)
None of the above
Other (WRITE IN)

Q5. In the past twelve months, have you done any volunteer work for any groups, clubs or organisations? By volunteering, we mean any unpaid work done to help people besides your family or friends or people you work with.

READ OUT
*single response
Yes
No

ASK ALL
Q6.**SHOWCARD 4:** Do you agree or disagree that you can influence decisions affecting your local area?
READ OUT
*single response
0 Definitely agree
0 Tend to agree
0 Tend to disagree
0 Definitely disagree
0 Don't know

ASK ALL
Q7. **SHOWCARD 5:** How safe or unsafe do you feel when...?
READ OUT
*items popup

	Very safe	Fairly safe	Neither safe nor unsafe	Fairly unsafe	Very unsafe	Don't know
Outside after dark						
Outside during the day						
Home alone at night						

SECTION B: YOUR FEELINGS AND RELATIONSHIPS

ASK ALL
Q8. **SHOWCARD 6:** Below are some statements about feelings and thoughts. Please tick the box that best describes your experience for each statement over the past two weeks

*items popup

	None of the time	Rarely	Some of the time	Often	All of the time
I've been feeling optimistic about the future					
I've been feeling useful					

I've been feeling relaxed					
I've been dealing with problems well					
I've been thinking clearly					
I've been feeling close to other people					
I've been able to make up my own mind about things					

ASK ALL

Q9. **SHOWCARD 7:** All things considered, how satisfied are you with your life as a whole nowadays on a scale of 1 to 10 where 1 is extremely dissatisfied and 10 is extremely satisfied?

READ OUT

*single response

1 – Extremely dissatisfied
2
3
4
5
6
7
8
9
10- Extremely satisfied
Dont know

ASK ALL

Q10. Overall, to what extent do you feel the things you do in your life are worthwhile?

READ OUT

*single response

1 – Not at all worthwhile
2
3
4
5
6
7
8
9
10- Completely worthwhile
Dont know

ASK ALL

Q11. Overall, how happy did you feel yesterday?

READ OUT

*single response

1 – Not at all happy
2

3
4
5
6
7
8
9
10- Completely happy
Dont know

ASK ALL

Q12. Overall, how anxious did you feel yesterday?
READ OUT
*single response
1 – Not at all anxious
2
3
4
5
6
7
8
9
10- Completely anxious
Dont know

ASK ALL

Q13. QGenerally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people? Please give a score of 0 to 10, where 0 means you can't be too careful and 10 means that most people can be trusted.

Can't be too careful — Most people can be trusted

0	1	2	3	4	5	6	7	8	9	10

ASK ALL

Q14. **SHOWCARD 8:** How often do you talk to any of your neighbours? (**Interviewer note: This does not include anyone who lives in your home such as flatmates.)**
Is it . . .
READ OUT
*single response
On most days
Once or twice a week
Once or twice a month
Less often than once a month
Never

ASK ALL

Q15. **SHOWCARD 8:** We would like to ask how often you meet people, whether at your home or elsewhere. How often do you meet friends or relatives who are not living with you? Is it . . .
READ OUT
*single response
On most days
Once or twice a week

Once or twice a month
Less often than once a month
Never

ASK ALL

Q16. **SHOWCARD 9:** I am going to read a list of situations where people might need help. For each one, could you tell me if you would ask anyone for help?
[- **READ OUT)**
*items popup

	Yes	**No**	**Don't know / It depends**
You need a lift to be somewhere urgently			
You are ill in bed and need help at home			
You are in financial difficulty and need to borrow £100			
If you had a serious personal crisis, do you have people you feel you could turn to for comfort and support?			

ASK ALL

Q17. **SHOWCARD 1:** All things considered, how satisfied are you with your personal relationships?
READ OUT
*single response
Very satisfied
Fairly satisfied
Neither satisfied nor dissatisfied
Fairly dissatisfied
Very dissatisfied
Don't know

ASK ALL

Q18. To what extent do you agree that you have time to do the things that you really enjoy?
READ OUT
*single response
Definitely agree
Tend to agree
Tend to disagree
Definitely disagree
Don't know

ASK ALL

Q19. Thinking about the last 12 months, how often, on average, have you spent your leisure time out of doors?
By out of doors we mean open spaces in and around towns and cities, the coast and the countryside. This could be anything from a few minutes to all day. It may include time spent in your own garden, time spent close to your home, further afield or while on holiday. However this **does not include** routine shopping trips
READ OUT
*single response
More than once per day
Every day
Several times a week
Once a week
Once or twice a month

Once every 2-3 months
Once or twice a year
Never

ASK ALL

Q20. Overall how happy would you say your childhood was on a scale of 1 to 10 where 1 is extremely unhappy and 10 is extremely happy?

READ OUT

*single response
1 – Extremely unhappy
2
3
4
5
6
7
8
9
10- Extremely happy
Dont know

ASK ALL

Q21. Overall how violent would you say your home life as a child was on a scale of 1 to 10 where 1 is free from all violence and 10 is very violent? This includes violence you may have witnessed at home, not just been directly involved with.

READ OUT

*single response
1 – Free from all violence
2
3
4
5
6
7
8
9
10- Very violent
Dont know

SECTION C: ABOUT YOUR HEALTH

ASK ALL

Q22. How is your health in general? Would you say it is….

READ OUT

*single response
Very good
Good
Fair
Bad
Very bad
Don't know

ASK ALL

Q23. For each category please indicate which statement best describes your own health today

(INTERVIEWER NOTE: ENCOURAGE RESPONDENT TO COMPLETE RESPONSES TO THIS QUESTION THEMSELVES, RATHER THAN READING OUT) CODE ONE OPTION FOR EACH CATEGORY

*single response

Mobility	
I have no problems in walking about	
I have some problems in walking about	
I am confined to bed	
Self-Care	
I have no problems with self-care	
I have some problems washing or dressing myself	
I am unable to wash or dress myself	
Usual Activities (*e.g. work, study, housework, family or leisure activities)*	
I have no problems with performing my usual activities	
I have some problems with performing my usual activities	
I am unable to perform my usual activities	
Pain/Discomfort	
I have no pain or discomfort	
I have moderate pain or discomfort	
I have extreme pain or discomfort	
Anxiety/Depression	
I am not anxious or depressed	
I am moderately anxious or depressed	
I am extremely anxious or depressed	

ASK ALL

Q24. Has a doctor or nurse ever **told you that you have** any of the following				
	No	Yes	How many years ago were you first told? (NB: Interviewer write in number of years rather than date when told)	Are you taking medication for this?
High blood pressure (hypertension)	☐	☐ →		☐ Yes
Angina	☐	☐ →		☐ Yes
Coronary Heart Disease or heart attack	☐	☐ →		☐ Yes
Stroke	☐	☐ →		☐ Yes
Asthma	☐	☐ →		☐ Yes
Respiratory Disease such as *Chronic bronchitis/ Emphysema/ Chronic Obstructive Pulmonary Disease*	☐	☐ →		☐ Yes
Diabetes	☐	☐ →		☐ Yes
Digestive disease such as *gastritis, ulcer, Crohn's disease, colitis*	☐	☐ →		☐ Yes
Liver disease	☐	☐ →		☐ Yes
Cancer	☐	☐ →		☐ Yes
Depression, anxiety or stress	☐	☐ →		☐ Yes

ASK ALL

Q25a. Do you care for someone with long term ill health OR problems related to old age, other than as part of your job? And if so, for how many hours?

READ OUT

*single response

No

Yes, 1-19 hours a week

Yes, 20-49 hours a week

Yes, 50+ hours a week

ASK IF YES AT Q25a, OTHERWISE SKIP TO SECTION D

Q25b. Does this person live in your home?

READ OUT

*single response

No

Yes

SECTION D: LIFESTYLES AND LIFE EVENTS

ASK ALL

Q26. Have you heard of the five ways to wellbeing?

READ OUT

*single response

Yes
No
Not sure

ASK ALL

Q27. In the past week, on how many days have you accumulated at least 30 minutes of moderate intensity physical activity such as brisk walking, cycling, sport, exercise, and active recreation? (Do not include walking at a slow or normal pace).

READ OUT

*single response
0 days
1 days
2 days
3 days
4 days
5 days
6 days
7 days
Don't know / refused

Display5. **READ OUT: Now we would like to ask you about the times when you are not being physically active; when you are sitting or reclining at work and at home. This may be when you are sat in front of a computer or television, or listening to music. Do not include the time you spend sleeping.**

*no question

ASK ALL

Q28. Not including the time you spend sleeping, how much time do you usually spend sitting or reclining on a typical day?

[- INTERVIEWER INSTRUCTION: IF REFUSED CODE AS 9999 -]

* numeric

	HOURS		MINS	
WRITE IN NUMBER:				

ASK ALL

Q29. Smoking - which best describes you?

READ OUT

*single response
I have never smoked
I used to smoke occasionally but do not smoke at all now
I used to smoke daily but do not smoke at all now
I smoke occasionally but not daily
I smoke daily
Refused (try to avoid)

ASK Q30 IF SMOKES AT Q29 (CODES 4 OR 5)

Q30. Which of these factors is stopping you from quitting smoking?

READ OUT

*multi response

I do not want to quit
My spouse/partner smokes
My friends smoke
Life too stressful/just not a good time
Couldn't cope with the cravings
Would miss the habit/something to do with my hands
Worried about putting on weight
Lack of commitment to quitting
Other (specify)
Don't know / refused (try to avoid)

ASK ALL

Q31. How often do you drink alcohol?

READ OUT

*single response

I have never drunk alcohol	**Go to Q35**
Never – I used to drink alcohol but have now given up	**Go to Q35**
Less than once a month	
1 or 2 times a month	
Weekly	
2-4 times a week	
Daily (or almost)	
Refused (try to avoid)	

ASK IF CODES 3 TO 7 AT Q31

Q32. **SHOWCARD 10.** Which of these are the reasons you drink? (tick as many as apply).

READ OUT

*multiple response

		ASK IF CODES 1 TO 7 Of these, which is the one main reason you drink? *single response
It helps me to relax and unwind		
It makes socialising more fun		
It gives me confidence		
It goes well with food		
It relieves boredom		
It helps me to forget my problems		
Other reason		
Don't know / refused (try to avoid)		

Q33. Did you drink alcohol in the last week?

READ OUT

*single response

Yes
No

IF YES, COMPLETE TABLE BELOW

	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Did you drink alcohol on…?	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐

If so, what did you drink? Please complete the table below, entering the number of drinks in the spaces provided

	Mon	Tue	Wed	Thur	Fri	Sat	Sun
EXAMPLE DRINK	***1***	***0***	***2***	***0***	***3***	***7***	***0***
Pints of low alcoholic beer/lager/cider							
Pints of normal strength beer/lager/shandy/stout/cider							
Pints of strong beer/lager/cider							
Bottles of alcopops (330ml)							
Single glasses of spirits (25ml)							
Standard glasses of wine (175ml)							
Single glasses of fortified wine e.g. sherry/port/martini							

Q34. How often do you have six or more drinks in one session? (a single drink is a half pint of regular beer, lager or cider, a small glass of wine, a single measure of spirits, or a small glass of sherry**) INTERVIEWER NOTE: If asked a session refers to that period of time of drinking alcohol**

READ OUT
*single response
Never
Less than monthly
1 or 2 times a month
Weekly
2-4 times a week
Daily (or almost)

ASK ALL

Q35. How often, if ever, have you taken cannabis?
READ OUT
*single response
Never
Used, but not in last 12 months
Used in the past 12 months
Used in the past month
Refused (try to avoid)

ASK ALL

Q36. On a normal day, how many portions of fruit and vegetables (excluding potatoes) would you usually eat (one portion is roughly one handful or a full piece of fruit such as an apple)?
READ OUT
*single response
0
1
2
3

4
5 or more

ASK ALL

Q37. Which foods do you usually prefer?
READ OUT
*single response
Foods that are good for my long-term health
Foods that make me feel good when I eat them

ASK ALL

Q38. Which of these phrases comes closest to describing your feeling about your household income these days?
READ OUT
*single response
Living comfortably on present income
Coping on present income
Finding it difficult on present income
Finding it very difficult on present income

ASK ALL

Q39. How often would you say you have been worried about money during the last few weeks?
READ OUT
*single response
Almost all the time
Quite often
Only sometimes
Never

ASK ALL

Q40. Compared to a year ago, would you say that financially you are currently
READ OUT
*single response
Better off
Worse off
About the same
Refused (try to avoid)

ASK ALL

Q41. Looking ahead, how do you think you yourself will be financially a year from now, will you be
READ OUT
*single response
Better off than now
Worse off than now
About the same
Refused (try to avoid)

Display6. **SECTION E: ABOUT YOURSELF**
*no question

ASK ALL

Q42. What term do you usually use to describe your sexual identity?

DON'T READ OUT

*single response

Lesbian/Gay

Bisexual

Heterosexual

Other

Refused (try to avoid)

ASK ALL

Q43. Are you currently in a long term sexual relationship?

DON'T READ OUT

*single response

Yes

No

Refused (try to avoid)

ASK ALL

Q44. Have you been pregnant, or got someone pregnant in the last 12 months?

READ OUT

*single response

Yes

No

Refused (try to avoid)

Display7. **READ OUT: We would like to find out a little bit about the people who live with you in your household. If you live alone, then we only need information about yourself. If you have other people living with you, please complete the following questions for ALL household members.**

ASK ALL

Q45. Including yourself, how many people live in your household?

[- INTERVIEWER INSTRUCTION: IF REFUSED CODE AS 99]

* numeric

WRITE IN NUMBER: | | |

ASK ALL

(CAPI TO SHOW NUMBER OF PERSON ROWS IN LINE WITH RESPONSE TO Q44)

ASK Q46 TO Q49 FOR EACH PERSON IN HOUSEHOLD START WITH RESPONDENT:

CODE ONE ONLY FOR EACH HOUSEHOLD MEMBER IF DON'T KNOW OR REFUSED AND ASK FOR RANGE.

CODE ACCORDINGLY- IF NO PARTNER/ CODE PERSON 3 ONWARDS.

Q46 **SHOWCARD 11*:** What is the relationship between you and this household member?

Q47 How old are you/is s/he?

Q48 Is s/he female or male?

ASK Q49 FOR ALL PERSONS AGED 18 YEARS OR OVER

Q49 **SHOWCARD 11*:** Which of the following best describes this persons working status? **INTERVIEWER NOTE: If asked full time is typically described as 35 hours or more, and part time would be less than this.**

*items popup

	Q46. RELATIONSHIP		Q47. AGE				Q48. GENDER			Q49. WORK STATUS	
	Write in letter from showcard	N/A or refused	Age (WRITE IN) e.g. 85			Don't know / refused	N/A	Male	Female	Write in letter from showcard	N/A or refused
Respondent											
Partner / spouse											
Person 3											
Person 4											
Person 5											
Person 6											
Person 7											
Person 8											
Person 9											
Person 10											
Person 11											
Person 12											

***SHOWCARD 11 LIST:**

A Natural parent
B Step parent
C Foster carer
D Child
E Grandparent
F Sibling
G Niece/nephew
H Friend
I Other

***SHOWCARD 12 LIST:**

A Paid Work: Full Time
B Paid Work: Part Time
C Self Employed
D Full Time Education
E Out Of Work, registered unemployed and actively seeking work
F Out Of Work , registered unemployed but not actively seeking work
G Permanently Sick Or Disabled
H Not Working For Domestic Reasons
I Retired
J Other

ASK ALL

Q50. Do you, or anyone living in your home, own or rent the accommodation in which you live?

READ OUT

*single response
Owns outright
Owns with a mortgage or loan

Pays part rent and part mortgage (shared ownership)
Accommodation is a residential home or student halls
Rents from the Council
Rents from a housing association
Rents from a private landlord
Other

ASK ALL

Q51. Overall, how satisfied or dissatisfied are you with your home?
READ OUT
*single response
Very satisfied
Fairly satisfied
Neither satisfied nor dissatisfied
Fairly dissatisfied
Very dissatisfied
No opinion (SPONTANEOUS ONLY)
Not answered

ASK ALL

Q52. **SHOWCARD 13:** Which of these qualifications do you have? (If your qualification is not listed choose the nearest equivalent)
[**READ OUT AND CODE ALL MENTIONS**]
*multi response
1+ O levels/CSEs/GCSEs (any grades), Basic Skills
NVQ Level 1, Foundation GNVQ
5+ O levels (any grade), CSEs (grade 1), GCSEs (grades A*-C), School Certificate, 1+ A levels/ AS levels / VCEs
NVQ Level 2, Intermediate GNVQ City and Guilds Craft, BTEC First/General Diploma, RSA Diploma
Apprenticeship
2+ A levels, 4+ AS levels, Higher school Certificate
NVQ Level 3, Advanced GNVQ, City and Guilds Advanced Craft, ONC,OND, BTEC National, RSA Advanced Diploma
First Degree (eg BA, BSc), Higher degree (eg MA, PhD, PGCE)
NVQ Level 4-5, HNC, HND, RSA, Higher Diploma, BTEC Higher level
Professional Qualifications (eg nursing, teaching, accountancy)
Other vocational/work related qualifications
Foreign qualifications
No qualifications

ASK ALL

Q53. **SHOWCARD 14:** Which of the following best describes your ethnicity?
DON'T READ OUT
*single response
White - British
White – Irish
White – Eastern European
White – Other White Background
Mixed – White and Black Caribbean
Mixed – White and Black African
Mixed – White and Asian
Mixed – Any Other Mixed Background
Asian or Asian British – Indian

Asian or Asian British – Pakistani
Asian or Asian British – Bangladeshi
Asian or Asian British – Other Asian Background
Black or Black British – Caribbean
Black or Black British – African
Black or Black British – Other Black Background
Chinese
Don't know *(Try to avoid)*
Refused *(Try to avoid)*
Other (please specify)

ASK ALL

Q54. May we have your postcode; (but will be shown alongside data) and will only be used by **mruk** and Liverpool John Moores University for the purpose of geographical analysis
[- INTERVIEWER INSTRUCTION: IF REFUSED CODE AS 999999 -]
* numeric

Yes
No

WRITE IN | | | | | | | |

For back checking purposes we require your full name, address and telephone number. These details are held in confidence are are not linked to your answers, neither are they passed on to any third party.

Respondents full name with whom the survey was completed
* open

ASK ALL

ADDRESS. Respondents full address (excluding postcode)
* open

ASK ALL

POSTCODE. Respondents full postcode
* open

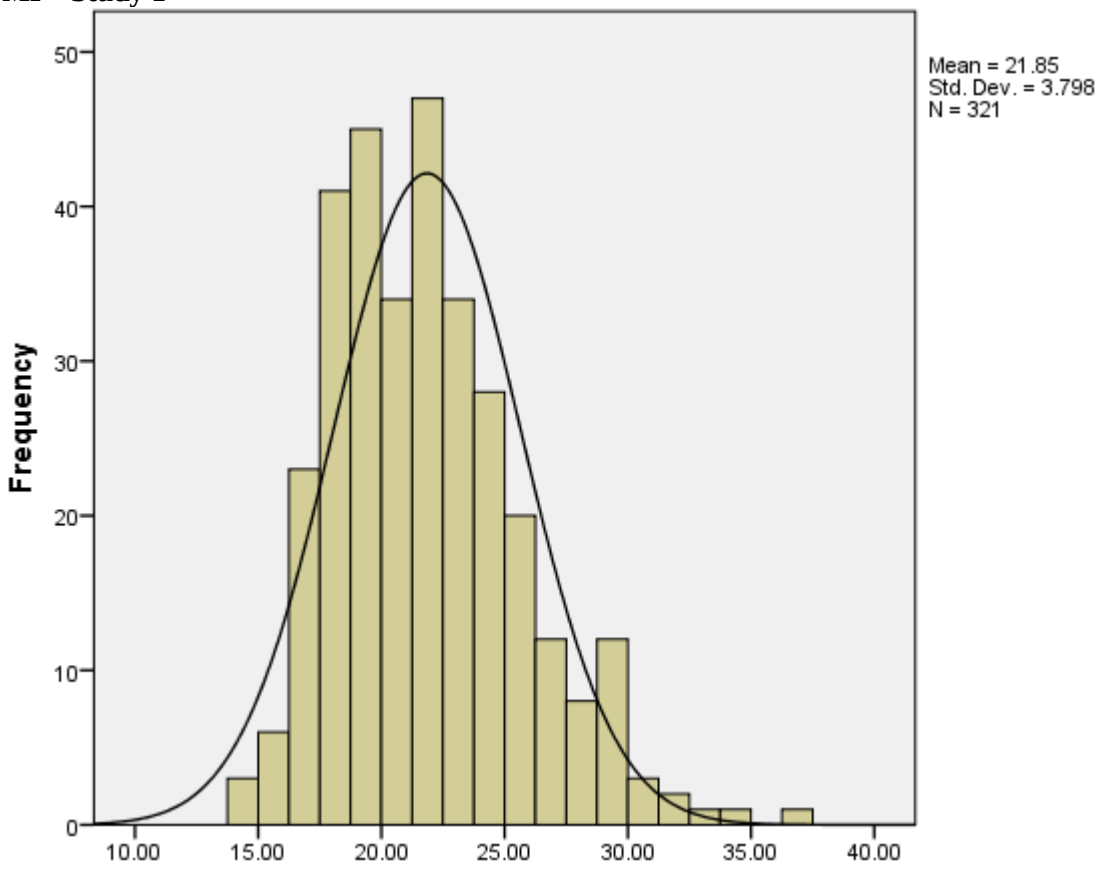
ASK ALL

TELEPHONE. Respondents telephone number
* open

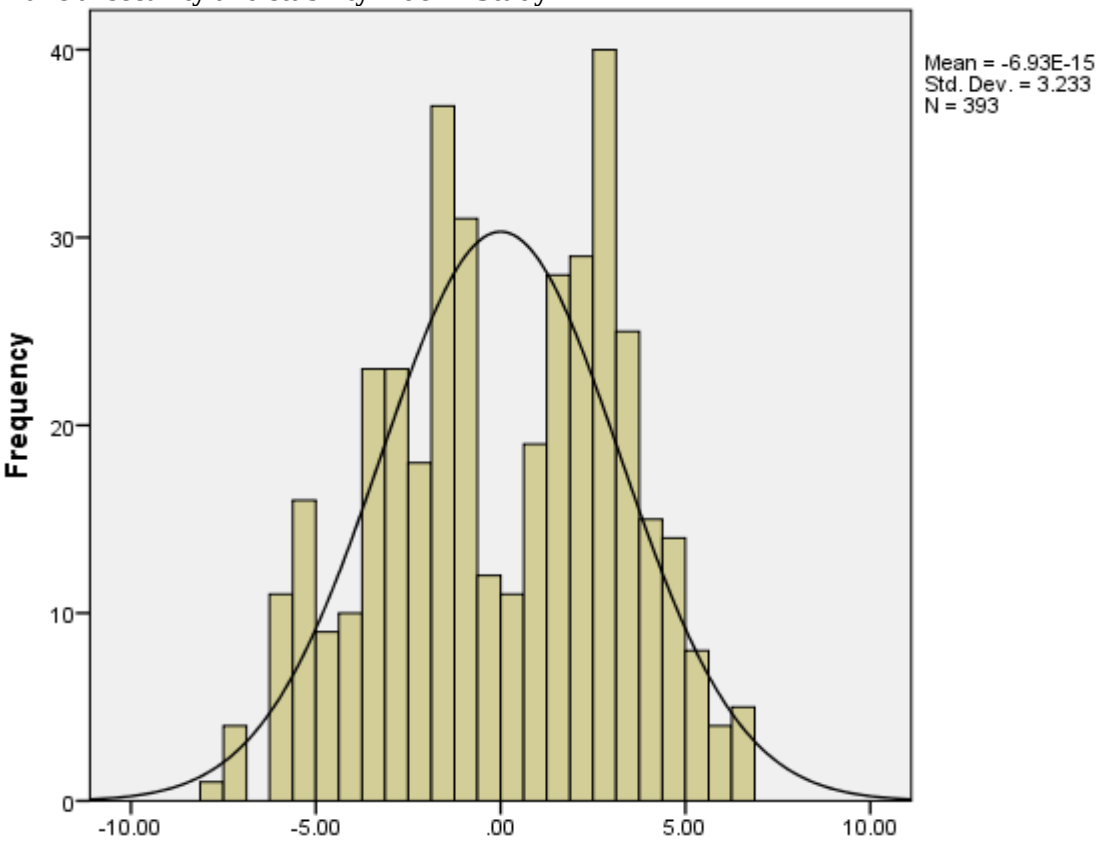
THANK YOU FOR YOUR TIME, MAY I JUST REMIND YOU THAT MY NAME IS _____ FROM MRUK RESEARCH LTD, OUR COMPANY FREEPHONE NUMBER IS 0800 073 2607 AND THE MARKET RESEARCH SOCIETY NUMBER IS 0500 39 69 99, SHOULD YOU HAVE ANY QUERIES ON OUR COMPANY OR WITH REGARDS TO THIS RESEARCH.

Appendix 6. Data distributions with normality curves for scales and indices

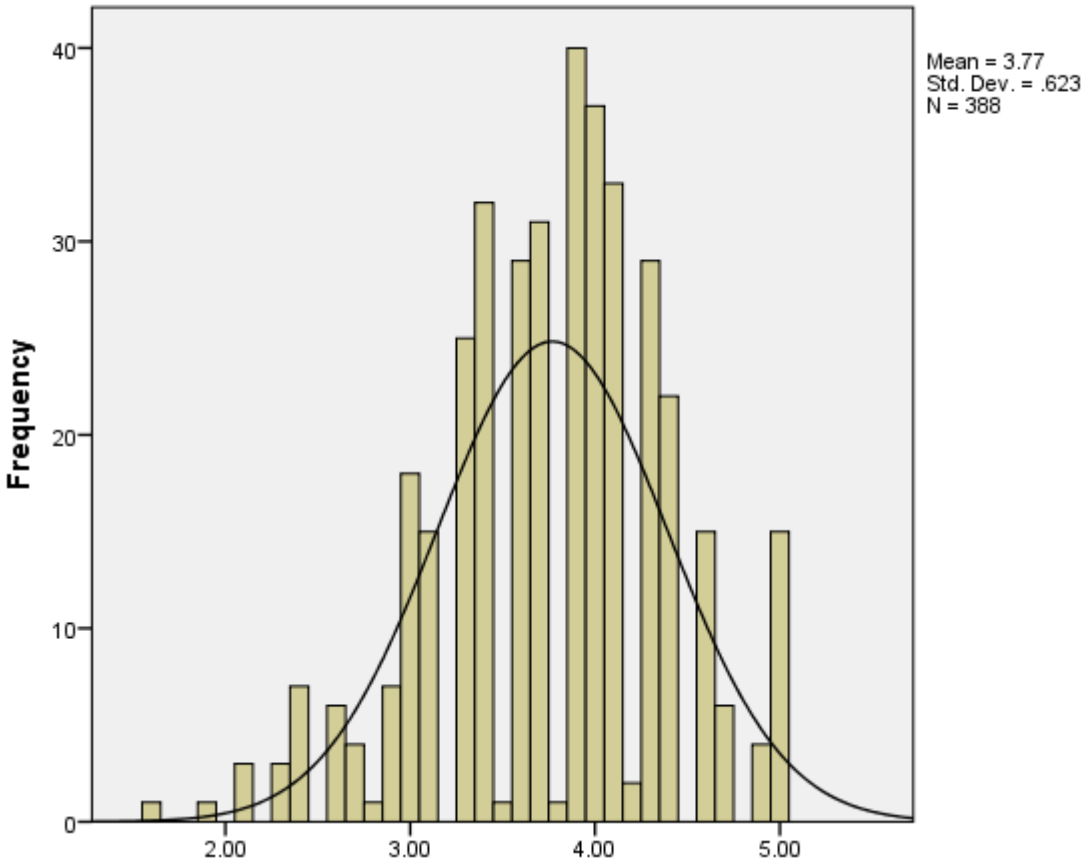
BMI – Study 1



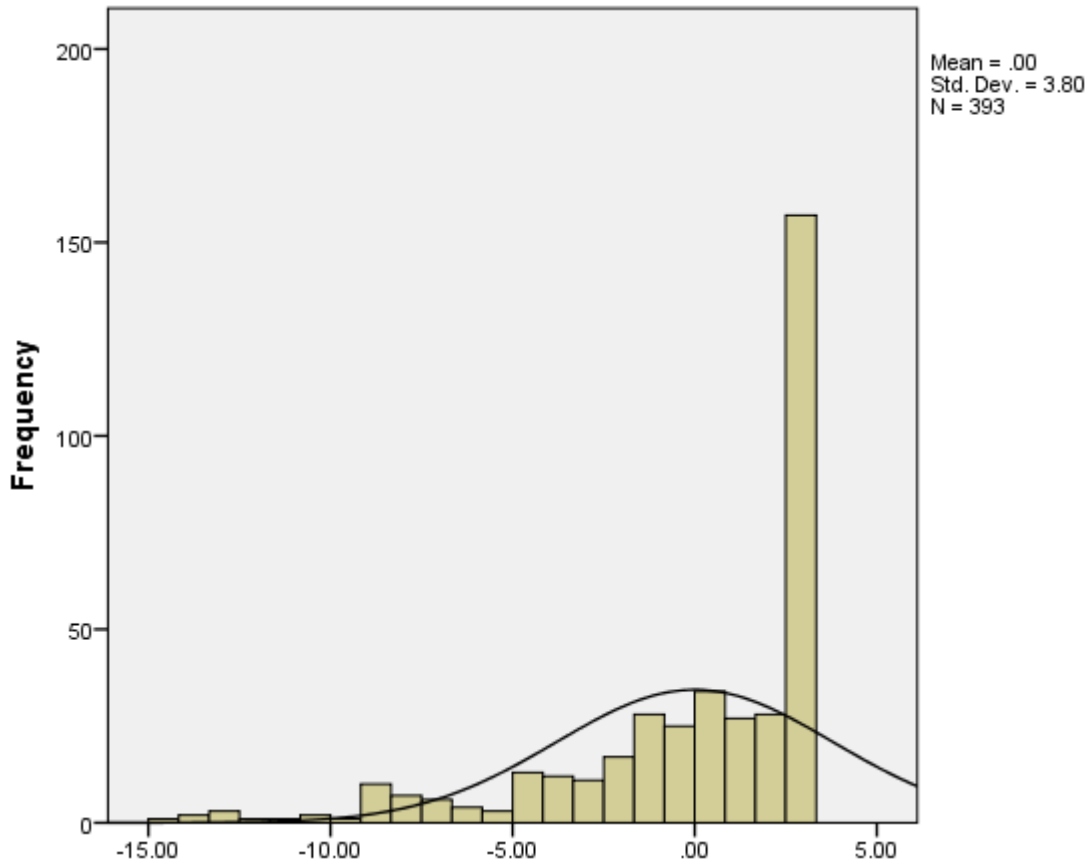
Financial security and stability index – Study 1



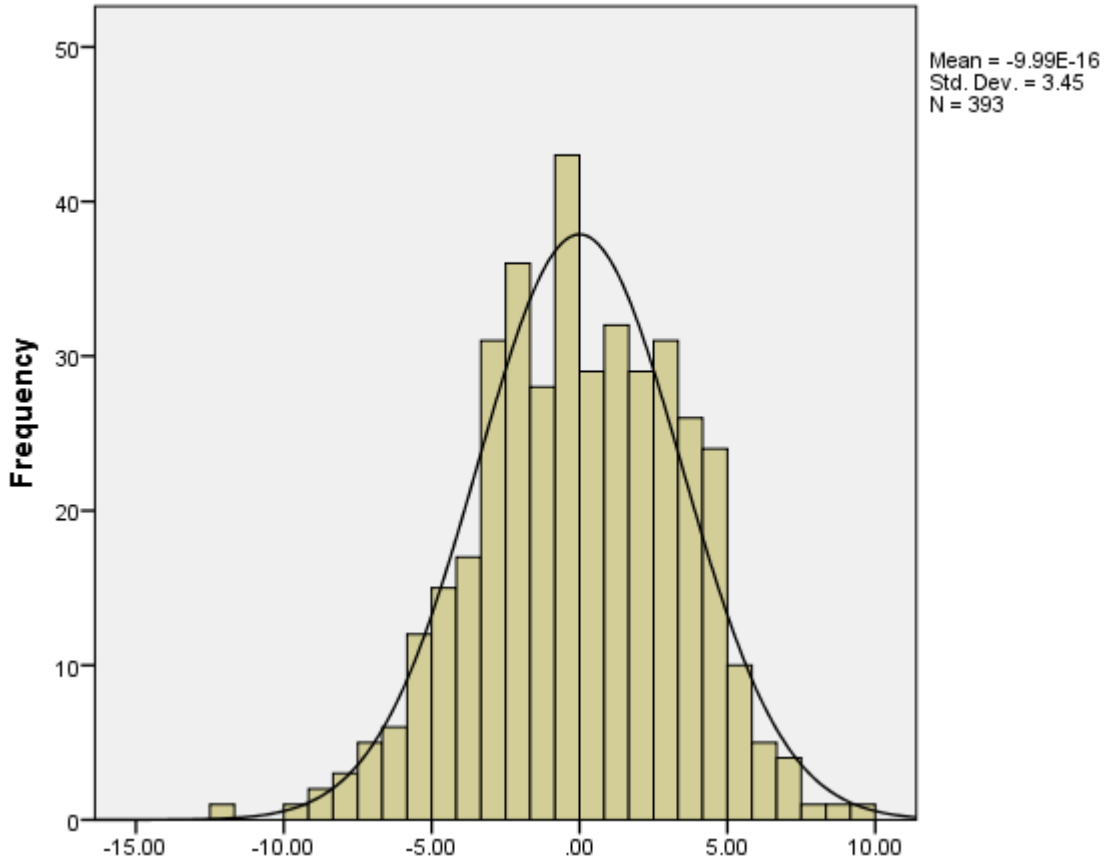
Adult well-being– Study 1



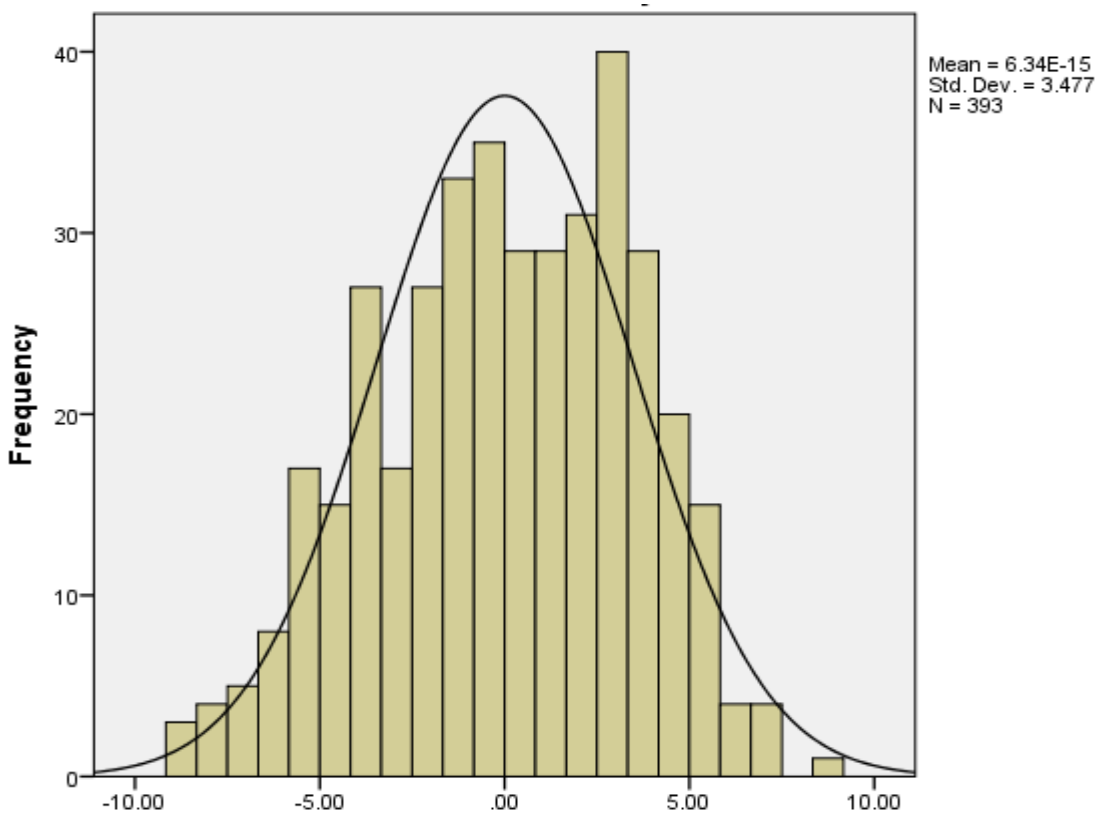
Childhood experience index– Study 1



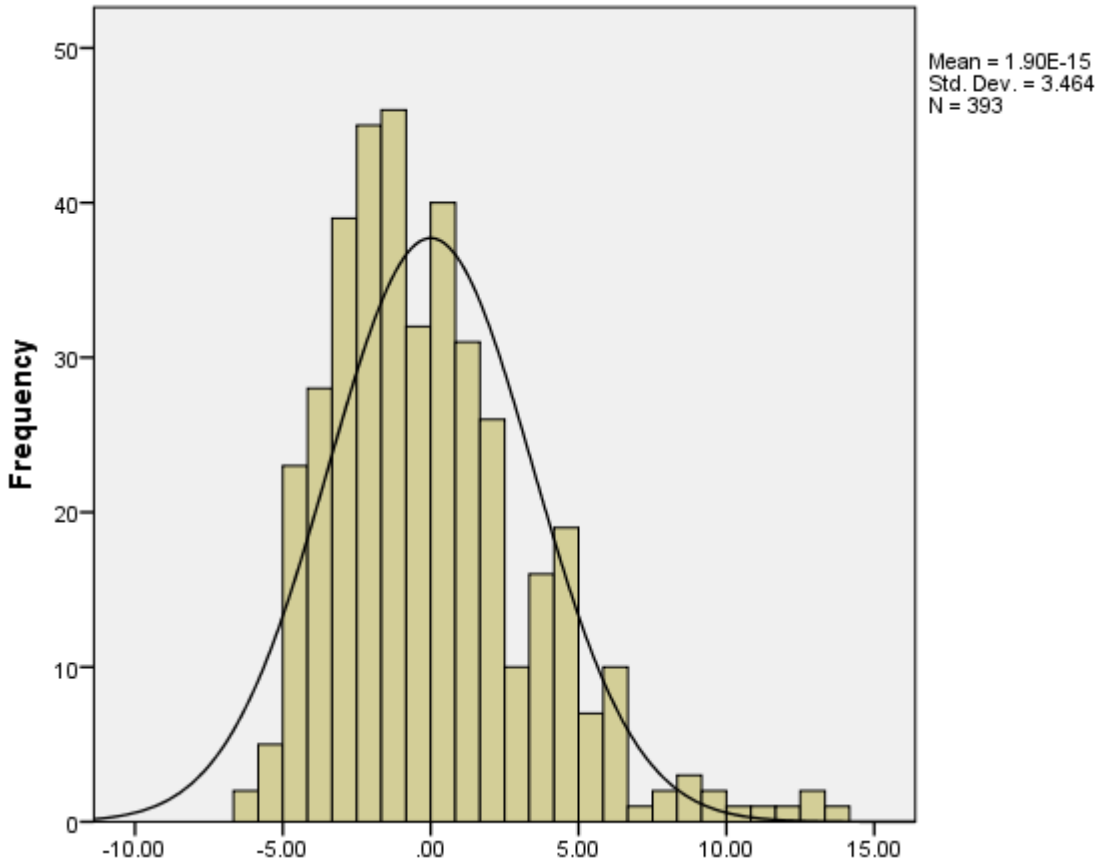
Eating for pleasure or health index– Study 1



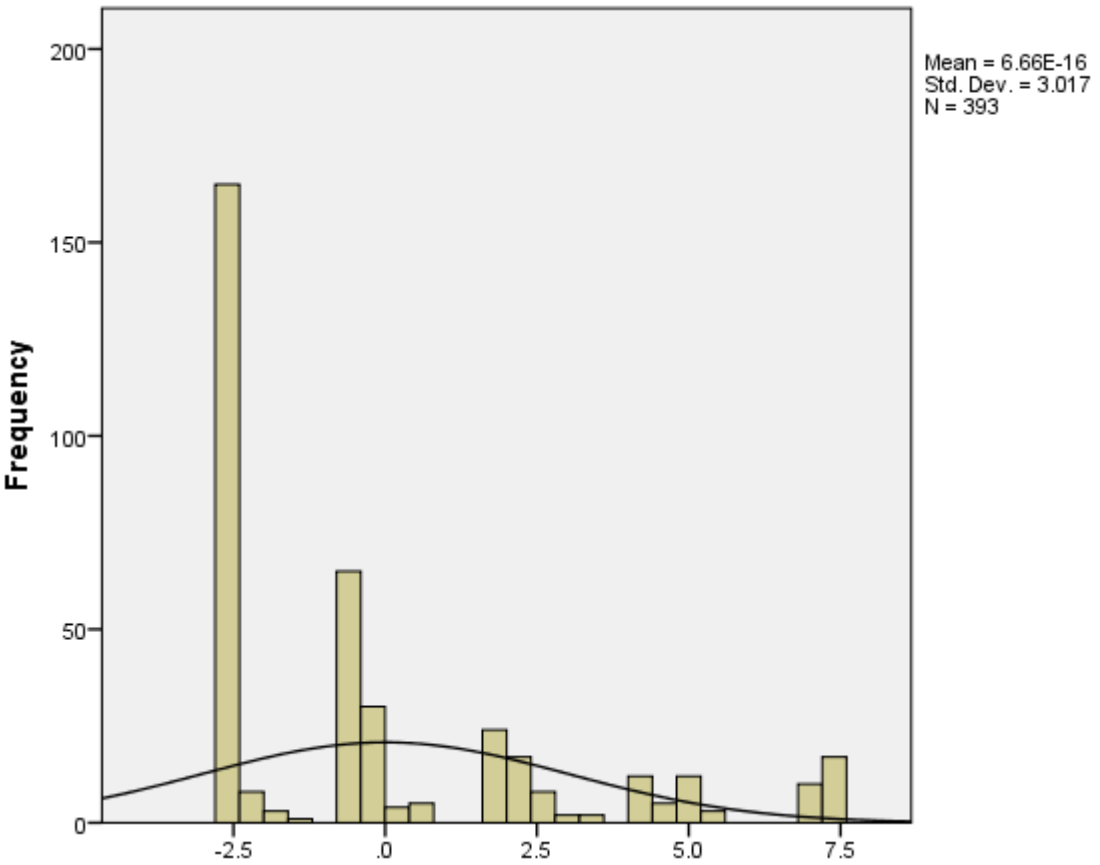
Physical activity index– Study 1



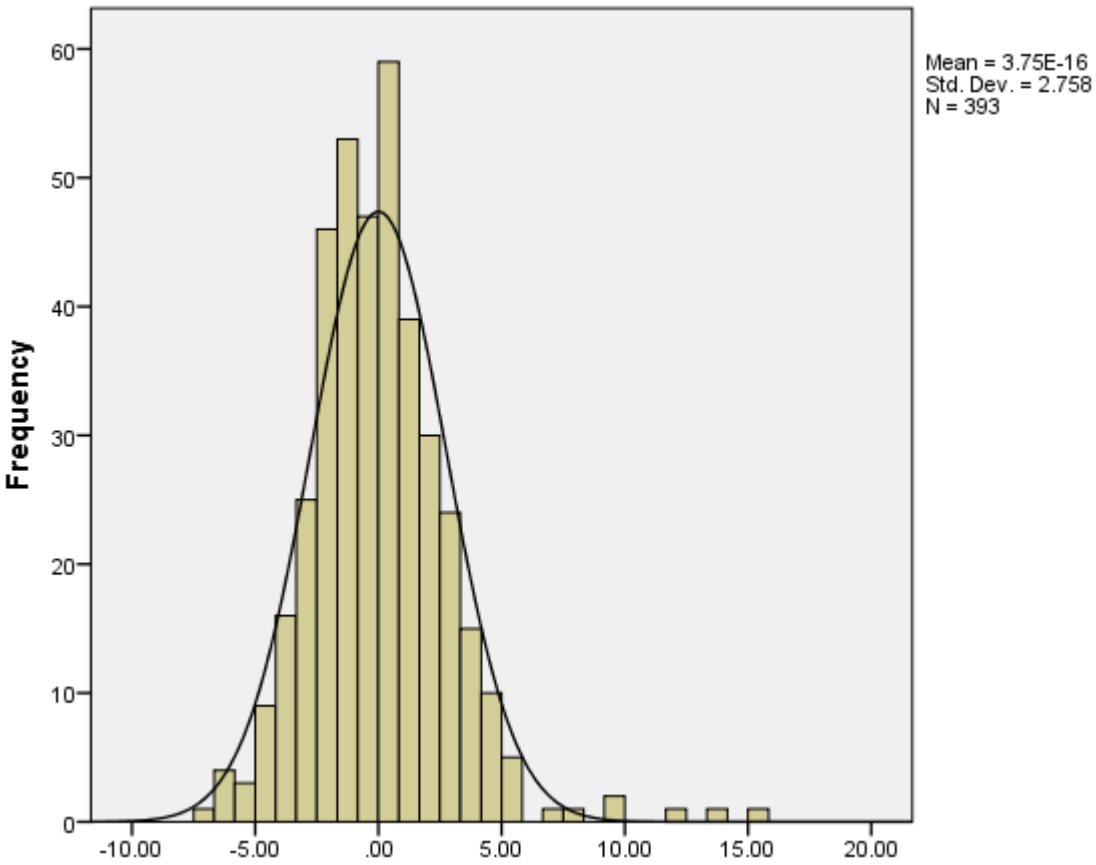
Health risk taking index– Study 1



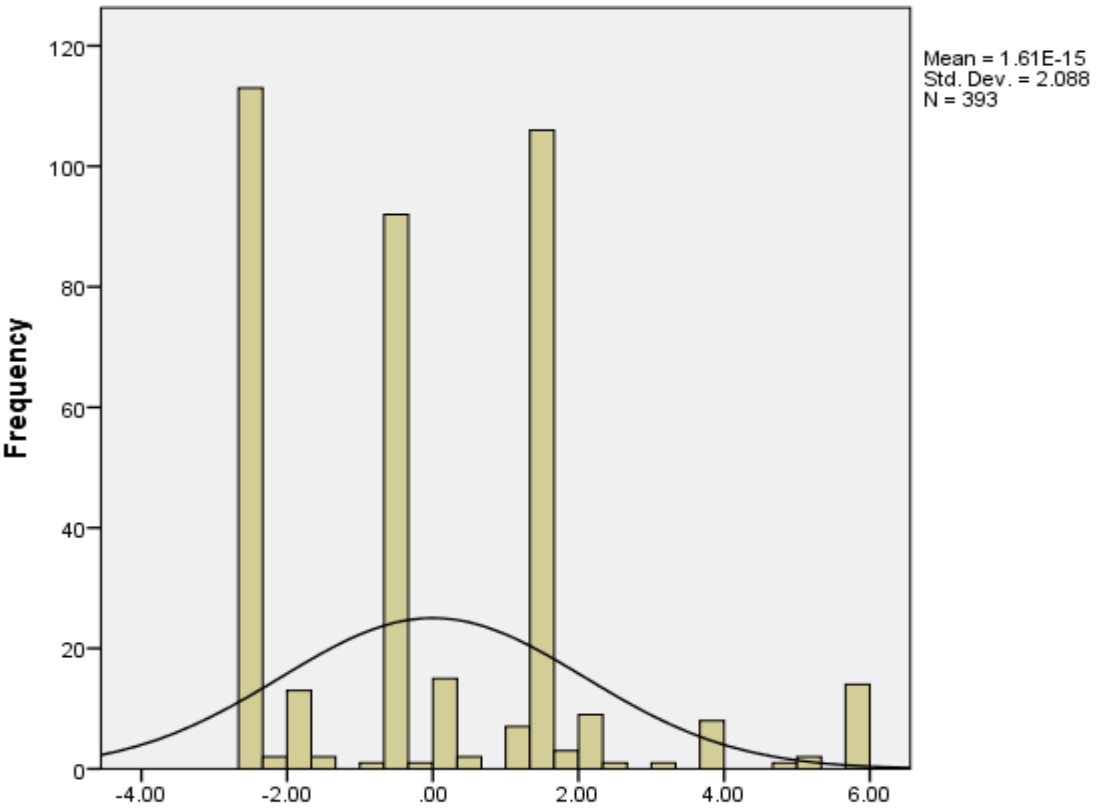
Financial risk taking index– Study 1



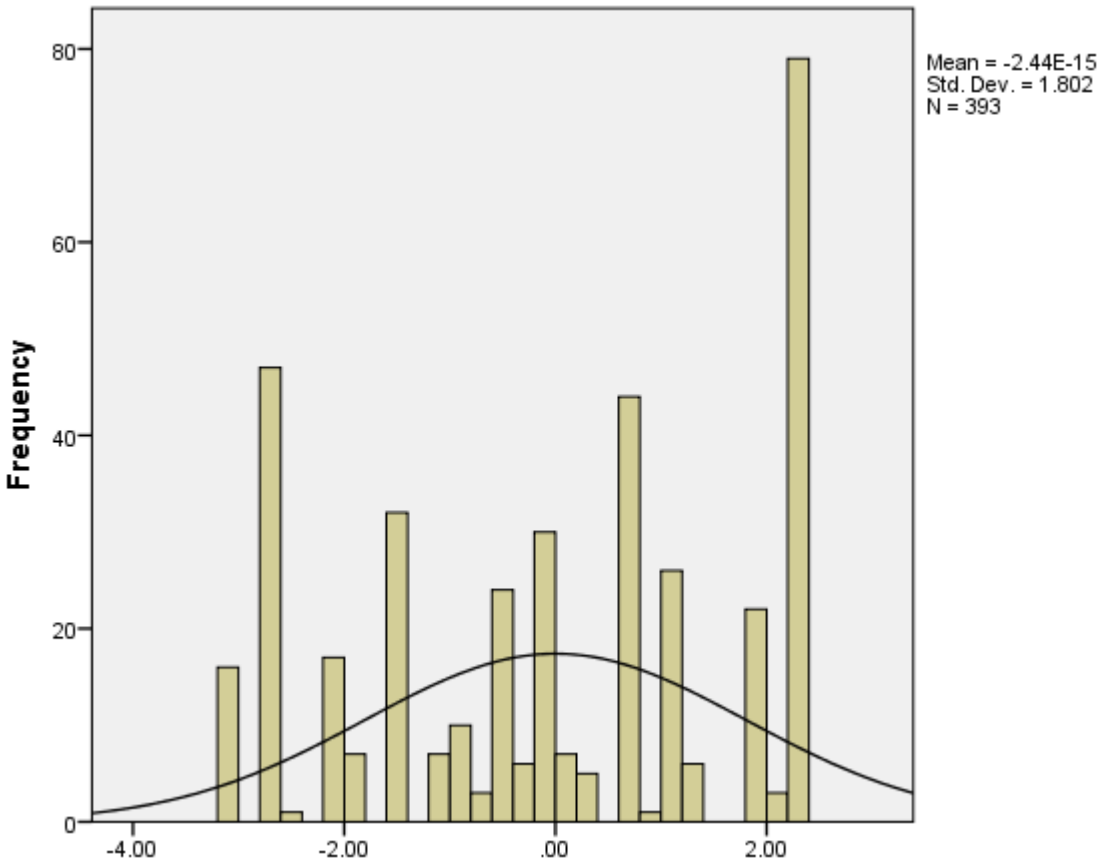
Reproduction index– Study 1



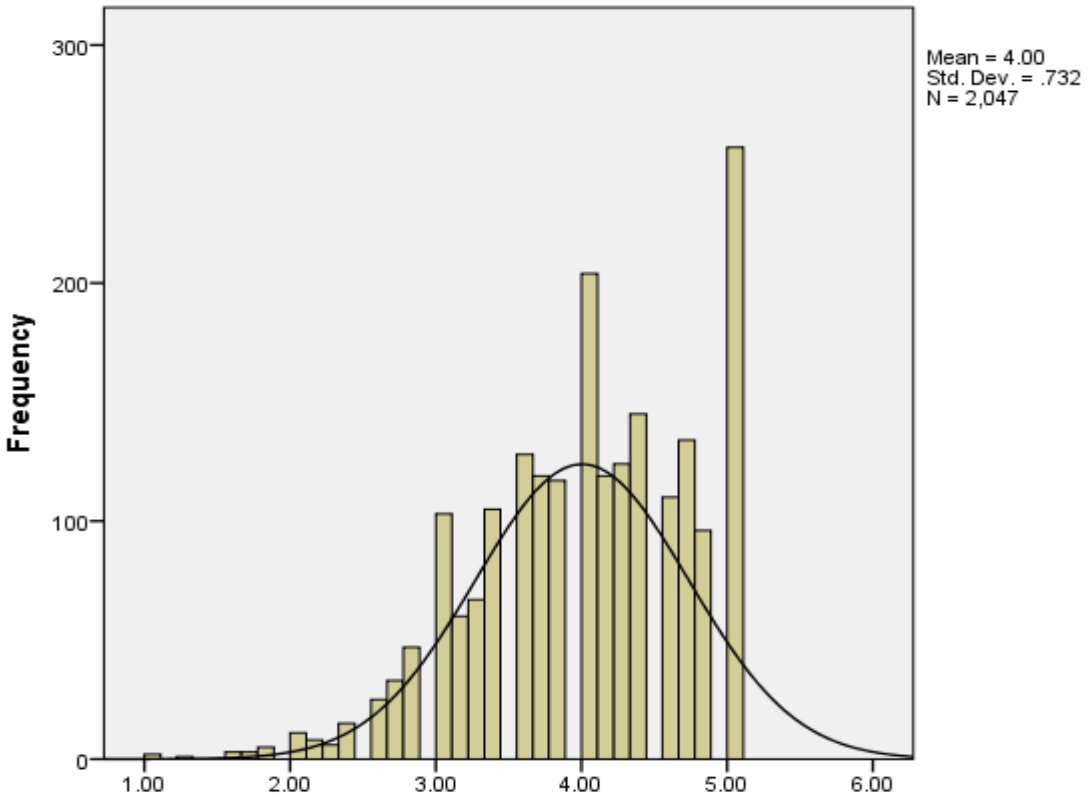
Offsetting index– Study 1



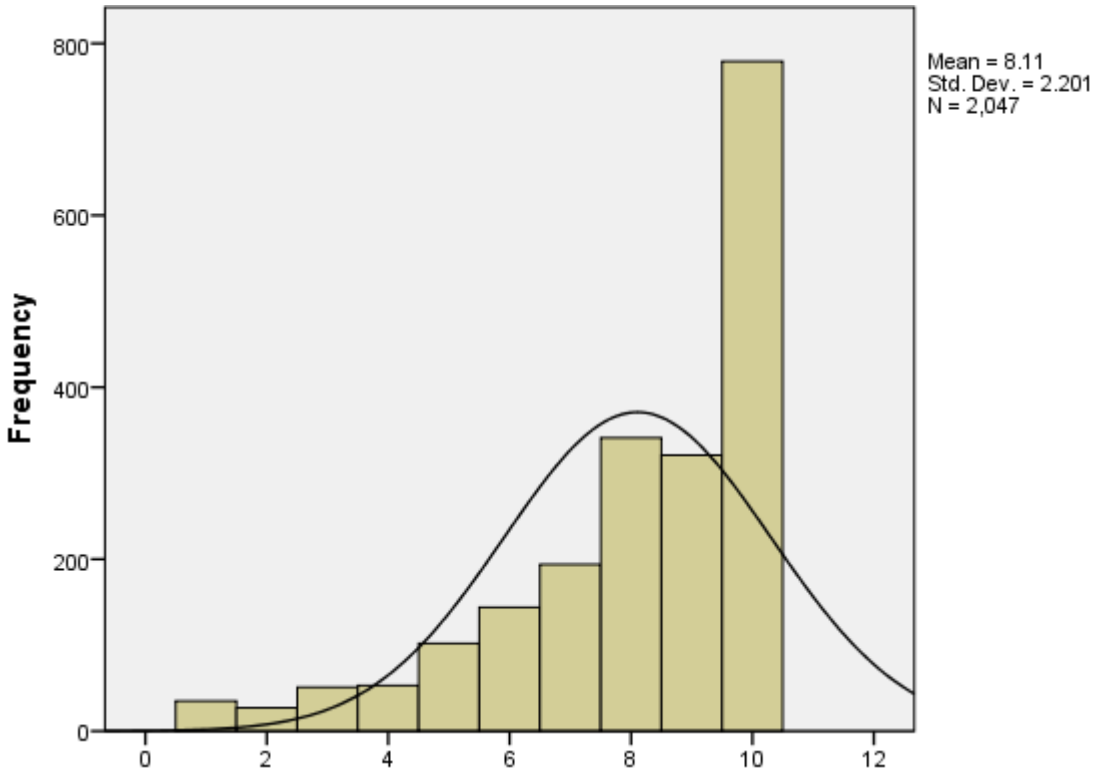
Achieving and striving index – Study 1



Adult well-being– Study 2



Childhood happiness – Study 2



Childhood violence – Study 2