

**An Investigation into
Dieting Practices, Nutritional Intake
and Nutritional Status
of a
Female Population.**

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

November 1999

Acknowledgements

Firstly, I would like to thank Liverpool John Moores University for funding this research. My thanks are also extended to Dr. Peggy Maxwell, my Director of Studies, for her invaluable advice and support, and also to my other supervisors for their help with this research: Prof. Rod Bilton, Peter McGuinness and Dr. Gaynor Bagnall. I am also very grateful to Dr. Allan Hackett for his help and advice regarding my work. My thanks also go to Dr. Gordon Lowe for his help.

I would also like to thank the following people for their help and assistance Ronnie, Colin and Barbara (lab technicians) and Joyce Storton (Senior Occupational Health Sister). My thanks also go to Brian Johnson and Dr. Anne-Marie Coufopoulos for their advice and support.

I am very grateful to the schools who agreed to take part in this study and to the staff for their help. My thanks go to all those who participated in this research.

Finally, I would like to thank my family for their help and support during this research.

Abstract

The prevalence of 'dieting' practices is widespread amongst females of all ages in the UK. However, there is a lack of research which relates general dieting practices to potential health problems which effect the female population as a whole. The aim of this research was therefore, to determine the dieting practices, nutritional intake and status of the female population and identify any predisposition to health problems.

Data regarding the dieting practices of 569 adolescent girls, aged 11-15 years and 128 young women aged 18-25 years was obtained by self-reported questionnaire. Results found the reported incidence of dieting to be 35.3% and 54.7% amongst the adolescent girls and young women respectively. The most popular type of reducing diet used by both groups was a low fat diet. The results of the adolescent study raised questions regarding the actual incidence of dieting and further investigation suggested that there may be similarities in the dietary practices of dieters and non-dieters. To assess the nutritional status of the female population a study was undertaken, involving 50 dieters, aged 18-45 years. A comparison was made with a group of 20 non-dieters. Data regarding dietary intake was collected using a 3-day estimated dietary diary and blood nutrient concentrations were measured using appropriate biochemical methodologies. Results showed that the mean energy intake in dieters was lower than non-dieters, 1390kcal/d and 1611kcal/d respectively. Dieters had a higher mean dietary intake of iron, folate, calcium, vitamin C and retinol equivalents than non-dieters, however, a large percentage of both groups failed to achieve the DRV's for these nutrients. A similar percentage of dieters (44.0%) and non-dieters (45.0%) had a haemoglobin (Hb) concentration below the recommended lower level of 11.5g/l. Mean total cholesterol concentrations were similar in both dieters (5.0mmol/l) and non-dieters (4.9mmol/l)

It is concluded from this study that dieting practices are not a clear cut issue and that both dieters and non-dieters are at risk from nutritionally deficient diets, which may predispose to health problems.

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Section 1.

Introduction to the study

“Dieting is normally defined as a reduction in calorific intake for the purpose of weight loss,” however, dieting has become a very complex issue, with such behaviour ranging from healthy changes in dietary intake to a severely restricted intake (Brownell & Rodin, 1994).

Weight control is not a product of the modern-day lifestyle, indeed references to this practice were made by Hippocrates (Brownell, 1995). During the 12th-15th Centuries obesity was regarded as a personal failure, a problem brought on by oneself, although later, during the 16th-17th centuries it was viewed as physiological problem (Bray, 1990). Similarities can be seen between these historical views and those of today. On the one hand we have culture assuming that women are able to dictate their own weight and body shape (Rodin et al, 1884) and alternatively a scientific view which suggests that weight may be genetically determined (Treasure et al, 1997) or influenced by brain neurochemical mechanisms (Leibowitz, 1992)

Standards of beauty have changed over the centuries, from the fuller figures depicted by Renaissance art to the ‘thin’ ideal of today (Brownell, 1991). Indeed, cultural thinking in the Western World now emphasises body thinness as being the ‘ideal’ and associates it with a successful lifestyle (Michaud & Terry, 1993). Consequently attempts at weight loss are prevalent among broad sectors of the population (Neumark-Sztainer et al, 1997), including those who are of normal weight (Biener & Heaton, 1995). Dieting however, may have significant adverse effects on health and well-being (Biener & Heaton, 1995). Because of the prevalence of dieting behaviour, the issue needs to be evaluated from not only a clinical perspective but also as a public health issue (French & Jeffery, 1994).

Section 1.1

Literature review

1.1.2 Dieting: cultural influences

Although weight is primarily influenced by such factors as dietary intake, activity level and personal motivation, many other factors enter the equation such as those of a socio-cultural nature i.e. families, organisations, communities and societies (Sobal, 1995). In today's society obesity is a highly stigmatised condition (Hill & Silver, 1995), creating psychological, social and economic penalties, which are a lifelong issue and appear to be more severe amongst females (Rodin et al, 1984, Gortmaker, et al 1993). Current opinion suggests that obese people are to be stigmatised with the prevailing cultural values of beauty being learnt at an early age (Feldman et al, 1988, Rodin et al, 1984).

Hill & Silver (1995) studied a group of 9 year old children to determine their preferences regarding different body shapes and how they related the different shapes to various scenarios. Results revealed that the obese shape was judged in a negative light when it was related to social behaviour and academic performance. A similar study was undertaken by Wardle et al (1995) which included children within the age range of 4 - 11 years. The children were asked to state their preferences regarding different body sizes, again negative attitudes were shown towards the obese shape, which increased with age. The negative stereotypes were quite vindictive and included descriptives such ugly, lazy, stupid and selfish. A less favourable attitude towards obesity was seen from higher social status schools.

A considerable amount of research has identified dieting behaviour to be more prevalent amongst higher social classes, indeed where eating disorders are concerned it has long been suggested that eating disorders are more common in the upper socio-economic classes (Pope et al, 1987). Work by Smukler (1983) found the incidence of such diseases to be higher amongst English Private Schools than State Schools. Dornbusch et al (1984)

studied US National Health Data and found evidence to support the hypothesis that females of higher social classes exhibit a greater desire to be thin than females in lower status groups. Consistent with these findings is the work of Wardle & Marsland (1990) who found that girls from higher socio-economic background schools showed more concern about their weight, even though they were slimmer. Story et al (1995) also found that girls of a higher socio-economic status dieted more frequently than girls of a lower status, although the girls of a lower socio-economic status were less likely to perceive themselves as being overweight. Although the majority of evidence supports the hypothesis that dieting is more prevalent in higher social groups, Fox (1991) suggests that the practice is evident amongst all social groups and research by Story et al (1991) demonstrated that dieting, particularly of a chronic nature, has permeated all levels of social status, a similar percentage of adolescent girls from parentage of low, moderate and high socio-economic status were found to have dieted continuously or for long periods.

Children learn from an early age, within the family environment that it is important to be concerned about their appearance (Streigel-Moore et al, 1986), indeed the decision to diet is very often influenced by the family, especially the mother (Hill, 1996), who is also heavily influenced by family members and friends (Levy & Heaton, 1993). It has been suggested that those girls who have developed eating problems over recent years are the daughters of the first 'weight watcher generation' (Streigel-Moore et al, 1986).

In fact work conducted by Johnson et al (1983) reported that families encouraged dieting in 37% of their sample of adolescent females. Hill et al (1990) identified a link between dieting mothers and their dieting daughters and also the effects of their negative moods, such as being upset, on their eating pattern. This link between dieting and family members was further highlighted by Wertheim et al (1997) who, in a study of 30 girls, found that 15 mothers were supportive of their daughters dieting behaviour and in three cases, joint diets occurred and it was reported that one mother and daughter had in fact dieted together seven times. Only three mothers were against the idea of their daughters dieting.

Although parents may be the most influential factors determining the nutritional habits adopted by their children, changes that occur beyond the family unit are strongly

influenced by peer pressure (Lau et al, 1990), especially in older children (Khan, 1981). Peers and friends play a major part in body image development and the decision to diet, with their values and standards being a great influence (Michaud & Terry, 1993), indeed, Maloney et al (1989) found that some children were of the opinion that their friends would like them better if they lost weight. Wertheim et al (1997) reported that most of the girls, in their sample of 30, could talk freely with each other about weight concerns and although they did not exert direct pressure on each other to diet, they did in fact influence each other in various ways. For example popular girls had the most influence as they were always thin and pretty and viewed as the ideal image. Heavier girls were despised and ridiculed thus creating a situation where girls felt they had to be thin and beautiful in order to be popular. Some girls reported that they would diet so as to 'keep in with their friends' and 'stay as skinny as them'. Others went on a diet because their friends who were of a similar size were dieting, and some girls dieted in order to lend support to their friends. This dieting behaviour occurred even though only two girls out of the group really needed to lose some weight.

In addition to the influence of family and friends, are strong messages from the media (Michaud & Terry, 1993). The media is a major factor in the social environment of an individual, and may have a great influence on behaviour (Lewis et al, 1989), by relaying to society the culturally accepted trends and ideals (Michaud & Terry, 1993). Many women obtain their dieting information from television, newspapers and magazines (Levy & Heaton, 1993). Research has shown that adolescents are more likely to receive nutritional advice from the mass media than from health professionals (Thomsen et al, 1988).

Wertheim et al (1997) revealed that young girls felt that magazines and television were swamped with images of thin models, who had found fame and success. This resulted in the girls feeling inferior and gave them the impression that achieving success was coupled with good looks, thus influencing their decision to diet. One girl revealed that she found her first diet in a magazine, and, suggested to a friend that they follow it together, a typical example of how adolescent girls influence each other. Boys also featured in the girls decision to diet, with many of them dieting in order to appear more attractive. This study also raised concerns regarding fashion and found that despite the girls having a normal

body mass index, the unavailability of fashionable clothes was a concern amongst the girls with some remarking that “most were made for slim people” and “you have to be thin to wear them”. The girls appeared to admire fashion models who were always slim and could wear tight clothes (Wertheim et al, 1997). Anderson & DiDomenico (1992) found that women’s magazines contained 10.5 times as many adverts and articles promoting weight loss as men’s magazines, thus suggesting that this finding may be partly responsible for the higher incidence of eating problems in females.

Women of age groups beyond the teenage years are not immune to the pressures associated with dieting and staying attractive (Streigel-Moore et al, 1986). They are influenced by the same factors as younger girls, those of fashion, the opposite sex, a successful lifestyle and their peers (Rodin et al, 1984, Bull, 1988), in fact bulimia nervosa is more prevalent between the ages of 18-25 years, than other age groups (Hill, 1993). During women’s lives they undergo several periods of hormonal change when they are susceptible to an increase in body weight; puberty, pregnancy and the menopause which may influence the decision to diet (Streigel-Moore et al, 1986). Pregnancy is a time of substantial weight gain causing many women to become concerned and worried about how they will reduce their weight after the birth (Davies & Wardle, 1994). It would appear to be the case that the physical and psychological campaign against increasing weight lasts a lifetime (Streigel-Moore et al, 1986)

The pressure for women to be thin is immense in society today, with them being influenced in many ways, in fact it may be suggested, that obesity is a punishable offence, especially for women, the consequences of which may be life destroying. Not only are the lives of the obese affected but also those of normal weight who are frightened of committing such a crime (Rodin et al, 1984).

1.1.3 Dieting behaviour in those of Normal weight

Due to the pressures to achieve a slim body shape, dieting has become a practice followed by those who are not only overweight, but also those unhappy about their size and shape (Wardle & Beales, 1986). Although the thin body ideal demanded by society is biologically inadvisable (Rodin et al, 1984), according to American research 64.0% of women who had never been overweight reported having been on weight loss diets at some time in the past (Jeffery et al, 1984). Biener & Heaton (1995) reported that amongst their sample of 708 adult (over 18 years), female, Caucasians attempting weight loss, 47% were of normal weight (body mass index (BMI) < 25), with their mean age and BMI being 38 years and 22.59 respectively. Similarly, Levy & Heaton (1993) report that 50.0% of the women in their study had a BMI below 26. Bellisle et al (1995) found that amongst female, university students throughout Europe there was a feeling that despite having a low BMI, many perceived themselves to be overweight, indeed the mean BMI amongst those dieting from England was 23.0.

The desire to achieve a thinner body has also been found to be evident amongst adolescent girls (Hill, 1993), with many teenagers of normal weight not only feeling that they are too fat but also following weight reducing practices (Feldman et al, 1986). An Irish study by Fox (1991) showed that 93% of their sample of 437 young women, aged 15-19 years, irrespective of their body size wished to be slim. Of this sample 71% had a BMI of 18.0 - 22.9, indicating that many were attempting to lose weight unnecessarily. This desire for thinness amongst those of normal weight is also evident among pre-teenage children. Hill et al (1994) found that children as young as nine years and amongst all weight categories expressed a desire for thinness and displayed associated dieting motivation. Research conducted by Blisset et al (1996) amongst two groups, aged 9 years and 6 years (n100) found that despite the majority being normal weight for age, 50.0% thought it was healthy to be thin, 30.0% expressed a desire to be thinner and 20.0% reported cutting down on their food intake in order to lose weight. This work demonstrates that young children can understand the concept of the negativity of obesity.

1.1.4 Dieting behaviour in women:

For many women, dieting has come to represent their 'normal' eating style (Herman & Polivy, 1991) indeed the reported incidence of dieting in the USA has ranged from 38.0% (Serdula et al, 1993) to 71.0% (Levy & Heaton, 1993) amongst the general adult population and 57.0% amongst the student population (Peters et al, 1996). In the UK the reported incidence of dieting to lose weight appears to be somewhat lower, the Dietary and Nutritional Survey of British Adults reported a figure of 12.0% (Gregory et al, 1990), whilst more recently amongst the student population, Bellisle et al (1995) found that 49.4% were trying to lose weight, whilst 21.4% were actually dieting. Whilst the difference in these figures may be due to the higher incidence of obesity amongst women in the USA, 32.9% (Okosun, et al 1999) than the UK, 18.0% (Bost et al, 1998), Horn & Anderson (1993) report that although more than one third of Americans see themselves as overweight, fewer than two thirds of these try to lose weight, which would suggest that many dieters in the USA are of normal weight.

Levy & Heaton (1993) found that the main motivation for women to diet (29.0%) was for appearances sake, present and future health were the next most popular reasons with 16.0% and 21.0% women, respectively. It was reported that the average length of diet in this study was almost six months and that 30.0% could be described as chronic dieters in that they had been on their current weight loss programme for at least one year. However, those with a higher BMI engaged in more weight loss attempts but of a shorter period. Weight loss goals ranged from 10kg for those with a BMI<26 to 30kg for a BMI over 30, although goals in those of higher BMI appeared to be unrealistic in comparison to achieved weight loss. Similar findings were reported by the National Institute of Health in the USA (1993) indicating that many American women, despite BMI status are prepared to diet for long periods in order to achieve their desired weight and body image.

1.1.5 Dieting behaviour in adolescent girls:

It would appear that dieting also appears to be the 'norm' amongst adolescents in the USA (Berg, 1992). Many studies have addressed dieting behaviour, and identified a wish to lose weight in 61-77% of adolescent girls (Perry-Hunnicut & Newman, 1993, Rosen et al, 1990, Wadden et al, 1989, Rosen & Gross, 1987). In the UK dieting is a practice which has now become common amongst adolescent girls (Hill et al, 1992). Two studies, conducted in the London area, addressing dieting amongst adolescent girls from a psychological angle found the incidence of dieting to be 15% (n161) and 26% (n163) respectively (Wardle & Beales, 1986, Wardle & Marsland, 1990). A later study conducted in Leicester by Button et al (1996), looking at self esteem in relation to the development of eating problems, found that in a sample of nearly 400 girls aged 15-16 years, 46% had dieted. More recently it has been reported that 25.0% of females aged 8-15 years were trying to lose weight (Bost et al, 1998) and a Health Education Survey found that 18.0% of 11 year old girls were dieting, 19.0% of 12 and 13 year olds, 15.0% of 15 year olds and 16.0% of 15 year old girls (HEA, 1999).

Dieting however, is not exclusive to adolescents and women (Hill & Robinson, 1991), two studies have demonstrated dieting behaviour in younger children. Hill & Silver (1995), found that amongst a sample of 83 girls aged 9 years there were high levels of dieting motivation and an inclination towards adult views regarding the 'ideal' body image. A more recent study (Blisset et al, 1996) has reported dieting behaviour in children much younger. In their group of 50 (mixed sex) children, aged 5-7 years, 14% had tried to 'cut down' their dietary intake and 6% had actually dieted. This research would suggest that during early childhood, girls learn to be concerned about their appearance and weight (Streigel-Moore et al, 1986).

Studies undertaken in the UK concerning adolescent dieting, such as those of Wardle & Marsland (1990), and Button et al (1996), view dieting from a psychological prospective, however, several studies undertaken in the US have addressed the subject in more general terms, such as actual dieting/eating habits (Moreno & Thelan, 1995, Perry-Hunnicut & Newman, 1993, Johnson et al, 1983). Moreno & Thelan (1995), studied dieting behaviour

in a group of 175 High School girls, with a mean age of 13.71 years and a mean self reported weight of 119.34lbs. Results found the earliest reported age of first dieting to be 6 years and that 63% were dieting by the age of 12 years. The most popular length of diet was 2-4 weeks, however, 14% reported a length of diet of 1-2 months and 14% over 3 months. It was reported that 4% dieted "all of the time," 7% "most of the time," 8% "a lot of the time" and 37% "some of the time." However, 44% had not dieted during the previous 12 months. In their study, Perry-Hunnicut & Newman (1993), reported that most of the girls had dieted at least once during the previous year, 16.3% two times, 11% three times and 20% four or more times. Johnson et al (1983) found that 44% had dieted between 1-5 times, 7% 5-10 times, 4% more than 10 times and 9% that they were always dieting, but , 36% had not dieted during the previous year. This study found that 3% had started to diet by the age of 10 or less and over half (52%) of the sample had dieted by the age of 14 years. The frequency and length of diets followed by some girls has led Story et al (1991) to suggest that dieting may be becoming a chronic condition in certain cases.

1.1.6 Dieting: what does it mean?

A considerable amount of research has reported various incidences in the prevalence of dieting behaviour (Bellisle et al, 1995, Serdula et al, 1993, Wardle & Marsland, 1990, Button et al, 1996). French & Jeffery (1994) suggest that the way in which a person is asked about their dieting behaviour may influence survey results. For example, general or broad questions, such as are you currently trying to lose weight? tend to produce more affirmative responses than more specific wording such as, are you currently dieting to lose weight? Similar discrepancies are obtained when time periods for the behaviour are specified differently, for example are you currently dieting? versus, have you ever dieted?

Neumark-Sztainer et al (1997) question actual dieting behaviour and suggest that self-reported dieting may not correlate with actual energy intake, therefore influencing the reported incidence of dieting. Although self reported dieting may reflect actual eating behaviours resulting in a lower caloric intake, it may also reflect a cognitive phenomenon

in which individuals are expressing a desire to eat less or to lose weight, but are not actually doing so.

A key element influencing eating behaviour is cognitive knowledge (Crockett & Sims, 1995) and Lowe (1993) suggests that dieting behaviour may also extend to the thought process, a separate issue from food restriction, and may be interpreted to include preoccupation with body shape and weight, and abnormal beliefs regarding food and exercise. It is therefore important to define what is meant by the word 'dieting' when undertaking research investigating dieting behaviour (French & Jeffery, 1994).

Various opinions regarding the meaning of dieting are evident amongst adolescents. Research by Neumark-Sztainer & Story (1998), using focus groups found that adolescents view 'dieting' from a much broader angle than do health professionals. Dieting was described by the adolescents in terms of both eating and exercise behaviours, and in the majority of groups was perceived as a healthful eating behaviour. Descriptions included: "eating healthier food," "eating healthy," "not eating any junk food," "eating balanced nutrition," "eating more fruit, veg and salads," and "eating less fat." Some groups did describe dieting in unhealthful terms such as "starvation," "not eating," and "skipping meals." The work of Neumark-Sztainer & Story (1998), reached similar conclusions to a previous study by Lytle et al (1997), which had been conducted using younger children (pre-adolescent) and had found that a number of children in each focus group thought that "diet" meant eating healthy food.

1.1.7 Conflicting views and misconceptions regarding dieting and nutritional advice:

It would appear that the subject of dieting is becoming a controversial issue, with different schools of thought looking at it from different perspectives (Brownell & Rodin, 1994). On the one hand chronic, severe dieting is a central feature in the aetiology of various diseases and eating disorders (Wilson, 1993, Kirkley & Burge, 1989). Alternatively dieting

represents a potential solution to a serious medical problem, that of obesity (Brownell & Rodin, 1994).

Perceptions of dieting and what is socially acceptable regarding body shape are passed on to children from adults (Lytle et al, 1997). However, Pugliese et al (1987) report that parental misconceptions and abnormal health beliefs regarding diet may be a cause for failure to thrive in infants. It was found that parents gave their children the type of diet that was recommended by health professionals for adults at risk from cardiovascular disease with the aim of preventing premature atherosclerosis and obesity. It is suggested that society's obsession with dieting and the aim to reduce the risk of heart disease may be affecting the health of young children.

Dixon et al (1996) report parental encouragement to diet in older children. In their sample of 232 girls aged 13-16 years, it was found that 50% of those whose parents encouraged them to diet were of normal weight or indeed underweight. Those girls encouraged to diet by their parents tended to associate being thinner with increased health, success and acceptance by society. At a time when the health of the nation is being promoted (Hill et al, 1992) it is important that adults who are part of children's environments are aware of the messages they pass on regarding image, weight and dieting. Dietary advice must be specific to them (Lytle et al, 1997). Health recommendations should not reinforce the stigma associated with obesity, as without such considerations, one health problem may exacerbate others (Hill et al, 1992). Biener & Heaton (1995), suggest that public health messages need to clarify that weight loss is not recommended for people of normal weight and that dieting may expose normal-weight individuals to unnecessary health risks.

Misconceptions regarding nutritional knowledge have been shown to be evident amongst young adults entering university (Chery et al, 1987) and despite obtaining nutritional knowledge during a university education a high proportion still held such misconceptions. This finding gives rise to a lot of concern as many students who study nutrition as part of a degree programme move on to work areas where they may be giving nutritional advice in a health or educational setting (Chery et al, 1989).

1.1.8 Methods of dietary weight loss: types of reducing diet

Although it is well known that the answer to a weight problem is an overall change of lifestyle, i.e. increasing exercise and eating a balanced diet, it would appear that a proportion of the dieting population are convinced that there must be a much quicker and easier solution (Dwyer & Lu, 1993). Many variations on these so called 'quick result' fad diets are published in books, newspapers and magazines frequently (Thomas, 1994). However, this type of diet is usually ineffective and may produce harmful effects to health (Dwyer, 1992). There are many different types of reducing diets available, some following healthy guidelines and others that do not, such as meal replacements, these diets may be followed independently or in a group situation (Which ?, 1997). Whatever the type of diet used, it is essential that it provides the body with adequate nutrients to meet health needs and must form the basis of a long term change of eating habits and not be a crash diet (Thomas, 1994). It is important that the diet allows for gradual weight loss i.e. no more than 1kg/week, any more than 3kg/week can result in the loss of lean body mass, especially if protein is restricted (Garrow, 1980).

A reducing diet which is currently very popular is a low fat diet (Dwyer, 1992). French et al (1995) found that among their group of 420 female adolescent dieters 26.9% used this method of weight loss. A low fat diet was the most popular type of diet reported by Neumark-Sztainer et al (1996) amongst their group of adult dieting women, with 64.4% using it. Fat reduction is popular because of the high energy content of fat, twice that of protein and carbohydrate. This type of diet very often includes the use of commercially produced low fat foods/'lite' products (Dwyer, 1995). Many slimming clubs offer diets that are of a low fat nature and one such club, the Rosemary Conley Diet and Fitness Club offers diets which are strictly low in fat where all foods containing more than 4.0% fat should be avoided, which may be rather excessive (Which?, 1997).

Low calorie diets, also popular, may provide 1000-1500 kcal/day (NIH, 1993). Such diets should be undertaken with medical supervision since so few calories make it very difficult to meet nutritional needs with food sources alone. These diets are most suitable for people who need to lose a significant amount of weight because of conditions such as non-insulin

dependant diabetes mellitus, hypercholesterolaemia, hypertension and orthopaedic conditions, all who should be under medical supervision (Dwyer, 1992). Calorie intake may be restricted further in the form of a very low calorie diet (VLCD). VLCD's are defined as 'commercially produced nutrient preparations providing normally less than 600kcal/day and marketed for use as a total food substitute (DHSS, 1997). However, any diet that contains less than 800kcal/day is below that required for resting metabolism. This type of diet requires supplementation to be nutritionally adequate and should only be undertaken with strict medical supervision.

Many women attend slimming clubs, with the hope that group support may be helpful. However, misleading advertising may raise expectations which are not realistic. Also on the negative side is the financial cost involving a joining fee and weekly payments (Cormillot, 1995). There are a number of slimming clubs presently operating in the UK, however, there are no laws which govern the market and it is a matter for concern that anybody can set up this type of business. One such club, the Rosemary Conley Diet and Fitness Club, offers diets which are strictly low in fat. One of the plans offered is called the 'flat stomach diet,' which may offer false hope to many dieters as developing a 'flat stomach' is not being realistic (Which?, 1997). A British consumer report revealed that 11.4% of dieters were members of a slimming club, the most popular being Weight Watchers (Key Note, 1993).

Starvation is not recommended to any person in any situation trying to lose weight, because of the profound metabolic effects (Dwyer, 1995). However, starvation or fasting, appears to be commonplace amongst adolescent girls, wishing to lose weight. With a third of dieters in one study reporting that they fasted for 24 hours at least once a week (Berg, 1992). Such practices have also been reported by Moore (1988) who found that of a group of females aged 12-23 years, 21.4% underweight, 24.3% normal weight and 40.7% overweight had tried to lose weight by fasting. Perry-Hunnicut & Newman (1993) report that 54.5% of the dieters they studied, had fasted in order to aid weight loss. Several studies would suggest that skipping meals also appears to be a popular dieting practice. Incidences of 11.6% (French et al, 1995) and 49% (Serdula et al, 1993) have been

reported. Perry-Hunnicut & Newman (1993) also report on this practice being common amongst female dieters and non dieters, with 48.5% dieters and 41.2% of non dieters reporting that they had skipped breakfast five times or more during the previous week. Lunch was also missed by 20.9% of dieters and 12.4% of non dieters.

Such findings may be of concern as it has been suggested that the consumption of breakfast may improve performance with regard to certain cognitive tasks (Smith et al, 1994), although Vaisman et al (1996) suggest that the timing of a meal may be more important than meal content, as improved cognitive functions appear to be more related to glucose levels. However, research has shown the important role played by breakfast in meeting daily recommended calcium intake in schoolchildren. Ortega et al (1998) found that the intake of milk products and calcium at breakfast correlated with the consumption of these foods in the whole diet. Intakes at breakfast appeared to reflect the intake during the rest of the day.

1.1.9 Are diets effective?

Dieting to lose weight may be successful in the short term, however, more often than not, some or all weight lost is usually regained (NIH, 1992). A study by Grodstein et al (1996) demonstrated this. A group of 192 dieters were followed for up to 3 years after participating in a diet programme, during which, the average weight loss had been 22kg. After the follow up period the mean weight of the group was 102.6kg, only slightly less than at the start of the diet (105.9kg). Most had maintained at least 5% of their weight loss, but 40% had gained back more than they had lost.

Weight loss is a serious matter and the decision to diet should not be taken lightly. It should not be attempted by those of normal weight, nor by obese people, if the chance of success is minimal (Rossner, 1989, Beiner & Heaton, 1995). When considering weight loss, the potential adverse physiological and psychological effects should be taken into account and no matter how much weight loss is required, realistic goals and a slow rate of loss will increase the probability of losing and maintaining the loss (NIH, 1992)

1.1.10 Nutritional implications of dieting behaviour

In order to establish whether the dietary intake of a dieter is health promoting or a health risk it is necessary to identify the nutritional content of the diet, and also determine whether it is different from that of a non dieter (Neumark-Sztainer et al, 1996). French & Jeffery (1994) propose several hypotheses: that dieters may “consume a more nutritious diet because they eliminate high fat or high calorie foods and replace them with low fat or low calorie foods”. Alternatively, “in an attempt to limit total energy intake, dieters may restrict intake of all foods so that their nutritional requirements are not met”. Thirdly, “dieters may consume high fat or high calorie foods to the exclusion of more nutritious items in an attempt to limit total calorie intake”.

French & Jeffery (1994) suggest that dieters who follow weight loss programmes usually obtain a diet that is fairly well balanced, however, it seems to be the case that a gap exists in the literature which addresses the dietary composition of UK adult female dieters who diet on their own. Although the Dietary and National Nutritional Survey of British Adults (Gregory et al, 1990) identified dieters and non dieters in its dietary analysis, no specific information regarding the dieters’ behaviour was given. However, an American study by Neumark-Sztainer et al (1996) analysed the self-reported nutrient intake of a group of 999 adult female dieters and non dieters who were participating in a community based dietary study, with reference to the type of reducing diet used. The mean age and BMI of the subjects was 34.5 years and 27.1, respectively. Various different types of diet were reported, with the most popular type, a reduced fat intake (64.4%). Mean total energy intake amongst the dieters was 1549kcal/d (31.5% fat) and non-dieters, 1629kcal/d (34.7% fat). Those following a low fat diet had a mean energy intake of 1587kcal/d (33.2% fat). Mean iron and calcium intake was 11.3mg/d and 869.2mg/d, respectively for both dieters and non-dieters. Iron and calcium intake was very similar in those following a low fat diet compared to other types of diet.

In the UK the food and nutrient intake of female dieters between the ages of 15-25 years has been investigated by Crawley & Shergill-Bonner (1995), although, again no reference was made to specific dieting behaviour. Analysis of the dietary intake of 204 female

dieters, mean BMI 23.6, and 226 non dieters, mean BMI 19.5, aged 16-17 years, who were part of a national (UK) study was undertaken. Results revealed that there were major deficiencies in nutritional intakes amongst teenagers in general, however the intakes of female dieters were much lower than non-dieters. Twice as many dieters as non-dieters failed to achieve the reference nutrient intake (RNI), as stated by the Department of Health COMA Report 1991, for retinol equivalents, thiamin, riboflavin, folates, vitamin B12, vitamin B6, zinc, copper and selenium. Approximately 90% of dieters failed to meet the RNI for iron and calcium, and approximately 80% of dieters failed to meet the RNI for retinol equivalents. The mean energy intake for the dieters was 1604 kcal/d compared to 2460kcal/d for the non dieters. Fat intake for both groups was similar; 40.5% and 42.5% (% food energy) for dieters and non-dieters respectively. Such findings of these studies are very disturbing when you consider that food choices made during the teen years can affect health, during this time and also in the future (Benton & Roberts, 1988).

1.1.11 Implications of reduced nutritional intake

Malnutrition is not a specific condition, as it takes into account both overnutrition and undernutrition and may relate to single or multiple micro/macronutrients. Research has generally focused on developing countries, and in comparison, it would appear that malnutrition has received little attention in developed nations, despite sub-optimal nutrition being a risk factor in metabolic functions and disease aetiology (Karr et al, 1997, Kirkley & Burge, 1989).

One particular nutrient which has become the focus of attention is dietary fat (Schwartz & Borra, 1997). High dietary fat intake is a major cause of obesity and hypertension and more specifically, saturated fat is associated with the development of atherosclerosis (Kuller, 1997). Because of these adverse effects, dietary fat is generally on the receiving end of bad publicity, and the importance of dietary fat tends to be ignored (Sanders, 1994).

Over recent years nutritional recommendations have placed importance on reducing dietary fat (DoH 1991,1994). However, it would appear to be the case that advice has

become distorted, particularly that given via media messages, which might imply that 'all fat is bad' (Horm & Anderson, 1993). Schwartz & Borra (1997) suggest that the importance placed upon dietary fat over recent years has seriously damaged consumer perception of the requirements of healthy eating. Their findings showed that 15% of Americans believed it was important to eliminate all types of fat from their diet and 81% of children aged 9 to 15 years incorrectly believed that a healthy diet means one that is devoid of all high fat foods. The findings of Schwartz & Borra (1997) would suggest that consumers do not understand the nutritional role that dietary fat fulfils, and therefore, greater recognition should therefore be given to the positive aspects of dietary fat (Sanders, 1994).

Fat is an important source of energy and is especially important in providing sufficient energy density in young children. It is also necessary for the provision and absorption of fat soluble vitamins and the provision of essential fatty acids (Gurr, 1993). Fat soluble nutrients are poorly absorbed on a low fat diet (Sanders, 1994), which is of concern because of their role in maintaining health and preventing disease (Calzada et al, 1995). Fat soluble vitamins such as vitamin A are essential for growth and development, particularly in that of the foetus and vitamin D plays an important role in bone health (Sanders, 1994).

It is suggested that antioxidant micronutrients such as vitamins E and C (C not being fat soluble) may be protective against the development of coronary heart disease possibly as a result of the oxidation of low density lipoprotein (Enstron et al, 1992, Stampfer et al, 1993, Abbey et al, 1993). Vitamins A and E may also protect against cancer (Kuller, 1997). It has also been suggested that vitamin A plays a role in iron metabolism and may feature in the aetiology of nutritional anaemia (West & Roodenburg, 1992, Roodenburg et al, 1992).

Upritchard & Ball, (1993) expressed concern because low fat diets may not meet requirements where mineral intakes are concerned (i.e. iron, calcium, zinc and magnesium). Results from their study found that women consuming a diet where less

than 25-30% of the total energy intake was from fat were less likely to meet dietary recommendations than those women consuming greater than 30-33% of their energy from fat.

Because of the nutritional density of fat it is difficult to achieve recommended nutrient levels without consuming a large amount of food, therefore to avoid the adverse consequences of consuming a low fat diet, appropriate nutritional counselling should be given in situations where such a diet is needed, for example in those people with hypercholesterolaemia. Dietary fat has become an obsession with people over recent years, with various sources giving out dietary information. As a result misunderstandings and confusion have arisen thus, placing obstacles in the path of achieving healthy dietary goals (Schwartz & Borra, 1997).

1.1.12 Dieting: related health problems

Dieting, an increasing concern to health professionals, may have significant negative effects on the health and well being of an individual, and therefore should it be asked, do the risks of dieting outweigh the actual benefits? (Brownell, 1993). There are many potential side effects associated with dieting, which may be as severe as the complications of obesity (McCargar & Yeung, 1991).

There is further cause for concern due to the number of unsupervised dieters, which may exacerbate potential health problems, especially if the dieter has a concurrent health problem (Blackburn, 1993). Mallik (1982) suggests that no diet undertaken is completely free from adverse effects. As dieting now extends not only to women but adolescents as well (Hill, 1993), inappropriate dietary intakes followed throughout adolescence and into adulthood may well have lifelong negative health effects (Manore, 1996).

Studies undertaken amongst adolescent dieters have found that general symptoms such as fatigue, weakness, depression, headaches, nausea, anxiety, preoccupation with food, and lack of concentration/poorer school performance are common (Nylander, 1971, Mallik,

1982). Research has also linked dieting behaviour more specifically with various potential behavioural and physiological health problems (Kirkley & Burge, 1989).

1.1.13 Behavioural problems

Although pathological and biological factors contribute to the development of eating disorders (Hsu, 1997), there is evidence to suggest a link with dieting (Wilson, 1993). Patton et al (1990) found that adolescent dieters were eight times more likely to develop an eating disorder than non dieters. Stress has been associated with dieting, especially amongst the non-obese (Rosen et al, 1990), which in turn is linked to binge eating (Wilson, 1993). Behavioural health problems associated with dieting have been investigated by Green & Rogers (1995) who demonstrated impairment of cognitive functioning associated with dieting. It has also been suggested that episodes of losing and gaining weight may also have negative effects on mood and self esteem (Garner & Wooley, 1991).

1.1.14 Physiological problems:

1.1.14.1 Growth and development

Adolescence is a period of rapid growth and development, with energy requirements reflecting this, however, it has been suggested that a failure to meet these requirements may result in retarded growth and delayed sexual maturity (Marino & King, 1980, Dwyer, 1993, Kaplan & Toshima, 1992).

Evidence to support this is presented by Pugliese et al (1983) who found that of a group of 201 children/adolescents aged 9-17 years, 14 demonstrated a pattern of growth failure, which was due to malnutrition. Calorie intake in these subjects ranged from 32-91 per cent of recommended intakes and skipping meals was frequently reported. It was reported that self imposed dieting was a result of a fear of developing obesity, however, none of these subjects displayed any psychiatric disturbances. Retarded growth associated with prolonged calorie deficient intake has also been demonstrated by Davis et al (1978), but,

after treatment and a 12 month follow-up normal growth had resumed. Kirkley & Burge (1989) doubt whether the kind of dieting undertaken by the majority of adolescents would actually result in problems to such a serious extent, although this may depend on developmental age as prepubertal growth is more sensitive to calorie restriction than post pubertal growth.

1.1.14.2 Bone density

Concern for the increasing incidence of dieting amongst preadolescents is warranted as almost half of the adult skeletal mass is laid down during adolescence. Failure to maintain normal weight gain during puberty may predispose to reduced skeletal mass and the development of osteoporosis in later life, which is considered a major health issue (Kreipe & Forbes, 1990, Kanis & Pitt, 1992, WHO, 1994).

Berg (1996) suggests that a lifetime of dieting may lead to a deficient intake of nutrients such as calcium, which is associated with bone health. Indeed a study by Holbrook & Barret-Conner (1993) found that a lower bone density was associated with a lifetime body mass index of under 24 and chronic dieting and weight loss. Similarly, Fogelholm et al (1997) suggest that weight cycling may be associated with lower spine and distal radius bone mineral density. Research by Nowalk et al (1995) reported that of the women they studied, those consuming a diet containing $\leq 30\%$ fat, had a calcium intake which fell below recommended levels. Shepherd & Towler (1992) found that although females had a positive attitude towards dairy products, their behaviour was negative. Indeed a large scale study by Neumark-Sztainer et al (1997) involving 36,284 adolescents found that dieting was strongly associated with low consumption of dairy foods. It has been shown that bone growth is improved by 1-5% with the use of calcium supplements, however, when dairy products are used as calcium supplements the growth improvement is up to 10% (Kerstetter, 1995). Cadogan et al (1997) also demonstrated the benefits of increased milk consumption with regard to increased bone mineral acquisition.

It has been reported that the peak periods for calcium retention for girls are in the pre and early pubertal periods and the current intake of calcium by American girls during these growth periods may not be adequate to enable maximum mineral retention and therefore it is recommended that calcium levels during this time should be increased (Sentipal et al, 1991, Abrams & Stuff, 1994). Although genetic factors determine peak bone mass nutritional factors are also influential (Ott, 1991) and therefore, as the evidence would suggest, adolescent girls should be encouraged to increase their dairy product intake (Kerstetter, 1995).

1.1.14.3 Reproductive risk

Both adolescent girls and young adult women have reproductive potential, however, this may be at risk because of dieting behaviour (Kirkley & Burge, 1989). The associated risks may present in the form of menstrual dysfunction (Manore, 1996) or in relation to pregnancy outcome (Kirkley & Burge, 1989). It has been reported that energy restriction may change the hormonal profiles and the menstrual cycles of healthy women (Barr et al, 1994, Kurzer & Calloway, 1986). The degree of menstrual dysfunction may depend on energy stores prior to energy restriction and also on the individual's hormonal status (Manore, 1996, Pirke et al, 1985).

Concern regarding the high incidence of low birth weight babies in the US, led to research which found a relationship between maternal preconceptual weight and birth weight. It was found that the greater the weight deficit before pregnancy the more effect it had on the neonate (Gormican et al, 1980). Extensive research undertaken recently has demonstrated how undernutrition during pregnancy may retard the various stages of embryonic growth, thereby predisposing the baby to cardiovascular risk factors, such as hypertension (Law et al, 1993), increased insulin resistance (Fall et al, 1995), high plasma concentrations of the haemostatic factors: fibrinogen and factor VII (Barker et al, 1992) and abnormal LDL cholesterol metabolism (Barker et al, 1993).

Because foetal iron reserves have been found to be dependent on maternal iron stores (Milman et al, 1987) complications such as anaemia may occur, which during pregnancy has also been associated with underweight women (Worthington-Roberts, 1985, Scholl & Hediger, 1994).

1.1.14.4 Anaemia

Iron deficiency is believed to be the most common nutritional disorder in the world (Thomas, 1994), which may predispose to iron deficiency anaemia (MacPhail & Bothwell, 1992). An estimated 30.0% of the world's population has been reported to be anaemic, with, certain groups of the population, such as adolescents, women of reproductive years and pregnant women at higher risk of developing iron deficiency anaemia (BNF, 1995). These groups are also those who are most likely to diet (Streigel-Moore, 1986). The BNF report (1995) suggests that low energy diets consumed by those trying to lose weight are unlikely to provide adequate levels of dietary iron unless the diet is nutritionally very well balanced, indeed dieting behaviour has been linked to the development of anaemia (Houston et al, 1997).

1.1.14.5 Cardiovascular disease

Repetitive weight loss and regain are known as weight cycling (Manore, 1996). It has been suggested that the negative effects of weight cycling, make future weight loss attempts even more difficult, possibly leading to increased obesity and an increased risk of developing coronary heart disease (Wilson, 1995). Coronary heart disease being a major cause of death in women (Kris-Etherton & Krummel, 1993). Unrestrained weight gain may worsen atherogenic risk factors such as hypercholesterolaemia, hypertension and impaired glucose tolerance and also may raise fibrinogen, which may predispose to vascular occlusion (Kannel, 1987).

Various studies have found an significant association with regard to weight fluctuation and the development of coronary heart disease (Lissner & Brownell, 1992). A longitudinal

study by Lee & Paffenbarger (1992) followed a group of 12,000 men, average age of 58 years, for 10 years. Self-reported weight for the 15 years prior to the study was used. None of the subjects had been diagnosed as having cardiovascular disease or cancer at the start of the study. Results showed that cardiovascular mortality was associated with weight gain and loss. Mortality was lowest in those maintaining a stable weight. Similarly a study by Hamm et al (1989) demonstrated that weight cycling was associated with coronary heart disease.

The use of liquid protein diets and very low calorie diets have been used as a method of weight loss for many years (Howard, 1989). However, during the 1960's and 70's such diets were associated with an increased risk of cardiac death, due to arrhythmia's (Surawicz & Waller, 1995). Although the cause of these deaths have never been proven, it is thought that electrolyte disturbances may have been a cause, The number of such occurrences have now decreased with the inclusion of higher-quality proteins (Wadden et al, 1990, Xavier Pi-Sunyer, 1993). It is the opinion of Garrow (1989) that very low calorie diets should not be used and Xavier Pi-Sunyer (1993) suggests that anybody who goes on a diet which contains less than 800 kcal/d should undergo an electrocardiogram and if any arrhythmia's are detected then investigations for electrolyte disturbances should be performed.

1.1.14.6 Weight loss and mortality risk

Several authors have reviewed the available data, linking weight loss with increased mortality, morbidity and longevity. From the six studies they reviewed, linking weight loss with increased longevity, Williamson & Pamuk (1993) concluded that this link may be questionable. They found that two of the studies did not provide data to support their findings and the methodologies in general contained too much bias. No information regarding the method of weight loss was given nor information regarding any prevalent disease nor whether weight loss was voluntary and involuntary. The long term effects of body weight in relation to mortality were discussed in another review by Andres et al

(1993), who concluded that long term weight loss or an excessive gain is associated with high mortality rate, whereas the lowest mortality rates were associated with modest gains.

Higgins et al (1993) reporting on results from the Framingham study showed that after a 20 year follow up, amongst women, prevalence rates of hypertension, pulmonary conditions and indeed any disease were significantly higher in those whose BMI decreased than amongst those whose BMI did not change. Results from a national study conducted in the USA by Pamuk et al (1993) showed a direct association between weight loss and the risk for death in those whose BMI fell between 26 and 29.

It would appear to be the case that there is more evidence which supports the association of weight variation to mortality rates than otherwise. However, the fact remains that not enough is known about the effect of dieting behaviour in relation to health, especially in those who are of normal weight, which is of concern because of the increasing incidence of dieting within this group. Therefore, any studies that investigate the adverse effects of dieting or the process of dieting are urgently needed and must be considered a priority (Biener & Heaton, 1995 & Brownell, 1991).

1.1.15 Biochemical changes due to dieting status

Popular diets may not be well balanced, and therefore may affect plasma nutrient status and present a health risk (van Dale et al, 1990). Research has been very specific, looking at the plasma levels of particular nutrients in subjects who are following specifically designed and controlled diets (van Dale, 1990, Zwiauer, 1988, Kasim et al, 1993, Kretsch et al, 1998, Merritt et al, 1981). The Dietary and National Nutritional Survey of British Adults (Gregory, 1990) analysed plasma nutrient levels in those who were dieting amongst the general population, however, no information regarding their behaviour was obtained.

1.1.15.1 Iron status

The need for iron is important for several reasons: it is a constituent of several proteins responsible for several functions such as hormone synthesis and fatty acid metabolism. One of the main iron containing proteins, haemoglobin is responsible for transportation of oxygen around the body (Brody, 1994). Two functional compartments of body iron are recognised: (1) an essential component, comprising of about 70% of the total, which is contained in haemoglobin, myoglobin, haem enzymes, cofactors and transport iron and (2) the remainder non-essential storage iron which is found predominantly in liver, spleen and bone marrow as ferritin and hemosiderin. Haemoglobin amounts up to 85.0% of the essential component (Shills & Young, 1988).

Iron deficiency is a diminished total body iron content. It may range in severity from reduced iron body stores without any restriction of erythropoiesis to a severe anaemia with multiple deficiencies of tissue iron enzymes. Three degrees of iron deficiency are recognised. Iron depletion refers to a simple decrease in iron stores without any effect on essential body iron. Iron deficient erythropoiesis occurs whenever the supply of iron to the erythroid marrow is inadequate, and represents anaemia which may be too mild to be detected by some arbitrary value for haemoglobin which is used to separate normal from anaemic states. Iron deficiency anaemia is anaemia resulting specifically from a decrease in total body iron (Bothwell et al, 1979) A deficiency of iron may slow the tempo of growth during adolescence (Brabin & Brabin, 1992).

Although haemoglobin (Hb) levels are an indication of iron status, iron deficiency can be diagnosed by a low serum concentration of ferritin (Hallberg et al, 1993). Iron is stored intracellularly as ferritin. The serum ferritin level accurately reflects the tissue stores of iron (Brody, 1994). Iron metabolism is investigated by undertaking the following measurements: (i) serum total iron concentration: low levels of this are found in iron-deficiency anaemia. (ii) Total iron-binding capacity (TIBC): this measures the maximal saturation of transferrin with iron, and is thus, a measure of the total amount of transferrin available for iron binding. TIBC is elevated in iron-deficiency anaemia. (iii) Unsaturated iron-binding capacity (UIBC): this is a measure of the concentration of transferrin not

bound to iron. UIBC is increased in iron-deficiency. (iv) Percentage saturation of transferrin: this represents the proportion of iron-binding protein that is saturated with iron. In iron-deficiency anaemia the percent saturation is very low, less than 15%.

A study by Kretsch et al (1998) analysed the dietary iron intake and plasma iron levels of 14 obese, dieting women, aged between 25-42 years with a mean BMI of 31.5. Over a 21 week period baseline and post diet data was obtained prior to and after the diet which lasted 15 weeks. A controlled dietary intake provided 50% of the energy of the baseline and post diet weight maintenance period. Dietary iron intake averaged between 33-36mg/d (a multi-vitamin supplement was given containing 18mg of iron). Results showed that Hb concentration decreased for 8 of the 14 subjects and increased for the rest. Mean (Hb) in those where it decreased started at 12.9 and dropped to 12.3g/l. Where the Hb increased, the level started at 13.2 and rose to 13.8g/l. For both groups serum iron and TIBC decreased across the study, 81.3 to 61.9 μ g/l and 345 to 308 μ g/l respectively. Data regarding ferritin was incomplete, although 50% of the sample had a low ferritin status initially (<20ng/l). This study suggests that iron status declines in obese women dieting to lose weight even with the provision of dietary iron. It would appear that tissue iron deficiency occurs in the presence of normal iron stores, as a result of proteins being utilised to meet general energy requirements.

1.1.15.2 Lipids

Dietary lipids are of concern because of their role in certain types of cardiovascular disease (Brody, 1994). Although raised total cholesterol levels are associated with the development of coronary heart disease (CHD), it would appear that CHD risk is largely mediated through low density lipoprotein (LDL) cholesterol (DoH, 1994).

Low concentrations of low density lipoproteins (LDL) are also a strong predictor of risk for the development of CHD (Katan, 1998).

A meta-analysis of studies which had investigated the effect of weight reduction on blood lipids and lipoproteins was conducted by Dattilo & Kris-Etherton (1992), who suggested

that weight reduction through dieting can be a viable approach to help normalise plasma lipids and lipoproteins in overweight individuals. They indicated that weight reduction was associated with significant decreases in total cholesterol, low density cholesterol, very low density lipoprotein, and triglycerol. An increase in high density lipoprotein occurred for subjects who had achieved a stabilised, reduced weight, however, levels decreased in those who were losing weight.

Kasim et al (1993) studied lipoprotein levels in women following a low fat eating plan (15% total energy intake), specifically designed by dieticians, who were responsible for counselling the subjects. The mean BMI of the subjects was 25.2. After 3 months mean total cholesterol levels decreased from 5.21 - 4.83mmol/l. Mean low density lipoprotein decreased, as did mean high density lipoprotein levels: 3.20 -2.88mmol/l and 1.56 - 1.35mmol/l, respectively.

Although it is debatable (Law & Thompson, 1991), concern has been expressed that low cholesterol levels might be associated with increased mortality rates from stroke, cancer and other non-cardiovascular diseases (Kannel et al, 1984, Jacobs et al, 1992)

1.1.15.3 Calcium status

Calcium is the most important mineral constituent of the skeleton (Smith, 1993) and plays an important role in maintaining skeletal mass (Brody, 1994). The primary function of vitamin D is to maintain plasma calcium levels. The external balance of calcium is determined by exchange between the skeleton, the intestine and the kidney. These fluxes are controlled by the action of the calciotropic hormones, parathyroid hormones, 1,25-dihydroxycholecalciferol and calcitonin. They are also influenced by sex hormones, growth hormones, corticosteroids and a variety of locally acting hormones (Smith, 1993). Hypocalcaemia and hypercalcaemia occur when the calcium regulatory hormones fail to respond. Although plasma calcium status does not generally reflect calcium status, animal studies have displayed problems such as impaired growth, rickets and poor mineralization where serum calcium levels have been 50% of normal levels as a result of calcium

deficient diets. About 40% of serum calcium is protein bound, with most of it (80%) being bound to albumin (Brody, 1994). Plasma calcium levels reported in the Dietary and Nutritional Survey of British adults (Gregory et al, 1990) were similar, 2.29mmol/l in dieters and non-dieters, however, no dietary details were given.

1.1.15.4 Protein status

Protein is essential for growth, development and protein turnover (Brody, 1994). Deficiencies in protein and energy may result in the development of protein-energy malnutrition. Hypoproteinaemia and hypoalbuminaemia are present in this condition (Alleyne et al, 1977). A deficiency in serum albumin levels is an indicator of nutritional depletion (Thomas, 1994). An increase in total protein may be found in haemoconcentration due to dehydration from loss of fluid (Bauer et al, 1974).

It has been suggested that patients following semistarvation diets with protein supplements may be at risk from pathological, subclinical malnutrition (Shetty et al, 1979). A study by Merritt et al (1981) involving 9 obese subjects, aged 9-16 years found small but significant decreases in total serum protein, albumin, transferrin and retinol binding protein after following a protein/fat diet of 698kcal/d (mean), although they did remain within normal levels. It was concluded that the decrease in levels did not warrant concern.

1.1.15.5 Fat soluble vitamins

Vitamin A is required for normal growth and development, cellular differentiation and vision (McLaren et al, 1993). The role of carotenoids appears to be somewhat controversial. Although it has been suggested that they play a part in the prevention of some cancers (Zeigler, 1991), more recent research has questioned their value, suggesting that β carotene supplementation may increase the incidence of lung cancer in smokers (De Luca, 1996). Vitamin E is important in cell maintenance, DNA synthesis and immune response (Duthie, 1993). It has been suggested that antioxidant properties possessed by vitamin E may offer protection from coronary heart disease and cancer (DoH, 1991).

The work of van Dale, et al (1990) studied the micronutrient status of 12 obese male subjects during a dieting and exercise programme, lasting 14 weeks. Measurements were taken before and after the study. The diet was low in energy, approximately 720kcal/d during the first 5 weeks and increased to approximately 930kcal/d during the last 9 weeks. The composition of the diet was low fat (21g/d, increasing to 36g/d) and high carbohydrate. Where the results were concerned with regard to the dieting only group, mean haemoglobin levels decreased from 9.2 - 8.8mmol/l. A reduction was also seen in mean plasma fat soluble vitamin levels, vitamin A (retinol): 2.05 - 1.65umol/l and vitamin E: 21.9 - 17.9nmol/l.

Similarly, a study by Zwiauer, et al (1988) showed a marked decrease in mean plasma levels of vitamin A: 505-252ug/l and vitamin E: 9.8-5.9mg/l, beta carotene: 258-217ug/l, retinol binding protein: 5.3-3.0mg/dl, prealbumen: 28.1-16.8mg/dl and low density lipoprotein: 132-82mg/dl in a group of 21 obese adolescent boys attending summer camp, following a very low calorie diet (approx. 600kcal/day) for a 3 week period. Zwiauer et al (1988) and van Dale et al (1989) suggest that the decrease in vitamins A and E may have been due to the decrease in the transport proteins of the vitamins concerned during the catabolic situation.

The literature reviewed has shown that there is a wealth of information regarding dieting practices, especially concerning adolescent girls. However, the majority of this research has been conducted in the USA. The incidence of 'dieting' has been previously reported amongst various age groups in the UK, however, studies which have investigated the subject in depth have involved adolescents and have done so from a behavioural point of view, measuring attitudes towards eating behaviour in relation to the development of eating disorders. There is a lack of research which approaches 'dieting' practices in more general terms, and looks at dieting/eating habits which may affect the health of the population as a whole. Previous research that has looked at the effects of reducing diets on blood nutrient levels has been undertaken in a clinically controlled environment, involving obese patients. In reality much of the dieting behaviour undertaken is unsupervised and therefore it is important that nutritional status is assessed amongst the general dieting population. Because of the many health risks associated with 'dieting' and the fact that such practices are common amongst females regardless of weight it would appear that 'dieting' has become a public health issue. There is an urgent need for research which investigates general dieting behaviour in relation to the health implications of such behaviour amongst the female population

It is anticipated that the complete study will give a greater understanding and awareness of dieting practices amongst female dieters in relation to the general female population and provide evidence that will support dietary advice and recommendations on the benefits/adverse effects of dieting/dietary practices.

The aim of this study is therefore, to:

- determine the dieting practices, nutritional intake and status of a female population and identify any predisposition to health problems.

The objectives are to:

- determine the incidence of dieting amongst young females (aged: 11-15 years and 18-25 years).
- determine dieting practices and identify the most popular type of reducing diet used.
- compare the nutritional content of the diet of dieters and non-dieters.
- determine the blood nutrient status in dieters and compare this with non-dieters.

Section 2.

Methodology

Methods of collecting information and study design:

There are various methods of collecting information about people, which include: unstructured interview, semi-structured interview, group discussion, interview administered questionnaire, self-reported questionnaire, self recorded behaviour and observation behaviour. The final choice depends on the information being sought and the situation in which the information is being collected. Good study design is essential to provide data that can be interpreted and meet the objectives of the study (Kemmm & Booth, 1992).

In order to fulfil the aims and objectives set out, the study was divided into four sections with the 'measurement instruments' used, being appropriate to the requirements of each section.

- Dieting behaviour/practices amongst adolescent girls.
- Dieting behaviour/practices amongst adolescent girls ~ follow up study
- Dieting behaviour/practices amongst young women.
- Female (adult) dieting study.

2.1 Dieting behaviour/practices amongst adolescent girls:

The main aim of this part of the study was to determine the incidence of dieting amongst adolescent girls, identify the most popular type of reducing diet used by this group and determine general dieting practices. Data was collected using a self-reported questionnaire.

2.1.2 Sample (recruitment)

A 'purposive sample' occurs when a researcher chooses a particular group or place to study because it is known to be the type that is wanted (McNeill, 1990). Initially, a 'sampling frame' which included all girls schools in the Merseyside area of England was used. These schools were approached and invited to take part in the study. Only two Girls High Schools, who had been involved in previous work with the university responded to the invitation. Mixed sex schools were then approached, with positive responses being obtained from four schools, the two Independent Schools who accepted the invitation had contacts with the university. If after four weeks of the invitation letter (appendix No.1) being sent out, no response had been received it was assumed that the schools concerned did not wish to participate. A two month time period was allowed for recruitment and after this time, six schools had agreed to take part: two Independent, two Comprehensive and two Girls High Schools. Where schools are concerned the readiness of the staff to cooperate in any data gathering exercise may heavily influence the choice of participating schools (Kemmm & Booth, 1992). Overall 569 girls, aged 11-15 years were recruited from these schools: 44 girls aged 11 years, 161 aged 12 years, 197 aged 13 years, 114 aged 14 years and 53 aged 15 years. Initially it had been intended to study girls aged 12-14 years old, however, the schools taking part included girls outside this age range and therefore, the age limit was expanded. The proportion of girls taking part in each school varied, but overall 85% of the target population was obtained. Those who did not take part were either absent from school on the day the study was undertaken or declined to take part. Participation was voluntary and no reason was asked from those who declined to take part,

in order to respect the confidentiality of the girls and the sensitivity of the subject. For ethical reasons therefore, no information was obtained about those who did not take part. Taking the advice of educationalists it was felt unwise to ask the girls directly about their social background. Therefore, the Independent (fee paying) and Comprehensive Schools (free schools) were used to give an indication of the socio-economic status of the girls and to make a comparison between middle and lower classes. This method of assessing social class has been used in previous research (Wardle & Marsland, 1990). As a particular school-type represented a particular social class, socio-economic status was not affected by non-participants. The sample obtained from the Girls High School were only included in the overall results and not in the comparison of socio-economic classes as they attract pupils from a broad social background.

2.1.3 Procedure

Ethical permission for the study was obtained from Liverpool John Moores University Ethics Committee. Consent was obtained from the Head/Principal of the schools concerned and also from the parents/guardians of the girls. Consent forms and information letters were sent to the parents by the schools (appendix No.1). The data collected were self reported and the questionnaires were explained and distributed to the girls by a teacher who had been briefed with regard to the study. Distribution of the questionnaires was done in this way because it met with the wishes of the schools and was a condition of their participation.

2.1.4 Questionnaire

A self-reported questionnaire was chosen to collect information from this group of girls (appendix No.1). Because of the sensitivity of the subject, anonymity and confidentiality were important considerations, which would not be met by other methods of data collection such as interviewing. By meeting these two conditions it was felt that although the use of a questionnaire would not guarantee truthfulness, it would be expected to improve the chances of the replies being honest (McNeill, 1990). Results of a study by

Rosen & Poplawski (1987) showed that the validity of self-reported questionnaires was generally positive. Amongst their sample of 165 High School subjects, it was found that self-reported weight change efforts are consistent with actual records of dietary behaviour and reports from parents, siblings and friends. The aim of the questionnaire was to identify dieting behaviour/practices amongst adolescent girls. Because no other study undertaken in the UK has approached the subject of dieting from a similar angle it was necessary to compile a questionnaire specific to the needs of the study. Previously validated questionnaires which address eating behaviour such as the Dutch Eating Questionnaire (van Strien et al, 1986) were not suitable for use in this study. Their design is more suitable for studies of a psychological/behavioural nature which address the causal development of eating disorders by measuring attitudes towards eating, and therefore would not have been completely relevant, as this study specifically looked at actual dieting practices and behaviour. Their completion is also time consuming and requires a lot of instruction. Because of the way in which distribution took place (i.e. by the teachers) it would have been impractical to attempt to use such a questionnaire. Due to the sensitive nature of the subject the content and design of the questionnaire had to meet the requirements of the Ethics Committee and be authorised by them.

The questionnaire was composed of three sections and designed according to the advice of educationalists: section A, which was to be answered by all pupils, section B, which was only to be answered by those who had admitted to dieting and section C, which was only to be answered by those who had never dieted. The reasons for this design was so that pupils who had never dieted would not have to answer any questions relating to dieting behaviour and therefore would not be influenced to diet. However, by giving the non dieters a section to answer they would be able to participate and not feel excluded from the study.

Section A consisted of general questions to establish age, sex, height and weight with social questions being included with the aim of introducing a lighter note to the questionnaire. In this section the subjects were asked if they had ever dieted to lose weight. This was further explained by asking if they had ever changed the way in which

they had eaten in order to make themselves thinner. Height and weight were self reported and were used to calculate body mass index (BMI).

$$\text{BMI} = \frac{\text{Weight (kg)}}{\text{Height (m}^2\text{)}}$$

Because of the way in which the schools wanted to conduct the questionnaire it was not possible to actually record height and weight. It could be assumed that this could introduce a degree of unreliability to the data. However, Stewart (1982), studying a sample of 3373 people, aged 14-61 years found that although there was an overall tendency for people to report their weight slightly less than it actually is, it was only by a mean of 1.1kg. Overweight people tended to underestimate their weight more than non-overweight, with a mean of 1.6kg and 0.7kg, respectively. These results led Stewart (1982) to suggest that self-reported height and weight are accurate indicators of actual height and weight. Indeed, further support for self-reported height and weight was shown in a more recent study by Imrhan et al (1996), who, in a group of 449 college students, found only small errors of estimation (3.54%). The results of these studies suggest that it is acceptable to use self-reported height and weight.

BMI has been popular for assessing obesity in adults for many years (Garrow & Webster, 1985), however, its use in children has only been developed over recent years (Cole et al, 1995). Adult BMI increases fairly slowly with age, so that age independent cut offs can be used to grade obesity, however, in children BMI changes substantially with age. For this reason, Cole et al (1995) suggest that child BMI needs to be assessed using age related reference curves. More recently, there has been a call for an internationally acceptable index to assess childhood obesity on a world-wide basis (Guillaume, 1999). The International Obesity Task Force concluded that although BMI is not a perfect measure in children because it covaries with height, it may be suitable because it is an easy measure of body fat that is reproducible and valid. However, in certain cases additional information may be required such as skinfold measurements (Bellizzi & Dietz, 1999). Data regarding BMI results from this study were analysed using Body Mass Index Reference Curves for the UK as devised by Cole et al (1995) and issued by the Child Growth Foundation, as

shown in table 2.1. These BMI reference curves were considered suitable as they had been designed for use in the UK and have been used by Bost et al (1998) in The Health Survey for England, The Health of Young People: 1995-1997.

Table 2.1: Body Mass Index (BMI): 11-15 years (Cole et al, 1995)

Age	BMI : underweight	normal limits	overweight
11 years	< 14	14 - 21.1	> 21.1
12 years	< 14.5	14.5 - 21.9	> 21.9
13 years	< 15	15 - 22.8	> 22.8
14 years	< 15.5	15.5 - 23.5	> 23.5
15 years	< 16	16 - 24.1	> 24.1

$$\text{BMI} = \text{weight (kg)} / \text{height (m}^2\text{)}$$

Section B consisted of questions relating to dieting behaviour. These questions addressed issues such as the age at which the pupils first started to diet, reasons for wanting to lose weight, type of reducing diet used, reason for choice of diet, parental approval regarding dieting and perception of dieting in relation to health. Although the questionnaire was specifically designed for the study the content of this was based on similar studies that had previously taken place in the USA. The self-reported questionnaires used in these American studies were not published in the papers concerned (Perry-Hunnicutt & Newman, 1993, Moreno & Thelan, 1995).

Section C was basically a food frequency questionnaire. Although this section is not particularly relevant to the main aims of the study it was included to meet the requirements of educationalists who were members of the ethics committee.

The questionnaire consisted of mainly closed questions. Although open-ended questions allow the respondent to provide more information it was felt that the inclusion of as many closed questions as possible would make it easier to understand and minimise the

completion time. Where open-ended questions were included it was possible to answer them briefly, and long explanations were unnecessary. All responses to closed questions were coded for statistical analysis and responses to open-ended questions were grouped and coded (McNeill, 1990). Prior to using the questionnaire in the main study a pilot study was carried out using a group of 25 girls who fulfilled the same criteria as those taking part in the main study. The pilot study demonstrated that the questionnaire provided a clear understanding of the questions and obtained the data that was required, thus establishing a degree of content and face validity.

2.2 Adolescent - follow-up study

Previous work has addressed the incidence of dieting in adolescent girls, however, it would appear that no previous work has actually questioned the difference between the dieting/dietary behaviour of dieters and non-dieters in relation to the perceptions of dieting held by these two groups. It was therefore, necessary to undertake a follow up study for several reasons. Firstly, as a result of some of the findings of the first questionnaire, which were that many dieters perceived dieting as a healthful behaviour and that some types of dieting behaviour could be interpreted as 'healthy eating'. Secondly, in order to identify the perceptions of dieting behaviour amongst dieters and non-dieters it was necessary to obtain information concerning dieting habits/behaviour from all girls, regardless of whether they had dieted or not. It had not been possible to obtain information from non dieters previously because of ethical requirements, however, when evidence from the findings of the first questionnaire were presented to Ethics Committee, which showed the importance of obtaining this information they reversed their decision.

The main aim of this follow-up study was therefore, to find out how the girls interpreted the terms 'dieting' and 'healthy eating' and to try and ascertain the 'actual' incidence of dieting amongst adolescent girls.

As with the first study information was collected using a self-reported questionnaire.

2.2.1 Sample (recruitment)

The schools which had been used for the first study were approached again, by letter (appendix No. 2) however, only one, a Girls High School, agreed to take part. One further school, a mixed sex Comprehensive was approached and agreed to take part. The number of girls taking part in the study was 140 and were aged 12-13 years. This age range was chosen because the results of the first study showed that most girls started to diet during this time. As with the first study, the proportion of girls taking part from each school varied, but overall 85% of the target population was obtained. Those who did not take part were either absent from school on the day the study was undertaken or declined to take part. Participation was voluntary and no reason was asked from those who did not take part in order to maintain confidentiality. With this study it was not possible to make any comparison regarding socio-economic status as no Independent Schools were included in the study.

2.2.2 Procedure

This was identical to the first study. The consent form and parental letter used in the first study were used again. Ethical permission and appropriate consents were obtained and again distribution of the questionnaires was done by a teacher who had been briefed with regard to the study.

2.2.3 Questionnaire

(appendix No.2)

The main aim of the questionnaire, which was self reported, was to address important issues that had been raised by the results of the first questionnaire and to gather the opinions of both dieters and non-dieters. The aim of the questionnaire was to gain specific information related to a previous study and so a unique questionnaire was compiled. However, as with the previous study a pilot study was carried out to ensure the respondents would have a clear understanding of the questions, and therefore establishing a degree of content and face validity.

As with the previous questionnaire, as many closed questions as possible were included to facilitate comprehension and completion. However, it was necessary to include a few open-ended questions as the opinions of the girls regarding certain issues was important. Questions regarding height and weight were included, which were self-reported and BMI was calculated. The questionnaire sought information concerning the girls' opinion regarding the terms 'dieting' and 'healthy eating' and also the incidence of dieting, both previously and presently. Questions were included to find out opinions regarding dietary fat, meal skipping habits and perceptions of image. All responses were coded for analysis.

2.3 Dieting behaviour/practices amongst young women:

The main aim of this study was to determine the prevalence of dieting amongst this group. to identify the most popular type of reducing diet used by them and to determine general dieting practices. Information was obtained by distributing a self-reported questionnaire.

2.3.1 Sample (recruitment)

Female students (750), aged between 18 and 24 years were randomly chosen by computer from the Liverpool John Moores University data base, to take part in the study.

2.3.2 Procedure

Ethical permission was obtained from the Liverpool John Moores University Ethics Committee. The questionnaires were distributed to the students via the university internal mail system, and returned in the same way. The questionnaire was accompanied by an information letter explaining the study and a consent form (appendix No. 3).

2.3.3 Questionnaire (appendix No. 3)

The main aim of the questionnaire was to identify dieting behaviour/practices amongst young women. Because it would appear that no previous study has specifically addressed this issue in the UK it was necessary to compile a questionnaire suitable for use in this study. Also the content of the questionnaire had to meet with the requirements of the Ethics Committee. However, an American study looking at the weight control practices of adults by Levy & Heaton (1993) was used as a guideline when compiling the questionnaire. Due to the sensitive nature of the questionnaire anonymity and confidentiality were stressed to the respondents.

The questionnaire was divided into two sections. The first section was answered by all respondents and asked questions regarding age, height and weight (self-reported) which were used to calculate BMI. The respondents were also asked how satisfied they were with their body image and if they had ever dieted to lose weight. The second section, only answered by the those who had dieted, determined information regarding dieting behaviour such as: their reason for dieting, the age at which they had first started to diet, the average length and frequency of diet, type of diet used and reason for doing so. All responses were coded for analysis.

Anthropometric measurements such as the measurement of height and weight and the calculation of BMI provide a useful method of nutritional assessment in the diagnosis of obesity and undernutrition (Fidanza, 1991). As a measure of obesity BMI is very practical as both height and weight may be measured easily. It is easy to apply to subjects with any degree of obesity and provides a measure of fatness which compares well with specialised laboratory methods, such as measuring body density, body water and body potassium (Garrow & Webster, 1985). The BMI categories used were those described by Garrow (1981) and shown in table 2.2:

Table 2.2: Adult BMI categories

Grade	Wt (kg)/Ht(m ²)	Level of obesity
0	20-24.9	Desirable
1	25-29.9	Overweight
2	30-40	Obese
3	>40	Very obese

A BMI below 20 is also undesirable to good health (Thomas, 1994).

Prior to using the questionnaire in the main study a pilot study was carried out using a similar group to those who fulfilled the criteria to take part in the main part of the study. The pilot study, involving 25 students demonstrated that the questionnaire provided a clear understanding of the questions and obtained the data that was required, thus establishing a degree of content and face validity.

2.4 Adult female dieting study:

The aim of this part of the study was to:

- (i) Identify the most popular type of reducing diet used by adult female dieters and analyse the nutritional content of their diet.
- (ii) Determine blood nutrient levels in adult female dieters and determine any relationship with dietary intake. The blood nutrient levels analysed were: haemoglobin, total iron, total iron binding capacity, ferritin, total cholesterol, high density lipoprotein, low density lipoprotein, calcium, total protein, albumin, vitamin A, E and carotenoids.
- (iii) Observe any change in body mass index (BMI) during the period of the reducing diet.
- (iv) Compare the nutritional intake, blood nutritional status and BMI of dieters and non-dieters.

The blood nutrient levels investigated were chosen, partly as a result of the findings from the initial questionnaires but also because of health concerns about the female population. Initial findings showed that the most popular type of reducing diet used was a 'low fat' diet. It was hypothesised that the use of this type of diet may be more likely to predispose to a deficiency in nutrients such as protein, calcium and iron, than a more well balanced reducing diet. It was therefore, decided, to see if dietary levels were reflected in blood levels. It was also thought that a reduction in fat intake may influence levels of fat soluble nutrient plasma levels. Because anaemia and coronary heart disease are major health risks to women, the study concentrated on the investigation of iron and cholesterol plasma levels in relation to their dietary intake.

The data were collected using a 3-day estimated food diary, semi-structured interview, appropriate biochemical methodologies and anthropometric measurements (height and weight).

2.4.1 Sample (recruitment)

Women (over 18 years of age) were invited to take part in the study (50). Although the aim of the study was to look at the effects of dieting on non-obese subjects, ethical requirements meant that it was not possible to make any specific requests in our recruitment advertisements. Therefore, all dieters regardless of weight were invited to take part. Recruitment took place by placing information posters on university noticeboards and also on the university computer network. A number of subjects were recruited by word of mouth. Ethical restrictions only allowed recruitment from subjects already dieting, therefore, it was not possible to obtain pre-diet baseline data. As a result of this a sub-group of 20 non-dieters were also recruited in order for a comparison to be made between a dieting and non-dieting state.

2.4.2 Procedure

The dieters were followed for a period of two months during their reducing diet. However, for the non-dieters only a one-off set of data was obtained. On volunteering for the study an appointment was made to meet the researcher and the study was fully explained and an information sheet given to the subject which described the study and what participation entailed. Written consent was obtained from the subject (appendix No. 3). During the first appointment a short semi-structured interview/questionnaire was completed and height and weight were measured and recorded. A dietary diary and instructions on completion procedures were given and a blood sample taken; either a venous sample or if refused, a finger prick sample. All procedures, apart from height were repeated on the subjects after one and two months. Feedback was given to the subjects regarding all measurements and results. In the case of any abnormal results, subjects were advised to seek medical advice.

2.4.3 Semi-structured interview/questionnaire

During the interview, information regarding dieting behaviour was obtained. The subjects were asked at what age they first started to diet, the usual length and frequency of their diets, the intended length of their present diet and the type of diet they were following. By comparing this information with the type of diet they followed and their dietary intake it may be possible to see if their dieting behaviour might have any long term effects on their health as a result of nutritional deficiencies.

2.4.4 Measurement of height and weight

The measurement of stature was undertaken using a stadiometer (Harpenden pocket stadiometer: CMS weighing equipment Ltd; London, UK), and weight was recorded using Soehnle electronic scales (CMS, London, UK). Height and weight were used to calculate BMI.

It is important that wherever possible measurements are made by a single observer as inter-observer variation has been found to be large (Fuller et al, 1990), although intra-observer

variation is very low (Lohman, 1988). As only one fieldworker took the measurements, it was considered that the results would be reliable. A pilot study was undertaken to assess intra-observer reliability by taking repeated measurements on six different people, on five occasions at hourly intervals (each measurement was taken three times and the mean value used). Mean variation were 0.08 and 0.25 for height and weight respectively (tables 2.3 and 2.4).

Pilot study results

Table 2.3: Reproducibility of height measurements (cm)

No. of determinants	Mean \pm SD	Variation %
5	170.14 \pm 0.21	0.10
5	172.10 \pm 0.19	0.10
5	166.12 \pm 0.17	0.10
5	167.08 \pm 0.10	0.05
5	164.10 \pm 0.14	0.08
5	181.10 \pm 0.14	0.07

Mean variation = 0.08

Table 2.4: Reproducibility of weight measurements (kg)

No. of determinants	Mean \pm SD	Variation %
5	70.24 \pm 0.21	0.29
5	68.18 \pm 0.14	0.20
5	60.58 \pm 0.08	0.08
5	66.30 \pm 0.23	0.34
5	61.40 \pm 0.15	0.24
5	59.64 \pm 0.33	0.33

Mean variation = 0.25

2.4.5 Measurement of dietary intake

There is no generally accepted method of measuring the dietary intake of free-living individuals however, “the methods chosen must be known, or shown, to be reproducible and sufficiently valid for the purpose of the particular investigation” (Marr, 1971). Such investigations can be difficult, indeed Bingham (1991a) states that “The validity of measurements of dietary intake in free living individuals is difficult to assess because all methods rely on information given by the subjects themselves, which may be incorrect.” Therefore, although “absolute validity is the ultimate goal, for many purposes relative validity may suffice” (Keys, 1965).

There are various methods of assessing dietary intake, ranging from prospective approaches involving the weighing of all food consumed, to retrospective approaches such as obtaining food histories with each method having its advantages and limitations (Bone, 1992):

Twenty four hour recall, is a method which estimates food consumption retrospectively. The advantage of this method is that the usual eating pattern is not disturbed, and also a lesser degree of co-operation is needed, thus increasing the likelihood of a higher response rate. However, limitations include inaccurate memory regarding consumption and a single twenty four hour recall may be an inaccurate guide to the usual intake of an individual because of day to day variation (Bone, 1992). Despite these limitations, Bingham et al (1994) suggest that although the 24 hour recall method is incapable of illustrating habitual dietary intake of individuals, it does compare well with weighed intake data.

A dietary history, is also a retrospective method where the respondent is questioned about their ‘usual’ food intake in a 1-2 hour interview. The aim is to construct a typical 7-day eating pattern (Ralph, 1993). Although validity studies of diet histories have reported intakes to be frequently higher than weighed methods, repeatability has shown this method to be generally good for assessing group means of energy and macronutrients, but poorer for micronutrients (Bingham, 1991a).

A food frequency questionnaire is another retrospective method, which, over the past decade has become increasingly popular for use in epidemiological research (Robinson et al, 1996). With this method the respondent is presented with a list of foods and is required to say how often each is eaten per day/week or month. Food lists may be chosen because they are important sources of a particular nutrient and may not assess total diet. The food frequency questionnaire has the advantage of being interviewer or self administered (Ralph, 1993). Studies by Paisley et al (1996) and Robinson et al (1996) propose that they give meaningful estimates of nutrient intakes, however, Bingham (1991a) suggests that this method needs to be developed and redeveloped and then piloted and tested to ensure validity in a new population.

Alternatively, prospective methods such as the weighed inventory method or dietary diary (estimated) avoid memory problems, although, having to record food actually consumed may affect the usual pattern of eating (Bone, 1992). These methods require a high level of subject co-operation, which may affect response rates.

Weighed records may include the weighed inventory technique where all portions served and wasted are weighed and recorded. The precise weighed method includes recording the weights of all ingredients, the cooked weight and the weight of all waste (Ralph, 1993). The semi-weighed method for measuring family food intake involves weighing the total quantity of food served to a family and the quantities given to individuals given in household measures (Nelson & Nettleton, 1980). The validity of weighed intake methods has been tested using 24-hour urine collections and shows that these methods may be an accurate measure of protein intake when compared with urinary nitrogen output (Bingham, 1991b).

Although it has been suggested that the weighed inventory method may be accepted as a 'gold standard' method for assessment of habitual intake (Garrow, 1995), the final choice of method will depend on various factors such as the aims of the study, the size of the sample, the accuracy and response rates required, the abilities and willingness to cooperate of the subjects and the resources available (Bone, 1992).

2.4.5.1 Chosen method: three day estimated food diary

The method chosen for this study was the three day estimated food diary, a method which has been used extensively (Crawford et al, 1994, Ricketts, 1997, Coufopoulos, 1997). Despite its extensive use, the logistics of the procedure were rehearsed during a small pilot study, using subjects who were eligible to take part in the study.

Some surveys have collected records for 3 or 4 days at a time, however, individuals would not be expected to keep accurate records for more than 7 days at a time (Bone, 1988). Stuff et al (1983) concluded from their study that in comparison to the 7 day record, a 3 day record is a reasonable approach for obtaining qualitative nutrient data and is adequate for assessing the general quality of the diet. Crawford et al (1994) assessed the validity of the 24-hour recall, 3-day food record and 5-day food frequency questionnaire for use in a national (USA) health study. Their results showed that agreement between observed and reported intakes from 3-day food records made it the best overall choice. It offered the highest degree of accuracy of reporting and displayed less bias.

A prospective method was chosen because blood samples were taken at the same time that dietary intake was measured in order to identify a relationship between plasma nutrient levels and dietary intake. However, the weighed methods were discarded because the subjects were required to complete their diary during working hours and therefore it would not be practical for them to use scales. Where weight loss is concerned, those trying to lose weight are encouraged to adopt a well balanced healthy intake and incorporate it into a healthier lifestyle over the long term. Weighing food is a very controlled and regimented action. It reflects the 'stigma' of being 'on a diet' and would not be part of long term dietary habits and therefore may not reflect the dietary intake of free-living individuals following self selected reducing diets. Weighing food is very tedious, which may affect compliance with the study (Bone, 1992), where dieters are concerned it may effect compliance with the reducing diet as well. A recent study by Bingham et al (1994) concluded that where an estimated record or open-ended food diary is concerned, individual values of nutrients were most closely associated with those obtained from

weighed records, and there were no significant differences in average food or nutrient intakes.

2.4.5.2 Procedure regarding completion of dietary diary

One fieldworker carried out the dietary study, which may be an advantage, as inter-observer variability would be eliminated. The subjects were given a dietary diary and asked to complete it during two week days and one weekend day. Despite the fact that the subjects were undertaking reducing diets, it is possible that their pattern of dietary intake may change at a weekend as with those following normal dietary patterns. Although the diary contained instructions and an example of a completed day, full instruction was given to the subjects during the interview. The importance of recording all food and drinks as soon as possible after consumption, was stressed. The subjects were asked to give as much information as possible regarding recipes, portion sizes and the use of 'lite' or low fat products. On completion, the diary was collected and the subject re-interviewed. In this study it was particularly important to verify food portion sizes with the subject as the use of average portion sizes as estimated by Crawley (1992) may not be suitable for a person following a reducing diet where portion sizes may be reduced and vary considerably between individuals.

Where the measurement of dietary intake is concerned it would appear that under/over reporting is a problem (Pryer et al, 1997) especially within certain groups, for example under reporting is more common amongst the obese than the non-obese (Bardini et al, 1990, Prentice et al, 1986). This emphasises the importance of checking the completed dietary diary with the subjects. The value of the use of food photographs in the estimation of food portion sizes has been demonstrated (Lucas et al, 1995, Nelson et al, 1996). Indeed, Robinson et al (1997) found that they improve the validity of dietary assessment, particularly where the mean intakes of populations are concerned. Therefore, in order to confirm the amounts consumed a food atlas compiled by Nelson et al (1997) was used.

The subjects were followed over a 2 month period and were asked to complete 3 diaries during this time (one at the start of the study, one after a month and the last one at the end of the two month period). Because dieting may be considered as an 'unstable' eating behaviour (Holland et al, 1995) it was felt that asking the subject to complete the diaries in this way may give a more reliable picture of their mean nutrient intake, as well as comparing it with any weight loss. Although this was done to monitor intake during the reducing diet, Hackett et al (1983) showed that the reliability of a dietary survey increases with the use of three 3-day records (reliability 63%) compared to two 7-day records (51%). Also, according to Black et al (1993), bias may not be important if subjects are studied repeatedly and act as their own control.

2.4.5.3 Analysis of dietary diaries

The three day diaries were analysed using the University of Salford nutritional analysis package 'Microdiet', with the aid of McCance and Widdowson's Composition of Foods (Holland et al, 1991) and all available supplements. The 'Microdiet' program performs nutrient analysis of a set of foods specified by the user. Analysis options include the total amounts of a wide range of nutrients and the contribution each food makes to any chosen nutrient. Comparisons may be made with Dietary Reference Values, Recommended Daily Amounts and similar standards. Southgate (1993) points out that the accuracy of food tables are affected by the composition of individual foods, which is beyond control. Chemical analysis of foods eaten is more accurate, however, facilities and cost deemed this method impossible.

2.4.6 Limiting bias in dietary surveys

In all dietary surveys, despite the method used, ultimately the information gained relies heavily on the participating subject (Thomas, 1994). A study by Bratteby et al (1998), involving 50 adolescents, found that under-reporting occurred in the use of a 7-day weighed dietary record when compared to measurements of energy expenditure using doubly-labelled water (DLW), indirect calorimetry and physical activity assessment. DLW

measurements have shown that habitual energy expenditure is substantially raised in obese individuals (Prentice et al, 1996), who tend to under-report energy expenditure (Black et al, 1991). Research by Johansson et al (1998) suggests that the desire for weight change may severely bias reported food intake in dietary surveys. However, results of their study found that although the proportion of under-reporters was high amongst obese subjects who wanted to reduce their weight, only 5.0% of the subjects were obese and as many as 52.0% of the under-reporters had a BMI below 25. %, suggesting that where the desire for weight change is evident under-reporting occurs regardless of weight. Where validity is in doubt it is advisable that an independent check should be carried out to compare energy input with energy expenditure (Thomas, 1994).

2.4.7 Methods of measuring energy expenditure

This can be undertaken by using a number of methods:

Direct calorimetry, involves the measurement of the energy expended by an individual over a given period by measuring the heat emitted by the body. This takes place in a room sized chamber designed to detect heat loss. However, disadvantages include the fact that results may be affected by anything, other than the subject in the chamber which may produce heat (McNeill, 1993).

Indirect calorimetry, is based on the fact that as foods are oxidised to produce heat in the body, oxygen is consumed and carbon dioxide is produced in proportion to the heat generated. A Douglas bag apparatus is most widely used to monitor the carbon dioxide produced (McNeill, 1993).

The doubly-labelled water technique (DLW), is a more recent advance in the measurement of energy expenditure. It involves the subject taking an oral dose of water containing stable (non-radioactive) isotopes of both hydrogen and oxygen. The isotopes, ^2H (deuterium) and ^{18}O , mix with normal hydrogen and oxygen in body water within a few hours. As energy is expended in the body, carbon dioxide and water are produced. The deuterium leaves the body in water and the oxygen 18 leaves in both water and carbon dioxide. The difference between the rates of loss of the two isotopes is used to calculate the carbon dioxide production of the subject, which in turn is used to calculate the energy

expenditure. This method provides information on the total energy expenditure of a free living individual over a period of up to 3 weeks. It is therefore, ideal for use in a field situation. However, a drawback is the cost of the doubly-labelled water and that of the mass spectrometer required to measure the concentrations of the isotopes in the body fluid samples (McNeill, 1993, Thomas, 1994).

Basal metabolic rate (BMR), a major component of energy expenditure, has been defined as “the sum total of the minimal activity of all tissue cells of the body under steady-state conditions, and is frequently expressed as the rate of heat production or oxygen consumption related to some unit of body size” (Bray & Atkinson, 1977). Measurement should take place with the individual lying at physical and mental rest in a thermoneutral environment, at least 12 hours after the previous meal. BMR may be influenced by a number of factors such as age, sex, body size, body composition, nutritional and physiological state, however, it remains a useful indication of the energy expenditure under standardised conditions, which can be compared within and between individuals (McNeill, 1993). A number of equations exist for predicting BMR, with the most recent being those devised by Schofield et al (1985). These equations were subsequently adjusted by the COMA panel (DOH 1991) on Dietary Reference Value’s (table 2.5) by excluding some of the data derived from studies in the Third World countries (Thomas, 1994).

Table 2.5: Equations for predicting basal metabolic rate from body weight (DoH 1991)

Age range	Females (kcal/day)
18-29 years	$14.8w + 487$
30-59 years	$8.3w + 846$

w = body weight (kg)

As it has been suggested, where possible dietary intake measurements should be validated against a method of measurement of energy expenditure (Thomas, 1994). Where this study was concerned it was not possible to use calorimetry and DLW techniques because of lack of equipment and cost. Therefore as a crude method of checking the validity of the results from the dietary diaries, the equations devised by COMA (DoH, 1991) were used to

measure the BMR of the subjects participating in this study. Although Goldberg et al (1991) suggest a figure of 1.35, the ratio of energy intake to calculated basal metabolic rate was compared to recommendations made by the World Health Organisation (1985) where values below 1.2 are unlikely to meet nutritional requirements. The figure was chosen because a comparison was made between the results of this study and those of the Dietary and Nutritional Survey of British Adults (Gregory et al, 1990), which used the figures set by the WHO (1985)

2.5 Biochemical analysis:

The extent of the analysis of blood nutrient levels depended on the type of blood sample that the subject was willing to provide. If the subject was willing to give a venous sample then a more extensive profile could be obtained: total iron, iron-binding capacity, ferritin, haemoglobin, total cholesterol, high and low density lipoprotein, calcium, total protein, albumin, vitamins A, E and carotenoids. However, if they were only willing to volunteer a finger-prick sample analysis was more limited: haemoglobin and total cholesterol. If enough blood could be obtained via this method it was possible to transport some back to the laboratory in a capillary tube, which meant high density lipoprotein and calcium could also be assessed. These methods only required very small amounts of plasma.

2.5.1 Procedure for obtaining blood samples

Venous blood was either taken by the fieldworker (Registered General Nurse) or the Senior Occupational Health Sister at Liverpool John Moores University.

2.5.2 Biochemical methods

The methods used for the analysis of blood nutrient status are described in this section. Each method used is described, followed by the pilot study results, which demonstrate the reproducibility of the method used. Before the samples could be analysed reproducibility tests were performed on the methods to be used. This is the extent to which the results

produced by an instrument when applied to the same subject on two different occasions agree with each other (Kemmm & Booth, 1992).

The following methods were chosen because they were suited to the laboratory facilities available for this research.

The reproducibility of the following methods was assessed by replicate analysis of 5 serum samples of various dilution. The mean of the coefficient of variation was then calculated for each method.

$$\text{Variation} = \frac{\text{SD}}{\text{Mean}} \times 100$$

(SD = standard deviation)

In all cases a control sample was analysed to test the accuracy of the results.

2.5.3 Iron status

The need for iron is important for several reasons: it is constituent of several proteins responsible for several functions such as hormone synthesis and fatty acid metabolism, however the main protein, haemoglobin is responsible for transportation of oxygen around the body (Brody, 1994). Iron deficiency is a diminished total body iron content. It may range in severity from reduced iron body stores without any restriction of erythropoiesis to a severe anaemia with multiple deficiencies of tissue iron enzymes (Bothwell et al, 1979). A deficiency of iron may slow the tempo of growth during adolescence (Brabin & Brabin, 1992).

Although haemoglobin levels are an indication of iron status, iron deficiency can be diagnosed by a low serum concentration of ferritin (Hallberg et al, 1993). Iron is stored intracellularly as ferritin. The serum ferritin level accurately reflects the tissue stores of iron (Brody, 1994). Iron metabolism is investigated by undertaking the following measurements: (i) serum total iron concentration: low levels of this are found in iron-deficiency anaemia. (ii) Total iron-binding capacity (TIBC): this measures the maximal

saturation of transferrin with iron, and is thus, a measure of the total amount of transferrin available for iron binding. TIBC is elevated in iron-deficiency anaemia. (iii) Unsaturated iron-binding capacity (UIBC): this is a measure of the concentration of transferrin not bound to iron. UIBC is increased in iron-deficiency. (iv) Percentage saturation of transferrin: this represents the proportion of iron-binding protein that is saturated with iron. In iron-deficiency anaemia the percent saturation is very low, less than 15%.

2.5.3.1 Serum total iron and total iron binding capacity (TIBC)

Various methods have been developed for testing total iron and total iron binding capacity, including colorimetry methods (ICSH, 1971, Horak et al, 1975) and atomic absorption spectroscopy (Olsen & Hamlin, 1969, Matousek & Stevens, 1971). However, the method chosen for this test was the Sigma (Poole, Dorset, UK) kit, which involves the quantitative, colorimetry, enzymatic determination of total iron, unsaturated iron binding capacity (UIBC) and total iron binding capacity (TIBC) in serum (TIBC = serum total iron + serum UIBC). This method employs a minimal amount of serum, avoids protein precipitation and minimises interference from other trace metals.

A method for determining serum iron with ferrozine described by Persijn et al (1971) serves as the basis for the Sigma procedure. Ferrozine, a sulfonated derivative of diphenyltriazine, forms a water-soluble magenta complex with iron (Stookey, 1970).

Principle of method: at acid pH and in the presence of a suitable reducing agent, transferrin-bound serum iron dissociates to form ferrous ions. These react with ferrozine to produce a magenta coloured complex with an absorption maximum near 560nm. The difference in colour intensity at this wavelength, before and after the addition of ferrozine, is proportional to serum iron concentration. At alkaline pH, ferrous ions added to serum bind specifically with transferrin at unsaturated iron-binding sites. Remaining unbound ferrous ions are measured with the ferrozine reaction. The difference between the amount of unbound iron and the total amount added to the serum is equivalent to the quantity

bound to transferrin. This is the UIBC. The serum TIBC equals the total iron plus the UIBC.

2.5.3.2 Total Iron

Method

1. Prior to beginning the analysis the water bath was set at 37°C and the spectrophotometer (Corning calorimeter, UK) wavelength was set at 560nm and the absorbency reading to zero with de-ionised water as reference. This equipment was used in the analysis of Total Iron and UIBC.
2. A series of tubes were set up for blank, standard and test.
3. To the blank, 250µL of iron-free water were added. To the standard, 250µL of iron standard were added and to the test 250µL of serum were added. Each tube was mixed thoroughly.
4. The absorbency (A) of the test and standard were read straightaway. This was the INITIAL A.
5. To each tube, 25µL of colour reagent was added. The tubes were mixed thoroughly and placed in a water bath for 10 minutes.
6. The absorbency of the test and standard were read. This was the FINAL A.
7. To determine the total iron concentration the following calculation was performed

$$A \text{ test} = \text{FINAL A test} - \text{INITIAL A test}$$

$$A \text{ test} = \text{FINAL A standard} - \text{INITIAL A standard}$$

$$\text{Serum Total Iron } (\mu\text{mol/l}) = \frac{A \text{ test}}{A \text{ standard}} \times \text{concentration of iron standard}$$

2.5.3.3 Unsaturated Iron-Binding Capacity (UIBC)

Method

1. A series of tubes were set up for blank, standard and test.
2. To the blank, 500µL of iron-free water were added, to the standard, 250µL of

iron-free water and 250µL of iron standard were added and to the test, 250µL of iron standard and 250µL of serum. Each tube was mixed thoroughly.

3. The absorbency (A) of the test and standard were read straightaway. This was the INITIAL A.
4. To each tube, 25µL of iron colour reagent were added. Each tube was mixed thoroughly and placed in a water bath at 37°C for 10 minutes.
5. The absorbency of the test and standard were read. This was the Final A.
6. To determine the UIBC concentration the following calculation was performed.

$$A \text{ Test} = \text{FINAL A Test} - \text{INITIAL A Test}$$

$$A \text{ Standard} = \text{FINAL A Standard} - \text{INITIAL A Standard}$$

$$\text{Serum UIBC } (\mu\text{m/L}) =$$

$$\text{Concentration of iron standard } (\mu\text{mol/l}) - \frac{A \text{ Test}}{A \text{ Standard}} \times \text{Conc. of iron std.}$$

$$\text{Serum Total Iron-Binding Capacity (TIBC)} = \text{Serum Total Iron} + \text{UIBC } (\mu\text{mol/l})$$

$$\% \text{ Saturation of transferrin} = \frac{\text{serum iron concentration}}{\text{TIBC}} \times 100$$

Table 2.6: Reproducibility of serum total iron measurement (µmol/l)

No. of determinants	Mean ± SD Absorbency measurements	Variation %
5	0.298 ± 0.032	10.7
5	0.280 ± 0.018	6.4
5	0.256 ± 0.011	4.2
5	0.394 ± 0.008	2.0
5	0.540 ± 0.020	3.7

Mean variation = 5.4

The mean reproducibility of total iron measurement was 5.4.

Table 2.7: Reproducibility of UIBC measurement ($\mu\text{mol/l}$)

No. of determinants	Mean \pm SD Absorbency measurements	Variation %
5	0.44 \pm 0.008	1.8
5	0.44 \pm 0.005	1.1
5	0.45 \pm 0.005	1.1
5	0.50 \pm 0.020	4.0
5	0.40 \pm 0.005	1.2

Mean variation = 1.84

The mean reproducibility of UIBC measurement was 1.84.

2.5.3.4 Haemoglobin

Several methods have been developed for the measurement of haemoglobin. Methods involving the photometric measurement of haemoglobin after conversion to haemoglobincyanide have been widely used (Van Kampen & Zijlstra, 1961, ICSH, 1978). A further method is available in which undiluted blood is measured photometrically after conversion to haemoglobinazide (Vanzetti, 1966). However, for the purposes of this study it was important to be able to measure haemoglobin in a fieldwork situation as not all subjects were prepared to volunteer a venous sample of blood for laboratory analysis. Therefore the HemoCue Photometer (HemoCue Ltd, Sheffield, UK) was chosen which has been found to compare favourably with other methods (Bridges et al, 1987).

The technique

The HemoCue technique is based on an optical measuring cuvette of small volume and short light path. The cuvette cavity contains reagents deposited on its inner walls and the blood sample is drawn into the cavity by capillary reaction and is spontaneously mixed with the reagents. The cuvette is then placed in a HemoCue Photometer in which the absorbency is measured and the haemoglobin level is calculated. Thus, the technique makes it possible to sample the blood, mix and chemically react it with the reagents in the same cuvette as is used for the subsequent measurement.

Principle of method

The reaction in the cuvette is a modified azidemetemoglobin reaction. The erythrocyte membranes are disintegrated by sodium desoxycholate, releasing the haemoglobin.

Sodium nitrite converts the haemoglobin iron from the ferrous to the ferric state to form methemoglobin, which then combines with azide to form azidemetemoglobin.

Method

1. The HemoCue Photometer was switched on. When the machine was 'ready' the procedure continued.
2. The microcuvette was brought into contact with a blood sample, either finger prick or venous (via a tube). The microcuvette was allowed to fill by capillary action.
3. The microcuvette was then placed in the cuvette-holder of the photometer, which was then pushed into position.
4. After 30-50 seconds the photometer produced a final result which was shown on the screen. The absorbency is read at a dual wavelength of 570 and 880nm.
The HemoCue will record Hb measurements up to 25.6g/l.

Table 2.8: Reproducibility of haemoglobin measurements using the HemoCue (g/l)

No. of determinants	Mean \pm SD Absorbency measurements	Variation %
5	10.60 \pm 0.05	0.004
5	11.22 \pm 0.08	0.007
5	12.00 \pm 0.04	0.003
5	11.80 \pm 0.07	0.005
5	10.80 \pm 0.04	0.003

Mean variation = 0.004

The mean reproducibility of haemoglobin measurement was 0.004.

2.5.3.5 Ferritin

Serum ferritin levels were measured using an enzyme-linked immunosorbent assay (ELISA). This assay, however, is a more recent development in the analysis of serum ferritin. Early work by Reissmann & Dietrich (1956) led to the development of an immunochemical method for measuring serum ferritin concentrations, however, using this method it was only possible to measure relatively high concentrations. A method described by Beamish et al (1971) using counter immuno-electrophoresis was capable of detecting ferritin but not quantifying it. Addison et al (1972) developed the first assay for serum ferritin using an immunoradiometric (IRMA) technique. This was the first technique capable of measuring nanogram amounts of ferritin. Addison's method was followed by an alternative: the two-site IRMA in which ferritin was reacted with a plastic surface that had been coated with antiferritin. In a second reaction the ferritin which has become bound to the wall of the tube was incubated with radiolabelled antihuman ferritin and the unreacted antibody then removed by washing (Miles et al, 1974).

Another radioisotopic technique is a radioimmunoassay (RIA) such as that described by Goldie & Thomas (1978). This method differs to IRMA in that it is the antigen rather than the antibody that is tagged. Early RIA techniques were less sensitive than IRMA, but with refinements in techniques, the sensitivity of the two methods for assaying serum ferritin has become roughly comparable. More recent developments have seen the introduction of an enzyme-linked immunosorbant assay (ELISA), which is based on the same principle as the two-site IRMA (Fidanza, 1991).

In an enzyme-linked immunosorbant assay (ELISA)

1. The antibody against the protein of interest is immobilised on an inert solid such as polystyrene.
2. The sample being assayed for the protein is applied to the antibody-coated surface under conditions in which the antibody binds to the protein and the unbound protein is washed away.
3. The resulting protein-antibody complex is further reacted with a second protein-specific antibody to which an easily assayed enzyme has been covalently linked.
4. After washing away any unbound antibody-linked enzyme, the enzyme in the

immobilised antibody-protein-antibody-enzyme complex is assayed thereby indicating the amount of protein present (Voet & Voet, 1995).

The ELISA technique was chosen for the purpose of this study for various reasons. Firstly, the lower costs involved with this method and secondly, the limited laboratory facilities available. However, use of the ELISA also eliminates the health hazards associated with the use of radioisotopic techniques and there is evidence which shows favourable comparisons between the ELISA and IRMA techniques (Harrison et al, 1987). It is the method developed by Harrison et al (1987) which has been used in this study.

Method

Preparation of antibody-coated micro elisa plates

0.2ml of coating antiserum (diluted 1:1968 in phosphate buffered saline) was added to each well and incubated at room temperature for 1 hrs. The plates were washed 7 times with phosphate buffered saline (PBS) using a wash bottle to fill each well. Excess moisture was removed by blotting the plates, which were then allowed to dry in air. Plates were stored at 4°C for up to one month.

Assay procedure

1. 0.1ml of sample and standard were added to each well at timed intervals and the plates were incubated at 37°C for 2 hours. Each well was aspirated after exactly 2 hours and then washed 6 times with bovine serum albumin (BSA) buffer followed by a final wash with PBS buffer to avoid bubbles forming before blotting dry.
2. 0.1ml of peroxidase-conjugate (diluted 1:1000 in BSA buffer) was added to each well at timed intervals and incubated at room temperature for 2 hours. The wells were aspirated after exactly 2 hours, washed 7 times with PBS buffer and blotted dry.
3. 0.1ml of working substrate (9.5ml citrate buffer pH 4.0, 0.04ml hydrogen peroxide, 30% w/v, 0.5ml aqueous ABTS solution) was added as quickly as possible to each well. The plate was incubated at room temperature for 1 hour.
4. The plate was then gently agitated and the absorbency read using the Microelisa

Auto Reader. Dual wavelengths of 405nm and 630nm were used, to eliminate optical variation not specific to the antigen-antibody reaction. Plates were zeroed on 2 wells containing only citrate buffer. A set of standards was included on each plate to produce a standard curve from which the concentrations of ferritin in the serum was calculated.

Table 2.9: Reproducibility of ferritin measurement ($\mu\text{g/l}$)

No. of determinants	Mean \pm SD measurements	Variation %
5	0.654 \pm 0.036	5.5
5	0.397 \pm 0.020	5.0
5	0.200 \pm 0.010	5.0
5	0.236 \pm 0.013	5.5
5	0.114 \pm 0.006	5.2

Mean variation = 5.24

The mean reproducibility of ferritin measurement was 5.24.

2.5.4 Lipids

Lipids are of concern because of their role in certain types of cardiovascular disease. However, despite this, lipids are of considerable physiological and nutritional importance (Gurr, 1993, Brody, 1994).

2.5.4.1 Total cholesterol (Accutrend method):

There are several methods for the determination of total serum cholesterol. Widely used are several types of compact chemistry analysers. However, as shown by Kaufman et al (1990), these are subject to a great deal of variation in the reliability of cholesterol determination. Their study looked at five analysers: Analyst, Ektachem DT-60, Reflotron, Seralyzer and Vision. Findings showed that only the Ektachem DT-60 and Vision

analysers had the accuracy and precision acceptable for cholesterol measurement, results supported by Wones et al (1988).

The Reflotron was the only instrument mentioned above that was available for this study. However, it was not possible to take it off the university site in order for use during fieldwork, and so, had to be rejected. For this study it was necessary to use a portable system for the measurement of cholesterol as not all subjects were willing to volunteer a venous sample of blood. Therefore, for use during fieldwork the Accutrend (Boehringer Mannheim, UK) was selected.

The Accutrend GC meter is a precision instrument which allows the reliable determination of blood cholesterol using the specially designed Accutrend cholesterol test strips. The measuring range is 3.88 - 7.75mmol/l.

To perform a measurement:

1. A test strip was taken out of the vial.
2. The on/off button was pressed. The code number that appeared on the screen matched the code on the vial containing the test strips. The measurement can only be performed if these numbers are identical (Calibrate if not identical).
3. When the meter was switched on flap was closed, the test strip was inserted into the slot at the bottom edge of the meter. When the two beeps were heard the flap was opened.
4. The side of the subjects finger was pricked and the first drop of blood was wiped off.
5. A large suspended drop of blood was applied to the yellow test pad, which must be completely covered. The flap was closed immediately. After 180 seconds the result were displayed.

Table 2.10: Reproducibility of total cholesterol measurement using the Accutrend (mmol/l)

No. of determinants	Mean \pm SD measurements	Variation %
5	4.16 \pm 0.08	0.01
5	5.02 \pm 0.04	0.007
5	6.12 \pm 0.04	0.006
5	3.94 \pm 0.05	0.01
5	4.56 \pm 0.05	0.01

Mean variation = 0.008

The mean reproducibility of total cholesterol using the Accutrend was 0.008.

2.5.4.2 Total serum cholesterol (Sigma method)

The method chosen for testing total cholesterol obtained from venous samples was the Sigma (Poole, Dorset UK) cholesterol testing kit, which involves the quantitative, enzymatic determination of total cholesterol. This method is based on that used by Allain et al (1974) who described a method for the determination of total serum cholesterol by use of a single aqueous reagent. The method has been shown to be reproducible and the results correlated with the standard method. According to Allain et al (1974) this method affords better specificity than those previously reported and has excellent precision.

Using the Sigma kit offers several advantages: firstly, after reconstitution the cholesterol reagent is stable for 60 days when refrigerated and secondly, the blood samples can also be refrigerated and stored after collection, before analysis. The tests therefore, can be carried out in batches at suitable intervals.

Principle of the method: cholesterol esters are first hydrolysed by cholesterol esterase to cholesterol. The cholesterol produced by hydrolysis is oxidised by cholesterol oxidase to cholest-4-en-3-one and hydrogen peroxide (H₂O₂). The hydrogen peroxide produced is then coupled with the chromogen, 4-aminoantipyrine and p-hydroxybenzenesulfonate in the presence of peroxidase to yield a quinoneimine dye which has an absorbency

maximum of 500nm. The intensity of the pink colour produced is directly proportional to the total cholesterol concentration in the sample.

Procedure:

1. The cholesterol reagent was prepared according to instructions on the vial label.
2. The spectrophotometer (Corning calorimeter U.K) wavelength was set at 490nm and the absorbency reading to zero with water as reference.
3. A series of tubes were set up for blank, standard and samples.
4. The reagent was warmed to assay temperature (room temp).
5. Using a pipette 1.0ml of reagent was put into tube.
6. Added to this was: 0.01ml (10uL) deionized water (blank), calibrator, control and sample to appropriately labelled tubes. The tubes were then mixed by gentle inversion.
7. The tubes were then incubated for 10 minutes, at room temperature.
8. The absorbency of all the tubes was read and recorded at 490nm, using a Corning calorimeter. The readings were completed within 30 minutes after the end of incubation time.
9. The total cholesterol was calculated by using the following formula:

Serum Cholesterol (mmol/l) =

$\frac{A \text{ test} - A \text{ blank}}{A \text{ calibrator} - A \text{ blank}} \times \text{concentration of Calibrator.}$

A calibrator - A blank

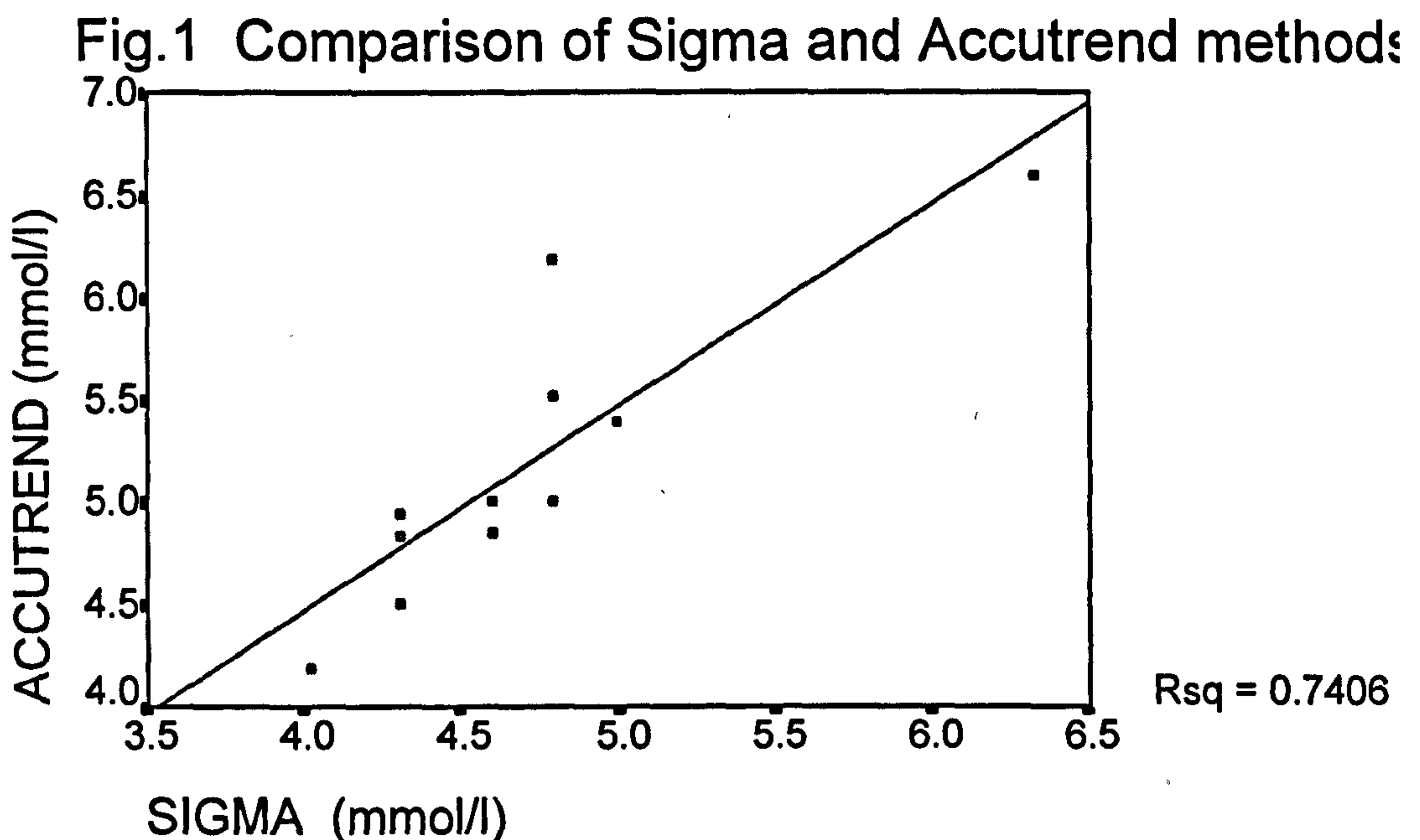
Table 2.11: Reproducibility of total cholesterol measurement (mmol/l) using the Sigma method.

No. of determinants	Mean \pm SD Absorbency measurements	Variation %
5	0.098 \pm 0.0044	4.1
5	0.25 \pm 0.0054	2.1
5	0.064 \pm 0.065	7.8
5	0.384 \pm 0.0054	1.4
5	0.19 \pm 0.007	3.7

Mean variation = 3.82

The mean reproducibility of total cholesterol measurement using the Sigma method was 3.82.

A comparison between the Accutrend method and Sigma reference method of measuring total cholesterol was made. Twelve samples were each tested using the two methods and the results plotted against each other. The mean concentration using the Sigma method was 4.7mmol/l and 5.1mmol/l using the Accutrend, this was significantly different ($p=0.001$). Taking the Sigma method as the independent variable a correlation coefficient of 0.7406 was obtained (fig.1). This would suggest that the Accutrend method is only 74.0% as accurate as the Sigma reference method



2.5.4.3 High density lipoprotein (HDL)

There are various methods of determining HDL cholesterol levels. Although the separation of lipoproteins by ultracentrifugation prior to enzymatic analysis of cholesterol remains the most accurate and is the accepted standard method, precipitation techniques are widely used and have been found to compare favourably (Assmann et al, 1983). A

disadvantage with these methods is the amount of plasma needed for analysis. A recently developed technique developed by Sigma Diagnostics (EZ HDL Cholesterol) involves using only 10 μ L of plasma, and therefore was used in this study. This technique eliminates the precipitation procedure, thus reducing the analysis time.

Principle of method: Anti human β -lipoprotein antibody in reagent 1 binds to lipoproteins other than HDL. The antigen-antibody complexes formed block enzyme reactions when reagent 2 is added. Cholesterol esterase and cholesterol oxidase in reagent 2 react only with HDL-C. Hydrogen peroxide produced by the enzyme reactions with HDL-C yields a blue colour complex upon oxidase condensation with FDAOS [N-ethyl-N-(2-hydroxy-3-sulfopropyl)-3,3',5-dimethoxy-4-fluoroaniline, sodium salt] and 4-aminoantipyrine (4AA) in the presence of peroxidase (POD). By measuring the absorbency of the blue colour complex produced, at approximately 600nm, the HDL-C concentration in the sample can be calculated when compared with the absorbency of the standard.

Method

1. The HDL cholesterol reagents were prepared and allowed to equilibrate to room temperature. The water bath was set at 37°C and the spectrophotometer was set at 600nm and set at zero with water as a reference.
2. A series of tubes were set up and labelled blank, standard and test.
3. 10 μ L of de-ionised water, standard and test were added to the appropriate tubes and then incubated at 37°C for 5 minutes.
4. 900 μ L of reagent 1 were added to each tube, mixed and incubated for a further 5 minutes.
5. 300 μ L of reagent 2 were added to each tube, mixed and incubated for 10 minutes.
6. The absorbency (A) of the tubes was then read.
7. To determine the HDL cholesterol concentration (mmol/L) of the sample the following calculation was used.

$$\text{HDL cholesterol concentration (mmol/l)} = \frac{\text{A Sample}}{\text{A Standard}} \times \text{Concentration of Std.}$$

Low density lipoprotein (LDL) concentration was calculated by subtracting the HDL concentration from the TC concentration.

Table 2.12: Reproducibility of HDL Cholesterol measurement (mmol/l)

No. of determinants	Mean \pm SD absorbency measurements	Variation %
5	0.382 \pm 0.0083	2.2
5	0.386 \pm 0.0114	3.0
5	0.156 \pm 0.0054	3.5
5	0.166 \pm 0.0054	3.3

Mean variation = 3.0

The mean reproducibility of HDL cholesterol measurement is 3.0.

2.5.5 Protein status

Protein is essential for growth, development and protein turnover (Brody, 1994).

Deficiencies in protein and energy may result in the development of protein-energy malnutrition. Hypoproteinaemia and hypoalbuminaemia are present in this condition (Alleyn et al, 1977). A deficiency in serum albumin levels is an indicator of nutritional depletion (Thomas, 1994). An increase in total protein may be found in haemoconcentration due to dehydration from loss of fluid (Bauer et al, 1974).

2.5.5.1 Total protein

Serum total protein may be analysed using electrophoresis, however, colorimetric methods are widely used and are less time consuming (Bauer et al, 1974). Several colorimetric procedures have been developed for the determination of protein: such as those by Gornall et al (1949), Lowry et al (1951) and Ohnishi & Barr (1978). Sigma (Poole, Dorset, UK) have developed kits for the determination of protein based on the biuret method as used by Gornall, which is widely used in clinical assays and the method of Ohnishi & Barr.

However, the method chosen for this procedure is that used by Gornall et al (1949) with commercial reagents obtained from Sigma (Poole, Dorset, UK).

Principal of method

The copper in the biuret reagent (alkaline copper sulphate), stabilised by tartrate, reacts with the peptide bonds of serum proteins to form a purple copper-protein complex with an absorption maximum at 540nm. The colour intensity is directly proportional to the total protein concentration.

Method

Prior to the analysis, the spectrophotometer (Corning calorimeter, U.K.) was set at 540nm and the absorbency reading to zero with water as a reference.

1. A series of tubes were set up for blank, standard and test.
2. To the blank, 0.5ml of de-ionised water was added, to the standard, 0.5ml of protein standard solution was added and to the test, 0.5ml of serum was added.
3. To all tubes 2.5ml of Biuret solution was added. All tubes were mixed thoroughly and allowed to stand for 15 minutes at room temperature.
4. The absorbency (A) of the test and standard was then read.
5. To determine the total protein concentration the following calculation was used.

$$\text{Serum Total Protein (g/l)} = \frac{A_{\text{Test}}}{A_{\text{Standard}}} \times \text{value of Standard}$$

Table 2.13: Reproducibility of total protein measurement (g/l)

No. of determinants	Mean \pm SD Absorbency measurements	Variation %
5	0.18 \pm 0.010	5.5
5	0.36 \pm 0.007	1.9
5	0.69 \pm 0.010	1.4
5	0.91 \pm 0.007	0.7
5	1.09 \pm 0.008	0.7

Mean variation = 2.04

Reproducibility of total protein measurement was 2.04.

2.5.5.2 Albumin

As with total protein, albumin may be analysed using electrophoresis (Bauer et al, 1974). There are several methods available for the determination of serum albumin, that involve the binding of a dye such as bromocresol green (BCG) to albumin (Doumas et al, 1971). This method has been modified by Sigma (Poole, Dorset, UK) into kit form, which involves the quantitative, colorimetric determination of albumin in serum or plasma. The binding procedures are simple to perform and have been extensively used in clinical laboratories. The Sigma kit was chosen for the purposes of this study.

Principle of method: albumin binds to BCG (anionic dye) to produce a blue green colour with an absorbency maximum at 628nm. The intensity of the colour produced is directly proportional to the albumin concentration in the sample.

Method

1. The spectrophotometer (Corning calorimeter, U.K.) wavelength was set at 628nm and the absorbency reading to zero with water as a reference.
2. A series of tubes were set up for blank, standard and test.
3. 1.0ml of albumin reagent (BCG) was pipetted into each tube.
4. At timed intervals 10 μ L of de-ionised water, protein standard and test samples were added to the appropriately labelled tubes. All tubes were then gently mixed.
5. The absorbency of the tubes was read at room temperature at intervals of exactly 1 minute or less.
6. To calculate the albumin concentration the following calculation was used.

Serum albumin concentration (μ mol/l) =

$$\frac{A_{\text{Sample}} - A_{\text{Blank}}}{A_{\text{Standard}} - A_{\text{Blank}}} \times \text{Concentration of standard.}$$

Table 2.14: Reproducibility of albumin measurement ($\mu\text{mol/l}$)

No. of determinants	Mean \pm SD Absorbency measurements	Variation %
5	0.25 \pm 0.010	4.0
5	0.24 \pm 0.020	8.3
5	0.23 \pm 0.008	3.4
5	0.20 \pm 0.008	4.0
5	0.17 \pm 0.008	4.7

Mean variation = 4.88

The mean reproducibility of albumin concentrations was 4.88.

2.5.6 Calcium

Calcium plays an important role in maintaining skeletal mass. Although plasma calcium status does not generally reflect calcium status, animal studies have displayed problems such as impaired growth, rickets and poor mineralization where serum calcium levels have been 50% of normal levels. About 40% of serum calcium is protein bound, with most of it (80%) being bound to albumin. The primary function of vitamin D is to maintain plasma calcium levels (Brody, 1994).

There are several methods available for the determination of plasma calcium levels, with atomic absorption being the reference method (Cali et al, 1977). However, a automated spectrophotometric method developed by Gitelman (1967) was found to be rapid, accurate and precise. Brett & Hicks (1981) assessed several commercial spectrophotometric kits: Eastman Kodak, Sigma, Fisher Scientific Co and Harleco and found them to be adequate for the quantitation of calcium.

The method chosen for this test was the Sigma (Poole, Dorset, UK) calcium testing kit, which involves the quantitative, colorimetric determination of calcium in plasma or serum. The method is based on those developed by Kessler & Wolfman, (1964).

Principle of method: this procedure involves the reaction of calcium with o-cresolphthalein, a chromogenic agent. This reaction produces a red complex at pH 10-12 with an absorbency maximum at 575nm. The intensity of the colour, measured at 575nm, is directly proportional to calcium concentration in the sample.

Method

1. Prior to analysis the spectrophotometer (Corning calorimeter, U.K.) wavelength was set at 575nm and the absorbency reading to zero with water as a reference and the water bath was set at 37°C.
2. A series of tubes were set up for blank, standard and test.
3. 1.0ml of calcium reagent was added to each tube and then the tubes were warmed to assay temperature (ambient to 37°C).
4. 10µL of de-ionised water, standard and test were added to the appropriately labelled tubes. The tubes were then gently mixed.
5. At least 3 minutes after the addition of the sample the absorbency (A) was read at 575nm.
6. To determine the plasma calcium concentration the following calculation was used. Calcium concentration (mmol/l) of sample = $\frac{A_{\text{Sample}} \times \text{Concentration of standard}}{A_{\text{Standard}}}$

Table 2.15: Reproducibility of calcium measurement (mmol/l)

No. of determinants	Mean \pm SD Absorbency measurements	Variation %
5	1.15 \pm 0.008	0.6
5	1.22 \pm 0.010	0.8
5	1.45 \pm 0.008	0.5
5	1.40 \pm 0.010	0.7
5	1.39 \pm 0.008	0.5

Mean variation = 0.62

The mean reproducibility of calcium measurements was 0.62.

2.5.7 Antioxidant status

Vitamin E (tocopherol), vitamin A (retinol) and carotenoids

Vitamin A is required for normal growth and development, cellular differentiation and vision (McLaren et al, 1993). The role of carotenoids appears to be somewhat controversial. Although it has been suggested that they play a part in the prevention of some cancers (Zeigler, 1991), more recent research has questioned their value, suggesting that β carotene supplementation may increase the incidence of lung cancer in smokers (De Luca, 1996). Vitamin E is important in cell maintenance, DNA synthesis and immune response (Duthie, 1993). It has been suggested that antioxidant properties possessed by vitamin E may offer protection from coronary heart disease and cancer (DoH 1991).

Various methods are available for the analysis of retinol, tocopherol and carotenoids: high-performance liquid chromatography, colorimetry and fluorimetry (Lee et al, 1992), however, clinical assays using colorimetry and fluorimetry techniques are no longer considered reliable, as they are subject to non-specific interference from other constituents (Mathews-Roth & Stampfer, 1984, Neirenberg, 1985). Therefore, the method chosen for this analysis was that developed by Lowe et al (1999) involving high -performance liquid chromatography (HPLC).

High performance liquid chromatography (reversed phase)

Chromatography is a separation process. The substance that is to be fractionated (the sample) is dissolved in a liquid (solvent), this is known as the mobile phase. The composition of the solvents depends on the type of system being used. Where an isocratic system is used the same solvent can be used for the whole run, however, where a gradient system is used, the solvent composition changed during the run. The solution is then percolated through a stainless steel column consisting of a porous solid matrix known as the stationary phase. It is along this column where the separation process takes place. Liquid column chromatography can be subdivided according to the pressure generated within the column during the separation process. HPLC generates a high pressure. For reversed-phase liquid chromatography, the stationary phase is a non-polar compound such

as octadecylsilane (ODS) and the mobile phase is a polar solvent. As the solvent passes along the column it comes into contact with molecules and elutes (binds). Because polar solvents dissolve compounds containing ionic bonds the more polar substances are separated first and the more ionic later, hence, in reverse order. The time it takes for the solute to emerge from the column is known as the retention time.

A HPLC system is used to perform chromatography and is composed of a pump, which will deliver solvents at high pressure, a Rheodyne valve where the sample is injected onto the column and the column itself. Solutes are detected by an absorbance system connected to a computer. Vitamin A and E are detected at 290nm and carotenoids at 460nm. From the chromatogram produced, integration can be performed in order to determine the area under the peaks, which is done by the computer.

The concentration of a sample is then calculated by the following equation:

Area of peak of unknown sample

Area of standard

x concentration of standard and any dilution factor

Method

Sample preparation (extraction process)

1ml of plasma or serum in an extraction tube was required for the process. The extraction process precipitates the protein in the sample: 1ml ethanol was added and, vortexed for a few seconds, 1.5ml diethylether was added, and again vortexed for a few seconds, lastly 1.5ml hexane was added. The tube was vortexed for a few seconds and left to stand for 5 minutes to allow the two phases to separate. After standing, the organic phase separated to the top and the aqueous phase the bottom. The organic phase was removed as close to the meniscus as possible and transferred to another extraction tube, which was then blown down under nitrogen at room temperature. To re-suspend the sample for injection onto the column 20 μ L tetra hydro furan and 180 μ L ethanol was added.

HPLC procedure

The HPLC system used was a Waters 600E Multisolvent Delivery System with a Waters 2487 Absorbency detector. Analysis was performed using an isocratic system. The solvent composition was made up of: 195ml aceto nitrile and 66ml tetra hydro furan and made up to 300ml with methanol. 3ml of 5% ammonium acetate (dissolved in methanol) was added. The solvent was de-oxygenated by sonication. The column was eluted at a flow rate of 1ml/min. 10 μ L of the re-suspended sample was injected onto the ODS2 reverse-phase column, which had a diameter of 5 μ m. The retention time was approximately 3 minutes for retinol (fig.2), 5 minutes for tocopherol (fig.3) and 8 minutes for beta-carotene (fig 4.). When the results had been obtained, integration was performed in order to calculate the plasma concentration levels.

Pilot results

Although the same method and technique was used for the analysis of these nutrients, two separate runs were required for this test as tocopherol and retinol are read at 290nm and carotonoids at 460nm. Reproducibility was tested by repeating the analysis of one sample 6 times. Two different samples were tested. The results reported are those for retinol (μ g/ml).

Table 2.16: Reproducibility of HPLC method for the determination of retinol levels (μ g/ml).

No. of determinants	Mean \pm SD measurements	Variation %
1	21117 \pm 2815	13.3
1	21902 \pm 2755	12.5

Mean variation = 12.9

The mean reproducibility of retinol measurement was 12.9.

Fig. 2 Chromatogram showing retention time of retinol standard ($\mu\text{mol/ml}$).

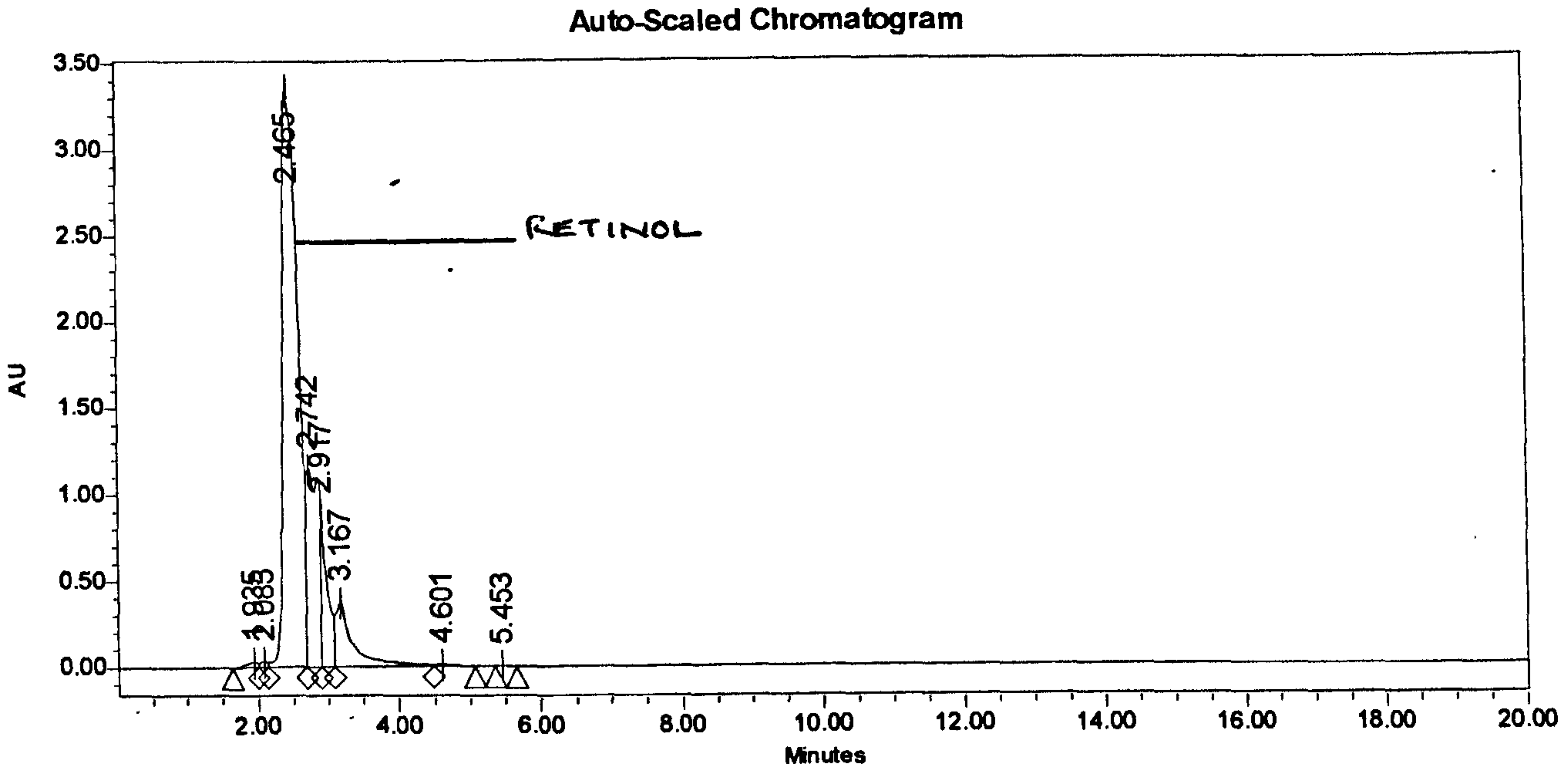


Fig. 3 Chromatogram showing retention time of tocopherol standard ($\mu\text{mol/ml}$).

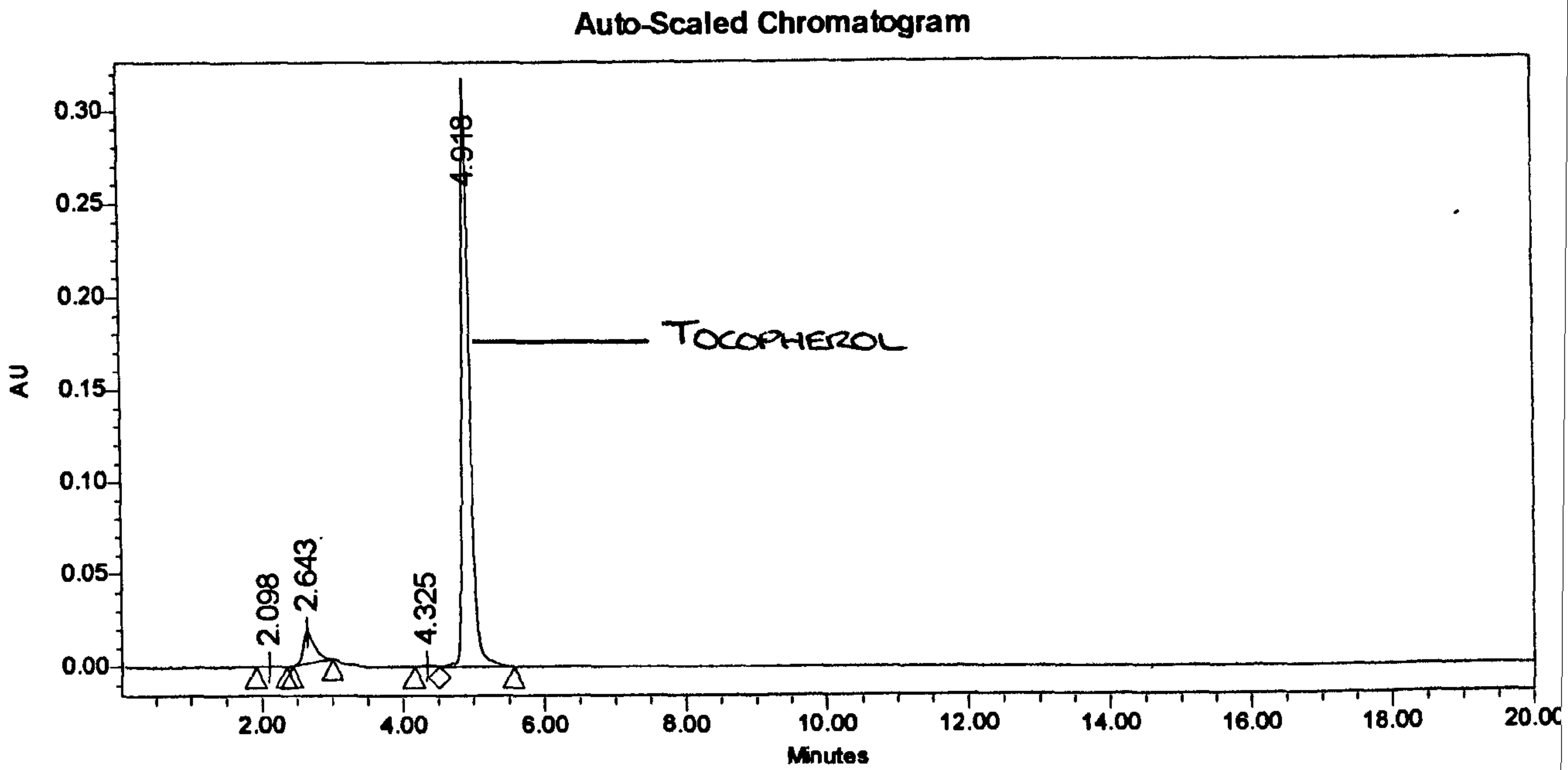
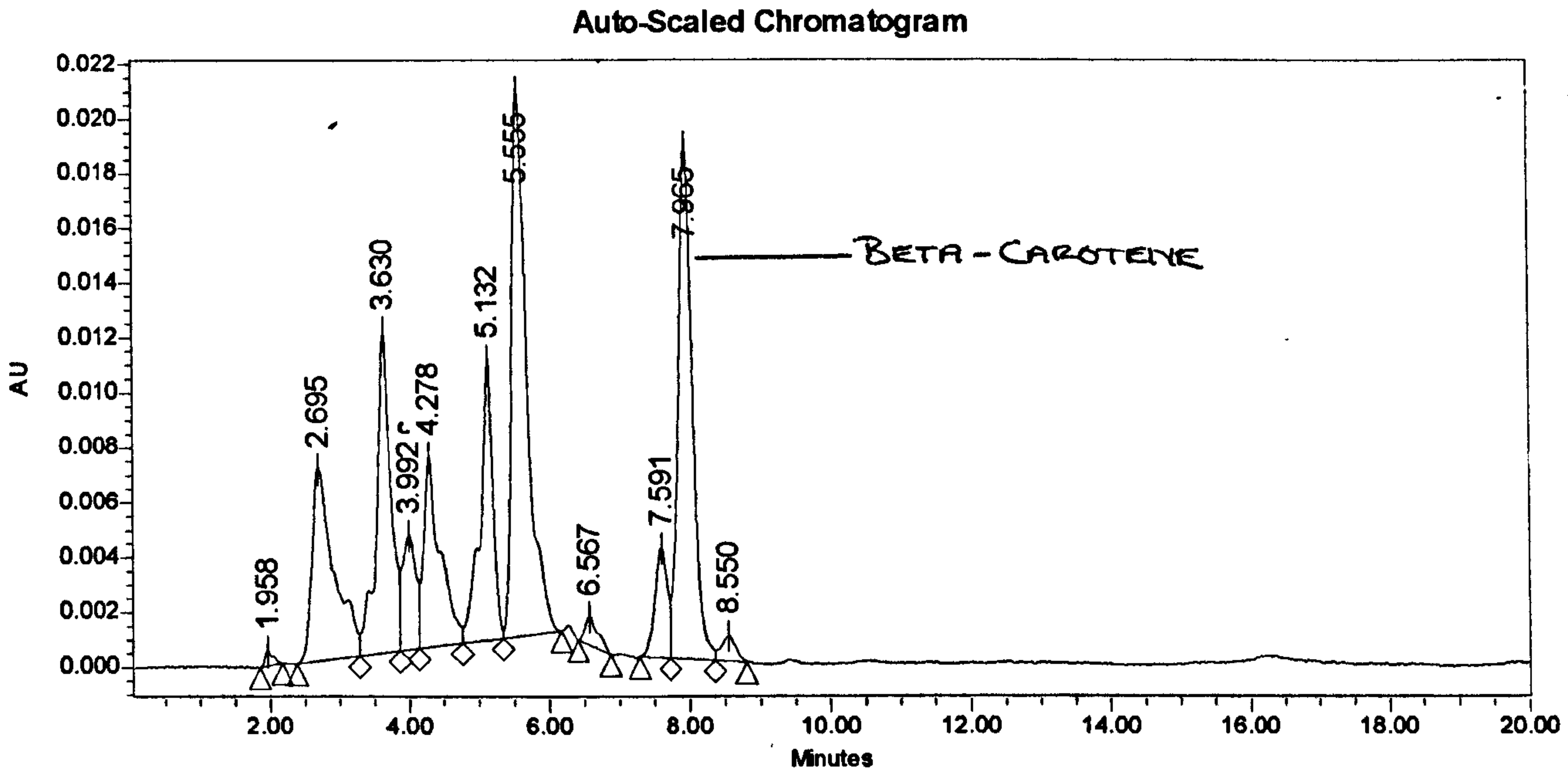


Fig. 4 Chromatogram showing retention time of beta-carotene standard ($\mu\text{mol/ml}$)



Section 2.6

Statistical analysis

All data were analysed using the Statistical Package for Social Scientists (SPSS). Frequencies and cross-tabs were performed to describe the data from the study and any association between variables were investigated using the following statistical tests: Chi-square (two-way) was a test used to identify any relationship between two variables. This test was used to analyse nominal (frequency) data, where subjects are assigned to categories. This test was used to analyse data obtained from the questionnaires. The t-test was used to test whether the means of two sets of scores were statistically significant. This test was used to compare mean results in all sections of the study. A correlation measures the relationship between two variables which have both been measured on an interval scale (a scale with units). This test expresses the extent to which two variables vary with respect to each other. A positive correlation means that as one variable increases, so does another. Whilst the correlation coefficient expresses the strength of an association, simple regression utilises the presence of an association between two variables to predict the values of one (the dependent variable) from those of another (the independent variable). The correlation coefficient squared indicates how much of the variance in y is explained by x . A simple regression test was used to identify any relationship between biochemical methodologies. Correlations were performed to determine if there were any relationship between the intake of dietary nutrients and blood nutrient concentrations (Foster, J J 1993, Kinnear, P R & Gray, C D 1997). In all tests $p < 0.05$ was considered to be significant.

Section 3.

Results and Discussion

As with the methodology, this section is divided into four sections:

1. Dieting behaviour/practices amongst adolescent girls.
2. Dieting behaviour/practices amongst adolescent girls ~ follow up study
3. Dieting behaviour/practices amongst young women.
4. Female (adult) dieting study.

With all sections, the results are described and then immediately followed by the discussion. An overall conclusion will link the four study areas together at the end.

Section 3.1

Dieting behaviour/practices amongst adolescent girls

Introduction

It has been suggested that dieting behaviour appears to be the 'norm' in the US (Berg, 1992), with the incidence of dieting reported to be between 61.0 and 77.0% amongst adolescent girls (Perry-Hunnicuttt & Newman, 1993, Rosen et al, 1990, Wadden et al, 1989, Rosen & Gross, 1987). Indeed, Hill et al (1992) report that dieting is a practice which has now become common amongst adolescent girls in the UK, with incidences of 26.0% (Wardle & Marsland, 1990), 46.0% (Button et al, 1996) and 25.0% (Bost et al, 1998). The Health Education Authority report an incidence of 16.0-19.0% amongst 11-15 year old girls (HEA, 1999). However, it would appear that dieting behaviour is becoming more evident amongst younger girls, with the existence of such behaviour being reported amongst children aged 5-7 years (Blisset et al, 1996).

The work of Wardle & Marsland (1990) and Button et al (1990) discuss the subject of dieting in terms of attitudes towards eating with reference to the development of eating disorders. These studies are representative of the approach which has been taken towards the subject of dieting over recent years, in the UK. In the US, studies have taken a more general approach looking at actual dieting/eating habits (Moreno & Thelan, 1995, Perry-Hunnicuttt & Newman, 1993, Johnson et al, 1983), providing information which may refer to the population as a whole, thus, giving an indication of how dieting behaviour may effect the general health of adolescent girls. It is evident that a gap remains in published literature here in the UK for such research.

There appears to be a common assumption that dieting is strongly linked with the development of eating disorders and indeed studies have identified such links (Wilson, 1993, Patton et al, 1990, Rosen et al, 1990). Dieting, however, involves the restriction of food generally or specific types of food, which may lead to a deficiency in nutrient intake, thus, predisposing to diseases much more common than eating disorders, such as

osteoporosis (Berg, 1996) and anaemia (BNF, 1995). Adolescence is a period of rapid growth and development (Dwyer, 1993), during which, inappropriate dietary intakes which are maintained into adulthood may well have lifelong negative health effects (Manore, 1996). Both adolescent girls and young adult women have reproductive potential however, this may be at risk because of dieting behaviour (Kirkley & Burge, 1989). Gormican et al (1980) demonstrated the importance of pre-conceptual weight in relation to birth weight, showing that the greater the weight deficit before pregnancy the more effect it had on the neonate. Extensive research undertaken recently has demonstrated how undernutrition during pregnancy may retard the various stages of embryonic growth, thereby predisposing the baby to cardiovascular risk factors such as hypertension (Law et al, 1993), increased insulin resistance (Fall et al, 1995), high plasma concentrations of haemostatic factors: fibrinogen and factor VII (Barker et al, 1992) and abnormal LDL cholesterol metabolism (Barker et al, 1993).

The health risks associated with dieting take on added importance when you consider that it is a practice which is becoming increasingly common amongst those of normal weight (Wardle & Beales, 1986) and indeed, amongst young children of normal weight (Hill et al, 1994, Blisset et al, 1996). It is clear that dieting may have significant negative effects on the health and wellbeing of an individual (Brownell, 1993) and therefore, it is important that the subject is investigated in terms of how dieting behaviour/practices may effect the general health of the female population. Such data are important in order to identify areas where there may be a need for a change in educational requirements and indeed, nutritional advice and recommendations.

This work will give a more general view of dieting behaviour/practices amongst adolescent girls. From identifying the most popular types of reducing diets used it may be possible to highlight those girls who may be at risk from developing nutritional deficiencies. Questions regarding the pattern of dieting behaviour may give an indication of the severity of their dieting behaviour and the degree of risk to their health.

3.1.2

Results

A total of 569 girls, were recruited with a mean age of 12.9 ± 1.0 years (range:11-15 years). The mean age of the girls in the different school types was as follows: Independent: 12.3 ± 0.5 years (range:11-14 years); Girls High: 13.3 ± 0.7 years (range:11-15 years); Comprehensive: 12.7 ± 0.07 years (range:11-15 years).

Only 448 (79.0%) girls out of the total sample of 569 reported their height and weight. The mean BMI of the sample was 19.2 ± 3.1 (range:14-37.2). The mean BMI in the different school types was as follows: Independent: 18.5 ± 2.6 (range:14.0-24.3); Comprehensive: 18.4 ± 2.9 (range:14.0-37.25) Girls High: 19.9 ± 3.34 (range:14.2-34.3). The mean BMI was significantly higher in the Girls High School than the other school types ($p=0.002$).

With reference to the criteria set down by Cole et al (1990) 385 (85.9%) of the sample were within normal weight limits for their age, 22 (4.9%) were underweight and 41 (9.2%) were overweight.

Incidence of dieting

Out of the total sample of 201, 35.3% girls reported they had dieted to lose weight. A similar population of girls in each school had dieted to lose weight, 32.8%, 33.5% and 37.5% from the Independent, Comprehensive and Girls High Schools respectively.

The mean BMI of the dieters, 20.7 ± 3.5 , was found to be significantly higher than that of the non-dieters, 18.3 ± 2.5 ($p=0.02$). The mean BMI of the dieters from the Independent and Comprehensive Schools was similar, 19.0 ± 0.8 and 18.45 ± 0.4 , respectively. The mean BMI of those dieter's from the Girls High Schools was 19.75 ± 0.7 .

Amongst those who had dieted, significantly more, 135 (80.0%) were within normal weight limits for their age than in the other weight categories ($p=0.006$, $\chi^2 = 7.45$,

df:1). Only three (1.8%) were underweight and 31 (18.2%) were overweight.

Of the girls who had not dieted 250 (89.6%) girls fell within normal weight limits for their age, 19 (6.8%) were underweight and 10 (3.6%) were overweight.

Most of the girls who had dieted, from the Independent Schools, 32 (84.2%) were within normal weight limits and six (15.8%) were overweight, none being underweight. In comparison, 30 (88.2%) from the Comprehensive Schools were of normal weight, two (5.9%) were overweight and two (5.9%) were underweight. From the Girls High Schools 73 (75.2%) were of normal weight, 23 (23.8%) were overweight and one (1.0%) was underweight.

Reasons for dieting

A wide variety of reasons, were given for dieting which are shown in table 3.1.1. They were mostly appearance related, with the most popular reason being because the girls felt 'too fat'.

Table 3.1.1: Reasons given by the girls for wanting to lose weight (n=195girls).

Number of girls (%)	Reason
82 (42.1)	Too fat.
29 (14.9)	Generally unhappy about appearance.
26 (13.3)	Wanted to be thin.
14 (7.2)	To keep fit and healthy.
12 (6.2)	They were too fat and everybody else was thin.
10 (5.1)	To be slimmer and increase self esteem.
6 (3.1)	Peer Influence.
6 (3.1)	To look good on holiday.
3 (1.5)	Their clothes were too tight.
3 (1.0)	To avoid becoming fat.
2 (1.0)	To look thin and be healthy.
2 (1.0)	It is fashionable.
1 (0.5)	Medical reasons

The mean BMI of the girls who were dieting because they felt 'too fat' was

20.5 ± 3.9. Most of these girls, 48 (78.7%) were within normal weight limits. Only 12 (19.7%) were overweight and two (3.3%) were underweight. Only one other girl was underweight and she was dieting to 'keep fit and healthy'.

The most popular reason for dieting amongst each school type was because they felt 'too fat'. Significantly more girls from the Comprehensive Schools, 35 (66.0%) than the Independent Schools were dieting because they felt 'too fat' (p=0.01, $\chi^2 = 5.75$, df:1). Compared to the mixed sex schools significantly less from the Girls High Schools, 31 (16.0%) dieted because they felt 'too fat' (p=0.003, $\chi^2 = 8.80$, df:1).

Age of first reported diet

The majority of girls started to diet around the age of 11 or 12 years, however, 51 girls (25.4%) reported that they had first started to diet during pre adolescent years. There were six girls who reported starting to diet before the age of eight years. Table 3.1.2 shows the age at which the girls first started to diet.

Table 3.1.2: Age of the girls when they first started to diet (n=201).

Number of girls (%)	Reported age of first diet
1 (0.5)	15
13 (6.5)	14
24 (11.8)	13
56 (27.9)	12
56 (27.9)	11
45 (22.4)	8-10
6 (3.0)	<8

The mean BMI of those who had started to diet by the age of eight years was 24.4 ± 2.3, and those who started to diet after the age of eight years had a mean BMI of 20.7 ± 0.7.

The majority of girls who had started to diet by the age of 10 years, 30 (73.1%) were

within normal weight limits, one girl (2.4%) was underweight and 10 (24.3%) were overweight. For those starting to diet after the age of 10 years their weights were as follows: 95 (81.8%) were of normal weight, one (0.8%) was underweight and 20 (17.2%) were overweight.

Significantly more girls from the Independent Schools (45.2%) had started to diet by the age of 10 years than from the Comprehensive Schools (24.0%), ($p=0.03$, $\chi^2 = 4.48$, $df:1$). Compared to the mixed sex schools only 19 (18.2%) from the Girls High Schools had started to diet by the age of 10 years ($p=0.02$, $\chi^2 = 4.99$, $df:1$).

Perceptions of dieting in relation to health

The majority of those that had dieted, 130 (66.0%) thought that dieting was good for their health. Amongst those within normal weight limits 87 (78.4%) thought dieting was good for their health. All of those who were underweight, three (100%), and 21 (70.0%) of those overweight thought that dieting was good for their health. Amongst those girls that thought dieting was good for their health the mean BMI was 21.0 ± 3.7 .

A similar number from the Independent Schools, 25 (59.5%) and Comprehensive Schools, 32 (58.1%) thought that dieting was good for their health. However, 73 (70.1%) from the Girls High Schools thought that dieting was good for their health.

Parental support/approval

Amongst those dieting, 102 (52.0%) girls said their parents did not approve. For these girls, the mean BMI was 19.5 ± 2.5 , with 75 (88.2%) being within normal weight limits, seven (8.2%) overweight and three (3.5%) underweight. Amongst those who were dieting with parental approval, 99 (48.0%), the mean BMI was 22.2 ± 3.8 , with 55 girls (69.6%) being within normal weight limits, and 24 (30.4%) were overweight.

Parental approval to diet was higher in the Independent, 18 (40.0%) than the Comprehensive Schools, 19 (36.5%). However, compared to the mixed sex schools, 58 (55.7%) from the Girls Schools were dieting with parental approval ($p=0.02$, $\chi^2 = 5.15$, $df:1$).

Types of reducing diet used

Various types of reducing diets were used by the girls (table 3.1.3), however, the most popular was a low fat diet, with 42.8% claiming to use it.

Table 3.1.3: Types of reducing diets used by the girls (n=199).

Number of girls (%)	Types of diet used
85 (42.8)	Low fat diet.
59 (29.6)	Healthy eating.
34 (17.1)	Omit specific foods, e.g. confectionery, chips.
8 (4.0)	Eat as little as possible.
4 (2.0)	Periods of starvation.
4 (2.0)	Food combination diet.
3 (1.5)	Generally reduce intake.
2 (1.0)	Stopped eating between meals.

The mean BMI of those using periods of starvation and eating as little as possible was 18.87 ± 1.2 and 19.71 ± 1.9 , respectively (all were within normal weight limits), whereas the mean BMI of those using a low fat diet and healthy eating was 20.21 ± 3.0 and 21.37 ± 3.7 , respectively. The majority of those using a low fat diet, 58 (81.7%) were within normal weight limits, 10 (14.1%) were overweight and three (4.2%) were underweight.

Only five (3.6%) girls admitted to using slimming pills/laxatives in order to aid weight loss, with three (60.0%) being within normal weight limits, one (20.0%) overweight and one (20.0%) underweight.

The numbers using a low fat diet from the Independent and Comprehensive Schools were similar, 21(50.0%) and 25 (46.2%), respectively. The number using a low fat diet from the Girls High Schools was 39 (38.0%).

Skipping meals

The number of girls skipping meals to aid weight loss was 84 (43.0%), with 61 (85.9%) being within normal weight limits, nine (12.7%) overweight and one (1.4%) underweight. Of those skipping meals, 16 (19.0%) said they were dieting using a 'healthy eating' diet and 22 (28.2%) had chosen their particular diet because they felt they were eating healthily. A number of girls, 32 (36%) who reported that they had not dieted during the previous year had skipped meals. Occasionally, 47 (58.0%) girls missed out more than one meal/day. The following table shows which meals were missed out by the girls.

Table 3.1.4: Meals missed out by the girls in order to aid weight loss (n=81).

Number of girls	(%)	Meal Missed
47	(58.0)	> 1 meal occasionally
19	(23.5)	Breakfast
8	(9.9)	Lunch
7	(8.6)	Dinner/tea

The Mean BMI of those missing out more than one meal was lower than those just missing breakfast, 20.23 ± 3.6 and 22.07 ± 3.8 , respectively. Amongst these 35 (89.7%) were within normal weight limits, three (7.7%) were overweight and one (2.6%) was underweight.

More girls from the Comprehensive Schools, 29 (55.7%) skipped meals than those from the Independent Schools, 17 (41.46%). The number skipping meals from the Girls High Schools was, 38 (38.0%). Significantly more girls from the Comprehensive Schools, 22 (81.4%) occasionally missed out more than one meal than those from the Independent

Schools, 7 (41.1%) $p=0.01$, $\chi^2 = 5.85$, $df:1$), which was similar to the percentage of girls from the Girls High Schools who missed out more than one meal (48.6%).

Reason for skipping meals

Of those missing out meals various reasons (table 3.1.5) were given for doing so. Most girls (37.7%) claimed that they could simply cope without meals.

Table 3.1.5: Reasons given for skipping meals (n=53).

Number of girls (%)	Reasons for skipping meals
20 (37.7)	Can 'cope' without meals.
10 (18.9)	If you don't eat, you don't put on weight.
7 (13.2)	Had no time to eat.
5 (9.3)	To increase weight loss.
3 (5.7)	Only missed out meals, their parent's wouldn't know about.
2 (3.8)	Eat snacks instead of meals.
2 (3.8)	Missed meals to eat as little fat as possible.
1 (1.9)	Felt the need to starve to lose weight
1 (1.9)	Missed breakfast because of 'high sugar content'
1 (1.9)	Missed lunch - made 'fun' of if seen eating at school
1 (1.9)	Have to feel hungry to feel as if weight loss was occurring

Those giving reasons such as 'had no time to eat' 'felt the need to starve to lose weight' and 'have to feel hungry to feel as if weight loss was occurring' had lower mean BMI's, 18.81 ± 3.8 , 8.30 ± 3.0 and 17.70 ± 1.4 respectively (within normal weight limits), than those who felt they could 'cope without eating' and those who felt that 'if you don't eat, you don't put on weight', 21.14 ± 3.5 and 19.95 ± 1.5 , respectively (within normal weight limits). Those who said they could 'cope without eating' 16, (84.2%) were within normal weight limits and three (15.5%) were overweight.

No significant differences were observed between the various schools, however, three (50.0%) of those from the Independent Schools giving a reason for skipping meals felt that, 'if you don't eat you don't get fat' and 14 (48.0%) of those from the Girls High Schools, 14 (48.0%) felt that they 'could cope without eating'. The most popular reasons given by the girls from the Comprehensive Schools was either because they 'could cope without eating' four (36.3%) or because they had 'no time to eat' four (36.3%).

Source of reducing diet

A variety of sources from which they obtained their reducing diet were offered by the girls (table 3.1.6) however, most of the girls made up their own reducing diet (60.0%).

Table 3.1.6: Source from which the reducing diet was obtained (n=200).

Number of girls (%)	Source of reducing diet
120 (60.0%)	Made own diet up.
35 (17.5%)	From magazine/book.
32 (16.0%)	Their mother.
9 (4.5%)	Variety of dietary information.
2 (1.0%)	Off a friend.
1 (0.5%)	Slimming club.
1 (0.5%)	Doctor.

The mean BMI of those that made their own diet up was 19.8 ± 2.5 , lower than those obtaining their diets from other sources, 22.6 ± 1.2 . With regard to those making up their own diet, 87 (87.0%) were within normal weight limits, 11 (11.0%) were overweight and two (2.0%) were underweight. Similar to those who obtained their diet from a magazine or book, 22 (75.9%) were within normal weight limits, six (20.7%) were overweight and one (3.4%) was underweight.

A number of girls obtained their diet from a magazine or book, 19 said they used teenage magazines (16 were within normal weight limits, two were overweight and one was

underweight), 10 (21.7%) used a Slimmers World diet book (four were within normal weight limits, four were overweight), four used a Weight Watchers diet book (two were within normal weight limits, one overweight), three used advice from the media (two were within normal weight limits, one was overweight), two used a Rosemary Conley diet book (both were within normal weight limits) and one who was overweight used an un-named slimming club book.

The number making their own diet up from each school type were as follows: Independent Schools, 27 (64.2%), Comprehensive Schools 37 (58.5%), Girls Schools 58 (57.0%).

Reasons for choice of diet

Reasons for their choice of diet varied, as shown in table 3.1.7 however, most of the girls, 72 (39.0%) chose their diet because they felt they were eating healthily. Most of those that chose their diet because they felt it was healthy eating were within normal weight limits, 46 (75.4%), 14 (23.0%) were overweight and one (1.6%) was underweight.

Table 3.1.7: Reasons given for their choice of reducing diet (n=185).

Number of girls (%)	Reason for choice of reducing diet
72 (39.0)	Felt that they were eating healthily.
25 (13.4)	Because it had worked for other people.
20 (11.0)	Advised to use it by mother/adult relative.
17 (9.2)	Easy to stick to.
15 (8.1)	Following advice from a book/magazine.
10 (5.4)	Thought it sounded 'reasonable'.
10 (5.4)	Hoping for a quick weight loss.
6 (3.2)	Their friends use it.
4 (2.1)	Drastic action was needed.
3 (1.6)	Following advice from slimming clubs.
2 (1.1)	Following advice from a doctor.
1 (0.5)	Had got the idea from nutrition lessons from school.

The mean BMI of those girls 'hoping for a quick weight loss' was slightly lower (19.14 ± 1.7 - within normal limits) than that of those who gave other reasons.

A greater percentage from the Independent Schools, 19 (61.2%) chose their diet because they felt they were eating healthily compared to 12 (34.4%) from the Comprehensive Schools ($p=0.02$, $\chi^2 = 4.99$, $df:1$). From the Girls High Schools, 41 (43.1%) chose their diet because they felt they were eating healthily.

Frequency of diets during the previous twelve months

During the previous twelve months, 96 (46.3%) girls had not dieted 63 (80.8%) of these were of normal weight, 13 (16.7%) overweight and two (2.6%) underweight. However, of those that had not dieted during the previous year, 38.0% of them admitted to skipping meals. Most girls that had dieted during the previous year, 61 (30.3%) had dieted up to two times (44 (86.3%) normal weight, seven (13.7%) overweight), 35 (17.4%) up to four times (20 (69.0%) normal weight, 8 (27.6%) overweight, 1 (3.4%) underweight) and 12 (6.0%) had dieted for most of the time 8 (72.7%) fell within normal weight limits and 3 (27.3%) overweight). The mean BMI of those who had not dieted during the previous twelve months was 19.7 ± 3.4 , compared with 21.5 ± 0.2 amongst those who had dieted.

No significant differences were found between the Independent and Comprehensive Schools, however, a smaller percentage of girls from the Girls High School had not dieted during the previous year (31.0%), compared to the Independent and Comprehensive (mixed sex) Schools (69.0%) and (58.0%), respectively ($p=0.002$, $\chi^2 = 8.94$, $df:1$). More girls from the Girls High Schools, 40 (38.4%) had dieted up to two times during the previous year, than those from the Independent and Comprehensive (mixed sex), 10 (24.0%) and 11 (20.0%), respectively ($p=0.002$, $\chi^2 = 9.32$, $df:1$). More girls from the Girls High Schools, 20 (19.2%) had dieted up to four times during the previous year compared to those from the Independent and Comprehensive (mixed sex), three (7.1%) and 12 (22.0%), respectively. The girls who were dieting for most of the time, 12 (11.5%) all came from the Girls High Schools.

Usual length of diet

Overall, 66 (33.0%) girls dieted for 2-4 weeks and 51 (25.5%) for over four weeks at a time. The number dieting for just a few days at a time was 44 (22.0%) and 39 (19.5%) dieted for a duration of one week. The mean BMI of those that dieted for less than four weeks at a time was 22.0 ± 4.9 , compared with 20.1 ± 0.6 for those that dieted for less than four weeks at a time. Of those dieting for more than four weeks at a time 33 (68.8%) were normal weight, 13 (27.0%) were overweight and two (4.2%) were underweight. With regard to the girls dieting for less than four weeks at a time 101 (83.4%) were normal weight, 18 (14.8%) were overweight and two (1.8%) were underweight. No differences in the length of the diets were found between the various school types.

Awareness of weight loss: Weight loss during previous diet

The number of girls that said they lost weight the last time they dieted was 145 (75.1%) with 99 (79.2%) being of normal weight, 23 (18.4%) overweight and three (2.4%) underweight). The mean BMI of those that had lost weight and had not lost weight was similar, 20.80 ± 3.4 and 20.85 ± 3.9 , respectively. After dieting, most girls, 142 (72.1%) said that they regained some of the weight they had lost, with 97 (80.8%) of these being of normal weight, 21 (17.5%) overweight and two (1.7%) underweight. However, 20 (10.2%) girls regained it all, with 10 (55.6%) being of normal weight and eight (44.4%) overweight. A number of girls, 35 (17.8%) did not regain any weight, with 26 (89.7%) being of normal weight, two (6.5%) overweight and 1 (3.4%) underweight. The mean BMI of those that regained all of their weight was 23.3 ± 4.8 compared to 19.6 ± 2.3 in those who did not regain any weight ($p=0.03$). The mean BMI in those that regained some of their weight was 20.6 ± 3.3 .

The number of girls who had lost weight during their previous diet was 28 (75.6%) from the Independent Schools, compared to 37 (68.5%) from the Comprehensive Schools. Amongst those from the Girls High Schools 80 (78.4%) had lost weight during the previous diet. The number regaining some or all of their weight was 35 (83.3%) from the

Independent Schools, compared to 41 (77.3%) from the Comprehensive Schools and 84 (84.3%) in the Girls High Schools.

Monitoring weight loss

In order to monitor their weight loss, 121 (60.5%) said they used scales, with 81 (78.6%) being of normal weight, 19 (18.4%) overweight and three (2.9%) underweight. A number used the fit of their clothes as a guide, 50 (25.0%), with 34 (89.5%) of normal weight and four (10.5%) overweight. Some girls used both of these methods, 29 (14.5%) with 19 (70.4%) being of normal weight and eight (29.6%) overweight. The mean BMI of those using scales was slightly higher than those using the fit of their clothes, 20.8 ± 3.7 and 19.9 ± 2.7 respectively.

More girls from the Comprehensive, 44 (80.0%) than from the Independent Schools, 18 (43.9%) relied solely on scales to monitor weight loss ($p=0.001$, $\chi^2 = 10.18$, $df:1$).

However, more girls from the Independent 11 (26.8%) used scales and the fit of their clothes compared to those from the Comprehensive, one (1.0%) and Girls High Schools, 17 (16.3%).

Satisfaction with weight loss

Of those dieting, only three (1.6%) were satisfied with their weight loss (all of normal weight). Most girls, 79 (41.4%) wanted to lose between 1-2 stone in weight, with 57 (85.1%) being of normal weight and 10 (14.9%) overweight. A number, 43 (22.5%) wanted to lose 8lb-1 stone, with 30 (78.9%) being of normal weight, seven (18.4%) overweight and one (2.6%) underweight. Some girls only wanted to lose up to 7lbs, 39 (20.4%), with 28 (84.8%) being of normal weight, four (12.1%) overweight and one (3.0%) underweight. However, 21 (14.1%) wanted to lose two stone or more, again a number were of normal weight, 10 (47.6%), also, 10 (47.6%) being overweight and 1 (4.8%) underweight. The mean BMI of those wanting to lose 1-7lb was lower (19.4) than those wanting to lose two stone or more (23.9) ($p < 0.05$).

The desire for a greater weight loss (>1 stone) was more evident in those girls from the Comprehensive than Independent Schools, 32 (62.7%) and 15 (42.1%) respectively ($p=0.04$, $\chi^2 = 3.84$, $df:1$). Of those from the Girls High Schools, 61 (59.9%) wished to lose more than one stone in weight.

3.1.3

Discussion

The results show that the incidence of dieting to lose weight amongst 11-15 year old girls in the North West of England was 35.3%, with the results being similar in all three school types. This figure is similar to previous work undertaken in the UK, involving adolescent girls (Wardle & Marsland, 1990, Button et al, 1996, Bost et al, 1998). The results of this study and other work would support the suggestion that dieting is a practice which has now become common amongst adolescent girls in the UK (Hill et al, 1992). Figures which suggest the incidence of dieting in this age group to be as high as 61.0-77.0% have been reported from the USA (Perry-Hunnicutt & Newman, 1993, Rosen et al, 1990, Wadden et al, 1989, Rosen & Gross, 1987), which might reflect the higher incidence of obesity in the USA, 32.9% (Okosun, 1999), compared with the UK, 18.0% (Bost et al, 1998). It has been suggested (French & Jeffery, 1994) that dieting prevalence may vary, depending on the specificity of the question wording, indeed wide discrepancies have been found amongst US studies. Thus the variation between the results of this study and others previously conducted in the UK (Button et al, 1996 and Wardle & Marsland, 1990) may be accounted for by the way in which the term 'dieting' is explained to the sample and also the interpretation of the term 'dieting' by the sample. However, the results of this study have identified 'dieting' behaviour amongst a considerable number of the female adolescent population in the North West of England, which would suggest that health/nutritional education needs exist within this group. Lytle et al (1997) suggest that dietary advice must be specific to the group it is aimed at. It may be the case that the needs of young girls in specific areas are not being met. This then would reinforce the importance of advice aimed at a local level.

Cultural thinking in the Western World emphasises body thinness as being the 'ideal' (Michaud & Terry, 1993). Research has shown that children develop an anti-social attitude towards obesity at an early age, viewing it in a negative light (Hill & Silver, 1995, Wardle et al, 1995). Due to the pressures to achieve a slim body shape, dieting has

become a practice followed by those who are not only overweight, but also by those unhappy about their size and shape (Wardle & Beales, 1986). A study by Fox (1991) showed that 71.0% of a sample of young women, aged 15-19 years, attempting to lose weight, were within normal weight limits. These results are similar to those found in this study, where 80.0% fell within normal weight limits for their age, although the girls in this study were younger. It could be suggested that the results may have been influenced by the fact that the height and weight were self reported, however, work by Stewart (1982) and Imrhan et al (1996) has shown that this may not be the case.

Studies have found dieting to be more prevalent and frequent in those with a higher socio-economic status (Dornbusch et al, 1984, Wardle & Marsland, 1990, Story et al, 1995). However, the results of this study found the incidence of dieting amongst those girls from the Independent and Comprehensive Schools to be similar and would therefore, agree with the work of Fox (1991) and Story et al (1991) which suggested otherwise, in that dieting is a practice which is spreading across all social groups. For the purpose of this study socio-economic status was determined by school-type, however, by no means does this suggest that school type is a direct indicator of differences of dieting incidence between socio-economic classes. Although this study was undertaken within the school environment, the decision to diet may have been influenced by various socio-cultural factors (Sobal, 1995).

Many reasons were given for wanting to lose weight and were mostly associated with appearance, only one girl was dieting for medical reasons. These results reinforce the issue of how important appearance is in our society, a factor highlighted by previous research. Wertheim et al (1997) found that the media was swamped with images of thin models who had found success, implying that success was associated with being thin, and resulting in making normal weight girls feel inferior, influencing their decision to diet. Their study also raised concerns regarding fashion and found that despite having a normal body mass index, the girls felt that they could not achieve the same look as the fashion models who advertised the clothes. The work of Wertheim et al (1997) is an example of how young girls are put under a tremendous amount of pressure in order to fit in with the

thin body image demanded by society, although this is biologically inadvisable (Rodin et al, 1984).

The main reason given for dieting was because they felt 'too fat', even though 78.7% of these were of normal weight and 3.3% underweight. Nylander (1971) suggested that many girls with or without cause feel themselves to be too fat and therefore diet to lose weight. It would appear that this was the case amongst the girls in this study. It has been suggested that peer pressure is very influential in a young girls decision to diet (Maloney et al, 1989, Wertheim et al, 1997), however, only 3.1% of the girls in this study gave direct peer pressure as a reason. Although this was the case it may be argued that those dieting for appearance related reasons are being indirectly influenced by their peers, as they perceive looking good to be a condition of being accepted by society.

Significantly more (66.0%) from the Comprehensive Schools dieted because they felt they were too fat compared to those from the Independent Schools (39.0%), however, a similar mean BMI was apparent within both school types. It may therefore, be suggested that the feeling of being too fat is not influenced by the prevalence of obesity in the schools. Significantly less (16.0%) from the Girls Schools dieted because they felt 'too fat', however, the mean BMI of those dieter's was 21.6, higher than the other school types and 23.8% of them fell within the overweight category. This would suggest that maybe they were justified in thinking they were 'too fat'. However, the remaining girls were still mostly dieting for appearance related reasons which probably were not justified. It is possible that the reason more girls were dieting because they felt 'too fat' from the mixed sex schools, even though they were mostly of normal weight, was because of the presence of boys and the need to appear more attractive to them (Wertheim et al, 1997), which may be interpreted as a type of peer pressure.

The incidence of dieting reported in this study is of concern, however, what is more worrying is the age at which the girls had started to diet. Results showed that most of the girls started to diet around the age of 11 or 12 years, similar to results reported by Moreno & Thelan (1995) who found that 63.0% of their sample of High School girls had started to

diet by the age of 12 years. Previous research has found that high levels of dieting motivation exist in girls as young as nine years (Hill et al, 1991). Indeed, Blisset et al (1996) found children aged five to seven years, had either tried to reduce their intake or had actually dieted. Similarly, Moreno & Thelan (1995) found the earliest reported age of dieting to be six years. The results of this study has also found that many girls reported that they had first started to diet during the pre-adolescent years. By the age of 10 years 25.4% reported that they had started to diet and 3.0% had started before the age of eight years.

Of those that had started to diet by the age of 10 years, 73.1% were within normal weight limits. The concern regarding body image and the desire for thinness in those of normal weight amongst children as young as this has also been reported by Blisset et al (1996) and Hill et al (1994). However, in this study, those who had started to diet by the age of eight years had a higher mean BMI (24.4), than those who started to diet after the age of eight years (20.7), which may suggest that those who started to diet at an earlier age may have had a problem with their weight for most of their life.

This research revealed significant socio-economic differences in the reported age of starting to diet, with a greater proportion from the Independent Schools, (45.2%) who had started to diet by the age of 10 years compared to those from the Comprehensive Schools (24.0%). These results would tend to agree with the hypothesis that dieting is more prevalent in higher socio-economic groups (Dornbusch et al, 1984, Wardle & Marsland, 1990, Story et al, 1995). Dieting behaviour may be more established within the culture of higher socio-economic groups, however, as the overall incidence of dieting revealed no differences between social groups, it could be suggested that those from a lower socio-economic background are more susceptible to changes that may arise from transferring to secondary school, thus influencing their decision to diet. Only 18.2% from the girls schools had started to diet by the age of 10 years, however, the fact that these girls come from a mixture of social backgrounds may influence this result.

One particular finding of this study which raises considerable concern was the fact that a large number (66.0%) of those that had dieted felt that the practice of dieting was good for their health. A large percentage of girls, who were of this opinion, were of normal weight (78.4%), as were all of the dieters who were underweight. Of those from the Independent Schools, 59.5% thought that dieting was good for their health, similar to 58.1% from the Comprehensive Schools. However, 70.1% from the Girls Schools thought that dieting was good for their health. These results would suggest that many girls may be confused and hold misconceptions with regard to the idea of dieting and healthy eating. Research found that adolescents view 'dieting' from a much broader angle than do health professionals (Neumark-Sztainer & Story, 1988). It has been concluded that many children perceive dieting as a healthful eating behaviour and that 'diet' meant eating healthy food (Neumark-Sztainer & Story, 1988, Lytle et al, 1997)

The confusion surrounding the concept of dieting also appears to be present amongst health professionals as well. Brownell & Rodin (1994) suggest that dieting is becoming a controversial issue, with different schools of thought looking at it from different perspectives. On the one hand chronic, severe dieting is a central feature in the aetiology of eating disorders (Wilson, 1993), alternatively dieting represents a potential solution to a serious medical problem i.e. obesity (Brownell & Rodin, 1994). These two perspectives highlight the common associations made with dieting: on the negative side, the development of eating disorders and on the positive side, an answer to obesity. However, these perspectives represent two extremes and do not take into account the middle factor which includes the majority of the girls who have dieted in this study, those who are of normal weight and who are unlikely to develop eating disorders.

The health risks associated with dieting are not just concerned with eating disorders. Most related problems are much more common and affect the female adolescent population as a whole, such as anaemia (BNF, 1995) and osteoporosis (Kriepe & Forbes, 1990, Kanis & Pitt, 1992). Studies undertaken amongst adolescent dieters have found that general symptoms such as fatigue, weakness, depression, headaches, nausea, anxiety,

preoccupation with food and lack of concentration/poorer school performance are common (Nylander, 1971, Malik, 1982).

Adolescent girls are very vulnerable where their appearance is concerned and from the results discussed so far, it is clear that many girls who are of normal weight are very conscious of their appearance and may perceive themselves as being larger than they actually are. It may be possible that because they perceive themselves as being obese they may adopt advice that is aimed at this group. Beiner & Heaton (1995) suggest that public health messages need to clarify that weight loss is not recommended for people of normal weight and that dieting may expose normal-weight individuals to unnecessary health risks.

Maybe over recent years too much emphasis has been placed upon the practice of 'dieting,' particularly in nutritional advice aimed at the obese. Health recommendations should not reinforce the stigma associated with obesity, as without such considerations, one health problem may exacerbate others (Hill et al, 1992). The evidence from the findings of this study and previous work would reinforce the importance that needs to be placed on developing a healthy lifestyle, both in nutritional and exercise terms, regardless of a persons weight. Promoting health needs according to weight, especially where young girls are concerned may only lead to them being victimised. Wardle et al (1995) found that negative stereotypes regarding obesity were quite vindictive.

This confusion regarding dieting being a healthy practice may also be reflected amongst the parents of the girls. Of those dieting, 52.0% said their parents did not approve, however, this left 48.0% who did support their daughter's dieting practices. Parental approval to diet was similar between those from the Independent and Comprehensive Schools, 40.0% and 36.5%, respectively, however, parental support was higher amongst those from the Girls Schools, 55.7%. This may be explained by the fact that there were more girls in the overweight category from the Girls Schools than the other types.

These results would imply that a number of adults hold misconceptions about the benefits of dieting, especially amongst adolescents and children. Previous research conducted

outside the UK has addressed this issue. Pugliese et al (1987) report that parental misconceptions and abnormal health beliefs regarding diet may be a cause for failure to thrive in infants. It was found that parents gave their children the type of diet that was recommended by health professionals for adults at risk from cardiovascular disease, with the aim of preventing premature atherosclerosis and obesity. Further research has reported parental encouragement to diet in older children, aged 13-16 years and found that 50.0% of those who were encouraged by their parents to diet, were of normal, or under weight. Those girls encouraged to diet by their parents tended to associate being thinner with increased health, success and acceptance by society (Dixon et al, 1996). Evidence would suggest that society's obsession with dieting and the aim to reduce the risk of heart disease may be affecting the health of young children.

Perceptions of dieting and what is socially acceptable regarding body shape are passed on to children from adults (Lytle et al, 1997), however, it is important that adults are aware of the messages they pass on regarding image, weight and dieting (Hill et al, 1992). The health needs of adolescents and children are completely different to those of adults, a point which needs to be reinforced not just amongst parents but also amongst other influential sources such as health professionals, teachers and the food and dieting industry.

Brownell & Rodin (1994) suggest that dieting behaviour may range from healthy changes in dietary intake to a severely restricted intake. Low fat diets are currently a very popular method of weight loss (Dwyer, 1992), which was found to be the case amongst the girls from this study. Various types of reducing diets were used by the girls, however, the most popular was a low fat diet, with 42.8% claiming to use it, a higher figure than the 26.9% found by French et al (1995). Further evidence suggesting confusion between the concepts of 'dieting' and 'healthy eating' was the fact that the second most popular type of diet used was a 'healthy eating' diet with 29.6% of the girls using it. Unhealthy dieting methods, such as starvation is not recommended to any person in any situation trying to lose weight, because of the profound metabolic effects (Dwyer, 1995). Various studies have found the prevalence of such a practice to be quite high (Berg, 1992, Moore, 1988, Perry-Hunnicut & Newman, 1993), however, in comparison only a small number of girls

did use such methods: eight (4.0%) tried to eat as little as possible and four (2.0%) did undergo periods of starvation. Those using these methods of weight loss were within normal weight limits, however, their mean BMI was lower than those using a low fat diet. Only five (3.6%) used slimming aids.

Those using a low fat diet from the Independent and Comprehensive Schools were similar, 50.0% and 46.2% respectively, but slightly lower in the Girls School 38.0%. However, more girls from the Girls Schools used healthy eating (33.0%) compared to the Independent (26.1%) and Comprehensive (26.9%) Schools. These figures may again be influenced by the girls perceptions of 'dieting' and 'healthy eating'.

Dietary fat is a nutrient which has become the focus of attention over recent years (Schwartz & Borra, 1997). However, because of the associated adverse effects, the importance of dietary fat tends to be ignored (Sanders, 1994). Over recent years nutritional recommendations have placed importance on reducing fat (DoH, 1991, 1994), however, much of this advice has become distorted, via the media or otherwise, with the implication that 'all fat is bad' (Horm & Anderson, 1993). Fat is an important source of energy with an important role in growth and development and the prevention of disease (Gurr, 1993, Calzada et al, 1995, Sanders, 1994). Because fat is such an important nutrient, especially among children and adolescents, it raises the question: are low fat diets a healthy option for this group? It may be suggested that this type of diet is not appropriate to the population as a whole. This is an issue that needs to be addressed, as further health problems may arise from the situation.

Several studies would suggest that skipping meals also appears to be a popular dieting practice. In a study by French et al (1995) 11.6% reported skipping meals, however, Serdula et al (1993) reported a much higher figure of 49.0% which is similar to the results from this study (43.0%). Most of the girls (85.9%) who reported skipping meals were of normal weight. Of those skipping meals, 19.0% said they were using a 'healthy eating' diet and 28.2% had chosen their particular diet because they felt they were eating healthily. These results would suggest further that young girls are unsure of the meaning of healthy eating and what it entails.

More girls from Comprehensive Schools (55.7%) than from the Independent Schools (41.46%) skipped meals and the number of those from the Girls Schools was 38.0%. A number of girls (58.0%) had on occasion missed out more than one meal per day and again they were all within normal weight limits. Significantly more from the Comprehensive Schools (81.4%) than the Independent Schools (41.1%) and the Girls Schools (47.3%) had on occasion missed more than one meal a day. The girls from the Comprehensive Schools may have had more opportunity to miss meals, since they maybe more likely to obtain their lunch outside school, if at all.

Various reasons were given for skipping meals, with the most popular (37.7%) being that they could simply 'cope without meals', which might imply that some girls did not see food in an important light and was something they could take or leave. However, this was the most popular reason amongst those from the Comprehensive Schools which may suggest that in situations where food choice may be restricted, food may become less of a priority. Despite being of a normal weight, some girls did give reasons which give cause for concern, such as 'felt the need to starve to lose weight' and 'have to feel hungry to feel as if weight loss was occurring,' which might imply that they could be at risk from developing an eating problem.

The girls obtained their diets from various sources, however, most (60.0%) of them made their own diet up. Although this was the case they probably obtained information and ideas from a variety of sources in order to make their own diet up. This finding is of particular concern as it is extremely doubtful that these girls would have the nutritional knowledge to compile a suitable reducing diet, a practice which they should not be undertaking in any case. The fact that so many girls are making up their own diets and hold misconceptions regarding dieting and healthy eating, highlights the urgent need for clearer and more consistent advice for this group. A similar number from each school type made up their own diet, which would suggest that despite their background, they all have a common, but unhealthy interest in their dietary intake. Of those making up their own diets most were of normal weight, however, their mean BMI was lower than those obtaining

their diets from other sources which may indicate that a number of them may not have had support for their decision to diet because of them not needing to lose weight.

The next most popular source from which their reducing diet was obtained was from a magazine or book (17.5%) Of those obtaining their diet from a book or magazine, just over half of them named their source as a teenage magazine and many named publications from various slimming organisations. It has been suggested that the media is a major factor in the social environment of an individual, and may have a great influence on behaviour (Lewis et al, 1989). Research by Thomson et al (1988) showed that adolescents are more likely to receive nutritional advice from the mass media than from health professionals. It would appear that this was the case regarding many girls in this study. Most of these girls were of normal weight and indeed of those stating slimming organisations as their source, none were overweight. Slimming clubs play a major part in the lives of many women, and from the results of this study it would appear that their influence reaches young girls as well. One such club, reported in the results, the Rosemary Conley Diet and Fitness Club, offers diets which are strictly low in fat, a type of diet which is totally inappropriate to a young girl. It also offers a 'flat stomach diet', which may offer false hope to many dieter's as developing a 'flat stomach' isn't being realistic (Which?, 1997). Although some adults may find these groups supportive during their diet they may also be considered as a potential health threat to young girls. Their ultimate goal is to make money and the negative effects of dieting on health may be glossed over. A disturbing fact is that there are no laws which govern this market, anybody can set up a slimming club in the UK (Which?, 1997). It would appear that urgent changes are needed in order to protect the health of young vulnerable children.

The third most popular source of a diet was their mother (16.0%). Within the family environment Hill (1996) suggests that the mother is most influential, indeed previous work by Hill et al (1990) identified a link between dieting mothers and their dieting daughters. Wertheim et al (1997) reported the occurrence of joint diets, between mothers and daughters. It is of concern that mothers should be advising their daughters to use a particular reducing diet, as it would imply that they are unaware of the potential health

problems associated with dieting and also of their daughters nutritional needs. The results of this research and previous work may indicate how much parents are influenced by 'cultural thinking' and may place more importance in their children being accepted by society than their nutritional needs. Adults need to be made aware of the health concerns that are associated with dieting and should be encouraged to prevent the practice of dieting in adolescents and children

Although the girls had obtained their diets from various sources, they gave various reasons for choosing their reducing diets. Results showed that the girl's choice of diet were influenced by many reasons, however, 39.0% felt that they were eating healthily. This finding is further evidence that young girls perceive dieting and healthy eating in the same light and is supported by the findings of Neumark-Sztainer & Story (1998), who found that some of the adolescents in their study described dieting as 'eating healthy'.

More girls from the Independent Schools (61.2%) than from the Comprehensive Schools (34.4%), chose their diet because they thought they were eating healthily. In some quarters there is a view that it is more expensive to eat healthily, indeed many diet products, which are advertised as healthy products, are more available in stores which those who are less affluent may not visit. Because more people from more affluent groups consume these products, maybe they feel that they are eating a healthy diet.

A number of girls (13.4%) used their diet because it had worked for other people and although they were not more specific this may have included family and friends.

However, some girls (11.0%) were more specific and named their mother or another adult relative as influencing their choice of reducing diet. The mean BMI of those girls 'hoping for a quick weight loss' was slightly lower than in those who gave other reasons. This may indicate that there were a number of girls who were very conscious of their weight and had unhealthy reasons for wanting to lose weight quickly. The variety of reasons given for their choice of diet, would suggest that some girls give particular thought to their method of weight loss and are open to suggestion from various ideas.

During the previous twelve months, 46.3% said that they had not dieted, however, it was found that 38.0% of these had in fact admitted to skipping meals in order control their

weight. It would seem that although skipping meals is a form of restricting dietary intake, which may lead to weight loss, some girls do not perceive it as dieting behaviour. A study by Moreno & Thelan (1995) found that 44.0% of their sample had not dieted during the previous twelve months, however, they present no information regarding the dietary behaviour of the girls during this time. The results of this study showed that of those that had not dieted during the previous year, the mean BMI was 19.7, compared with 21.4 amongst those that had dieted. This may indicate that there are a number of girls of a lower weight who might not want to actually admit to dieting, but may still restrict their intake by skipping meals. Of those that had dieted, 30.3% had dieted up to two times, 17.4%, up to four times and 6.0% for most of the time. These results would appear to be similar to previous findings (Perry-Hunnicuttt & Newman, 1993, Johnson et al, 1983). The frequency of dieting was higher in the Girls Schools than the mixed sex types, in fact those girls who dieted for 'most of the time' all came from the Girls Schools. Although, in mixed sex schools there might be pressure to diet in order to look attractive to boys, an all girls environment can be very competitive. Wertheim et al (1997) found that popular girls had the most influence as they were always thin and pretty, and therefore, there was pressure to diet in order to be popular.

Most girls (33.0%) dieted for a period of two-four weeks at a time, however, 25.5% said they dieted for over four weeks at a time. Although the mean BMI was slightly higher in those dieting for over four weeks, they were still of normal weight. No differences among the various school types was found. These results are consistent with the findings of Moreno & Thelan (1995) who found that the most popular length of diet was two to four weeks. The frequency and length of the reported diets would suggest that some girls may be restricting their intake and depriving themselves of essential nutrients for fairly long periods of time. Clearly the health of some of these girls could be at risk. Story et al (1991) suggested that due to the frequency and length of diets followed by some girls, dieting may be becoming a chronic condition in certain cases.

A considerable number (75.1%) of girls reported weight loss during their previous diet, with nearly 80.0% of these being within normal weight limits and similar number in each

of the school types. However, after weight loss 72.1% said that they regained some of the weight and 10.2% regained it all. The mean BMI of those that regained all of their weight was 23.3, higher than in those who had only regained some (20.6) or none (19.6). In those who are overweight it may be suggested that they find it more difficult to control their intake and maybe they take less exercise.

Repetitive weight loss and regain are known as weight cycling (Manore, 1996). It has been suggested that the negative effects of weight cycling, make future weight loss attempts even more difficult, possibly leading to increased obesity and an increased risk of developing coronary heart disease (Wilson, 1995). Various studies have found a significant association with regard to weight fluctuation and the development of coronary heart disease (Lissner & Brownell, 1992). Evidence suggests that the dieting practices followed by many girls in this study could be putting their future health at risk. They may be inadvertently putting themselves at risk from developing coronary heart disease in later life when they are under the impression that they are taking measures to prevent it i.e. reducing their fat intake and trying to reduce their weight. Lee & Paffenbarger (1992) report that mortality from cardiovascular disease is lower in those maintaining a stable weight.

In order to monitor their weight loss, 60.5% said that they used scales, 25.0% used the fit of their clothes and the remainder used both methods. These results illustrate the importance of appearance to the girls. The mean BMI of those using scales was slightly higher than those using the fit of their clothes. This result would highlight the concern regarding girls of normal weight obsessed with becoming thinner. More girls from the Comprehensive Schools used scales than from the Independent Schools, which may suggest that although the incidence of dieting may be increasing amongst the lower socio-economic groups, their weight loss efforts might be more likely to be for actual weight loss reasons than cosmetic. As Michaud & Terry (1993), suggest, cultural thinking in the Western World now emphasises body thinness as being the 'ideal'. To many girls it would seem that losing weight is not about being the correct weight for their height, but about striving to emulate the 'look' that is covering the front pages of teenage magazines.

Only three (1.6%) of those who had dieted were satisfied with their weight loss. Most girls (41.9%) wanted to lose between one-two stones in weight, the majority of whom were of normal weight. Of those who wanted to lose two stone or more, 47.6% were of normal weight, 4.8% were underweight and 47.6% were overweight. In those that were overweight it is understandable that their desired weight loss would be greater, however, these results would suggest that many girls have unrealistic perceptions of what their weight should be and maybe do not understand the concept of body weight. The desire for a weight loss over one stone was greater in the Comprehensive Schools than the Independent Schools. Although the results of this study show that the desire to be thin is evident across all social groups, maybe those who come from a less affluent background feel that they will gain more success if they are more attractive than those from a more privileged background, who may have more opportunities open for their future.

Limitations of the study

The results of this study may have been influenced by certain factors which determined the methodology. A validated questionnaire was not used because it was the intention of the study to collect specific information and not repeat previous work undertaken. Also, owing to the 'sensitive' nature of the subject, the content and wording of the questionnaire had to conform to the requirements of the University ethics committee and the schools concerned. Socio-economic status was assessed using school type: Independent and Comprehensive, which only provided an indication of differences between various social classes.

3.1.4

Conclusion

Despite any limitations associated with this study the findings have provided important information regarding the general dieting practices of adolescent girls in the UK and in particular, the North West of England. Some results are consistent with previously published work, however, the study has raised several issues that would appear have not been previously reported in the UK.

The results of this study showed there to be an incidence of dieting behaviour of 35.3% amongst 11-15 year old girls from the North West of England. Further evidence has been provided that gives concern regarding their reasons for dieting, the age at which girls become involved in dieting practices and also the frequency and duration of such behaviour. As with previous work the study highlights the fact that this behaviour is very prevalent amongst those girls who are of a normal weight for their age.

Many studies have produced figures regarding the incidence of dieting and demonstrated their concern that the behaviour of many girls may put them at risk from developing eating disorders. However, dieting is not just about 'eating disorders', dieting may lead to nutritional deficiencies, resulting in diseases much more common than eating disorders and just as serious in their nature. This study, therefore, provides much needed information regarding the type of reducing diets used by the girls and their reasons for using them, thus giving an insight into how their dieting practices may be affecting their nutritional intake.

The results of this study found that the two most popular types of reducing diet used were a 'low fat diet' and 'healthy eating diet,' many girls felt that dieting was 'good for their health' and indeed, many girls chose their particular diet because they felt they were eating healthily. These findings raise important questions regarding their perceptions of dieting and healthy eating and suggest that many young girls may be confused about nutrition issues generally. After all, what is the difference between following a low fat diet as a reducing diet and following such a diet because of healthy eating recommendations. If the

importance of certain types of fat i.e. monounsaturated and polyunsaturated, are misunderstood by both groups, then both will be following a nutritionally restrictive diet. Because of the apparent confusion that exists, maybe the numbers who are seriously dieting to lose weight is fairly low. A low fat diet does not necessarily lead to weight loss. Although girls may reduce the amount of fat eaten, their overall energy intake may not change. Because fat is such an important nutrient, a reduction of which is recommended generally to the population, it may be that so called 'non dieters' are at risk from nutritional deficiencies as much as 'dieters'. 'Dieting' and 'low fat' diets are terms that are heavily promoted by the media, as young girls follow fashion then they may claim they are following such diets because they want to do the 'fashionable' thing. It might therefore, be the case that young girls are more at risk from following low fat diets for whatever reason than they are from actual dieting practices. It was found that of those that had not dieted during the previous year, many had still been skipping meals. This finding would present further evidence that 'non dieters' may be following restrictive dietary practices to a similar extent as the 'dieters'.

Also from the results of this study it would appear that adults may hold the same misconceptions regarding this issue as children, which is of concern as they are an important medium for the education of their children. It may be the case that the nation has become saturated with various advice from different sources and because of a lack of understanding are misinterpreting it. The bid to improve the nation's health may only be serving to add to existing problems.

It would seem to be the case that subject of dieting amongst young girls has been approached very sensitively over recent years, because of the associations with the development of eating disorders. However, the implications of dieting maybe far more widespread, because of the apparent confusion with healthy eating. It is important to find out who is actually 'dieting' and who is restricting their nutritional intake because of misunderstandings regarding nutritional advice.

Although some work has been undertaken in the USA addressing this issue, no such work has been reported here. More extensive work is needed looking into this matter as it has important implications regarding the way in which nutritional advice is given and interpreted, and the effects on the health of the female population.

Section 3.2

Dieting behaviour/practices amongst adolescent girls ~ follow-up study

The findings from the first part of the study addressing dieting behaviour/practices amongst adolescent girls raised the issue of whether young girls do actually 'diet'.

The study showed that 'low fat diets' and 'healthy eating' diets were common practice and types of dietary intakes, which may be equally as common amongst non-dieters. Practices such as skipping meals were reported amongst those that had not dieted during the previous year. These results may suggest that the dietary intake of many female adolescent dieters may not be very different to that of non-dieters.

Results also showed that there was apparent confusion about dieting in relation to health, with many girls thinking that it was a healthy practice. Findings which are similar to those reported by Lytle et al (1997).

Research conducted in the USA has shown that adolescents view 'dieting' from a much broader angle than do health professionals and describe it in a wide variety of ways (Neumark-Sztainer & Story, 1998). There is a lack of any similar, published work in this country, which would provide an extremely important insight into the actual 'dieting' practices of adolescent girls here in the UK.

Dieting has become part of our culture and along with healthy eating these have become very fashionable terms. The results from the first study would suggest that any health concerns arising because of dieting behaviour are more likely to be related to nutritional deficiencies and not because of the association with eating disorders. It may be suggested that concerns regarding dieting amongst this age group are misplaced. Instead of being solely concerned with the so called 'dieters,' the results would suggest that restriction of nutritional intake is an issue which extends to the adolescent population as a whole.

In order to cast further light on the actual incidence of dieting practices among young girls it was vital to gain information from those who claim that they have never dieted, in order to identify any difference between the two types of behaviour.

Where the first study was concerned the design and content of the questionnaire was controlled by the requirements of the ethics committee and the schools concerned.

Because this was the case it was not possible to gain any information from those girls who hadn't dieted, regarding dieting behaviour and their thoughts regarding their own body image. A second application was made to Liverpool John Moores University Ethics Committee containing results from the first study, emphasising the importance of this matter. After consideration further work was allowed to proceed.

This study will therefore try and establish further, the extent of 'dieting' practices amongst adolescent girls and identify the perceptions held by adolescent girls with regard to 'dieting' and 'healthy eating'. It will attempt to determine the actual extent of dieting behaviour and how related health risks may affect the adolescent population as a whole.

As with the first study, normal weight for age was determined by criteria set by Cole et al (1990), as described in the methodology.

3.2.1

Results

The self-reported questionnaires were completed by 140 girls, all from year seven at school. Out of this group, 97 reported knowing their height and weight, of whom, 79 (81.4%) were within normal weight limits, five (5.2%) were overweight and 13 (13.4%) were underweight. The mean BMI was 17.59 ± 2.6 .

Incidence of dieting

Out of the total group, 47 (33.6%) girls said that they had dieted, their mean BMI was 18.29 ± 2.6 , with 33 (84.6%) within normal weight limits, four (10.3%) overweight and two (5.1%) underweight. However, only 22 (15.8%) said that they were dieting at the time of the study. The mean BMI of the group was 17.89 ± 2.3 , with 17 (94.4%) being within normal weight limits, one (5.6%) overweight and non underweight.

The mean BMI of those who said they had never dieted (93) was 17.12 ± 2.6 . Amongst these 46 (79.3%) were of normal weight, one (1.7%) overweight and 11 (19.0%) underweight..

Perceptions held regarding body image

Table 3.2.1: Perception of own body image - compared to dieting status.

Perceived image	Total group No. (%)	Dieter No. (%)	Non-dieter No. (%)
Very thin	9 (6.5)	-	9 (9.7)
Just right	84 (60.4)	19 (41.3)	65 (69.9)
A bit fat	41 (29.5)	24 (52.2)	17 (18.3)
Very fat	5 (3.6)	3 (6.5)	2 (2.2)

Most of the total group, 84 (60.4%) felt that their own body image was 'just right'. None of those who had dieted felt 'very thin'. Significantly more non-dieters felt 'just right' compared to dieters, 65 (69.9%) and 10 (41.3%), respectively ($p=0.002$, $\chi^2 = 9.36$, $df:1$). Significantly more dieters felt a 'bit fat' compared to non-dieters, 24 (52.2%) and 17 (18.3%), respectively ($p=0.00008$, $\chi^2 = 15.41$, $df:1$).

Table 3.2.2: Body weight of dieters and non-dieters - compared with perceptions of their own body image.

Perceived image	Dieter			Non-dieter		
	U No. (%)	N No. (%)	O No. (%)	U No. (%)	N No. (%)	O No. (%)
Very thin	1 (33.0)	5 (13.1)				
Just right	2 (67.0)	14 (37.0)	2 (50.0)	10 (100)	35 (85.3)	
A bit fat		18 (47.3)	1 (25.0)		6 (14.7)	1 (100)
Very fat		1 (2.6)	1 (25.0)			

Key; U: Under weight, N: Normal weight, O: Over weight

Amongst those girls who were of normal weight significantly more non-dieters than dieter's felt 'just right' 35 (85.3%) and 14 (37.0%) girls respectively ($p=0.008$, $\chi^2 = 11.24$, $df:1$). Within the same weight category, significantly more dieters than non-dieters felt 'a bit fat' 18 (47.3%) and six (14.7%), respectively ($p=0.002$, $\chi^2 = 9.02$, $df:1$).

The mean BMI of the dieters who felt 'very thin' was higher than the non-dieters 17.3 ± 2.7 and 15.9 ± 1.1 , respectively. A similar result was also seen in those dieters and non-dieters who felt 'just right' and 'a bit fat' 21.3 ± 4.7 and 19.7 ± 3.4 , and 18.9 ± 2.1 and 16.8 ± 2.3 , respectively.

Table 3.2.3: The body image of the girls as perceived by their friends - compared to dieting status.

Perceived image	Total group No. (%)	Dieter No. (%)	Non-dieter No. (%)
Very thin	19 (13.8)	2 (4.4)	17 (18.3)
Just right	112 (81.2)	40 (88.9)	72 (77.4)
A bit fat	6 (4.3)	3 (6.7)	3 (3.2)
Very fat	1 (0.7)	-	1 (1.1)

Most of the girls were perceived to be 'just right' by their friends, 112 (81.2%)

Most, 81.2% (n112) of the girls friends thought that they were 'just right'. Only three (6.7%) of those who had dieted and three (3.2%) who had not dieted were perceived as 'a bit fat' by their friends. Only one (1.1%) non-dieter was considered to be 'very fat'

Table 3.2.4: The body weight of dieters and non-dieters - compared to their body image as perceived by their friends.

Perceived image	Dieter			Non-dieter		
	U No. (%)	N No. (%)	O No. (%)	U No. (%)	N No. (%)	O No. (%)
Very thin		1 (3.1)	1 (25.0)	5 (55.0)	8 (7.3)	
Just right	2 (100)	32 (96.9)	3 (75.0)	6 (45.0)	38 (82.7)	1 (100)
A bit fat						
Very fat						

Key; U: underweight, N: normal weight, O: overweight.

With regard to both groups (dieters and non-dieters) none of the girls were perceived as being 'a bit fat' or 'very fat' by their friends. In both groups, most girls, who were of normal weight were seen as 'just right' by their friends, 32 (96.9%) and 38 (82.7%), respectively.

The mean BMI of those being perceived as 'very thin' and 'just right' was higher amongst those who had dieted than those who had not, 19.9 ± 6.7 and 15.7 ± 1.8 and, 18.2 ± 2.4 and 17.5 ± 2.6 respectively.

Table 3.2.5: The body image of the girls as perceived by their family - compared to dieting status.

Perceived image	Total group No. (%)	Dieter No. (%)	Non-dieter No. (%)
Very thin	22 (15.9)	4 (8.9)	18 (19.4)
Just right	106 (76.8)	35 (77.8)	71 (76.3)
A bit fat	8 (5.9)	5 (11.1)	3 (3.2)
Very fat	2 (1.4)	1 (2.2)	1 (1.1)

Most, of the girls, 106 (76.8%) of the girls were thought be 'just right' by their family. Only five (11.1%) of the dieters and three non-dieters (3.2%) were considered to be 'a bit fat' by their family. Similarly, one (2.2%) who had dieted and one (1.1%) who had not dieted were thought to be very fat.

Table 3.2.6: The body weight of the dieters and non-dieters - compared to their body image as perceived by their family.

Perceived image	Dieter			Non-dieter		
	U No. (%)	N No. (%)	O No. (%)	U No. (%)	N No. (%)	O No. (%)
Very thin		3 (9.0)		2 (18.0)	12 (26.0)	
Just right	2 (100)	26 (78.7)	4 (100)	9 (82.0)	33 (71.7)	1 (100)
A bit fat		3 (9.0)			1 (2.3)	
Very fat		1 (3.3)				

Key; U: underweight, N: normal weight, O: overweight.

Amongst dieters and non-dieters, most girls were perceived as being 'just right' by their family and were within normal weight limits, 26 (78.7%) dieters and 33 (71.7%)

non-dieter's. The mean BMI of those who were perceived as 'very thin' and 'just right' was higher amongst the dieters than non-dieters, 17.3 ± 0.8 and 15.9 ± 2.6 and 18.5 ± 2.8 and 17.4 ± 2.7 , respectively. However, the mean BMI of those perceived as being 'a bit fat' was higher in the non-dieters than the dieters 21.0 ± 2.7 and 17.8 ± 1.2 , respectively.

Emotional experiences regarding appearance

Table 3.2.7: The number of girls who have felt upset about their appearance - compared to dieting status.

Upset	Total group No. (%)	Dieter No. (%)	Non - dieter No. (%)
Yes	67 (48.2)	30 (63.8)	37 (40.2)
No	72 (51.8)	17 (36.2)	55 (59.8)

Of the total group, 67 (48.2%) had experienced upset about their appearance.

Significantly more of the dieters than non-dieters had experienced feeling upset about their appearance, 30 (63.8%) and 37 (40.2%), respectively ($p=0.01, \chi^2 = 6.03, df:1$).

Table 3.2.8: The body weight of the dieters and non-dieters - compared with the number of girls who have felt upset about their appearance.

Upset	Dieter			Non-dieter		
	U No. (%)	N No. (%)	O No. (%)	U No. (%)	N No. (%)	O No. (%)
Yes	1 (50.0)	20 (60.6)	2 (50.0)	3 (27.2)	14 (31.2)	1 (100)
No	1 (50.0)	13 (39.4)	2 (50.0)	8 (72.8)	31 (68.8)	

Key; U: underweight, N: normal weight, O: overweight.

Amongst those of normal weight from both groups, significantly more dieters than non-dieters had felt upset about their appearance, 20 (60.6%) and 14 (31.2%), respectively ($p=0.01, \chi^2 = 6.11, df:1$). The mean BMI of those feeling upset was higher amongst the

dieters than non dieters, 18.4 ± 2.6 and 17.6 ± 3.2 , respectively. The results were similar in those who had not felt upset, 18.0 ± 2.7 and 16.8 ± 2.2 , respectively.

Table 3.2.9: The number of girls who get teased about their appearance - compared to dieting status.

Teased	Total group No. (%)	Dieter No. (%)	Non -dieter No. (%)
Yes	33 (23.7)	10 (21.7)	23 (24.7)
No	106 (76.3)	36 (78.3)	70 (75.3)

Overall, 33 (23.7%) of girls had been teased about their appearance, with the percentage of dieters and non-dieters who had been teased about their appearance being similar, 10 (21.7%) and 23 (24.7%), respectively.

Table 3.2.10 The body weight of the dieters and non-dieters - compared with the number of girls who get teased about their appearance.

Teased	Dieter			Non-dieter		
	U No. (%)	N No. (%)	O No. (%)	U No. (%)	N No. (%)	O No. (%)
Yes		8 (24.3)		3 (27.2)	9 (18.7)	
No	2 (100)	25 (75.7)	3 (100)	8 (72.8)	37 (81.2)	1 (100)

Key; U: underweight, N: normal weight, O: overweight.

Very few dieters or non-dieters had been teased and none were overweight. Amongst those of normal weight, eight (24.3%) dieters and nine (18.75) non-dieters had been teased. The mean BMI of those who had been teased was slightly higher in the dieters than non-dieters, 17.4 ± 2.2 and 16.0 ± 2.1 , respectively.

Breakfast consumption

Table 3.2.11: Frequency of breakfast consumption by the girls - compared to dieting status.

Consumption Frequency	Total group No. (%)	Dieter No. (%)	Non - dieter No. (%)
Everyday	84 (60.0)	23 (49.0)	61 (65.6)
Every other day	20 (14.3)	9 (19.1)	11 (11.8)
Twice/week	7 (5.0)	5 (10.6)	2 (2.2)
Once/week	10 (7.1)	3 (6.4)	7 (7.5)
Never	19 (13.6)	7 (14.9)	12 (12.9)

Most girls ate breakfast everyday, 84 (60.0%). Breakfast was eaten on a daily basis by non-dieters more than dieters, 61 (65.6%) and 23 (49.0%), respectively. The number of girls who never ate breakfast was similar between the dieters and the non-dieters, seven (14.9%) and 12 (12.0%), respectively.

Table 3.2.12: The body weight of the dieters and non-dieters - compared with their frequency of breakfast consumption.

Consumption frequency	Dieter			Non-dieter		
	U No. (%)	N No. (%)	O No. (%)	U No. (%)	N No. (%)	O No. (%)
Everyday		17 (51.5)	2 (50.0)	11 (100)	31 (67.4)	
Every other day	2 (100)	4 (12.1)			5 (11.0)	
Twice/week		5 (15.1)			2 (4.3)	
Once/week		2 (6.2)			2 (4.3)	
Never		5 (15.1)	2 (50.0)		6 (13.0)	1 (100)

Key; U: underweight, N: normal weight, O: overweight.

A similar percentage of dieters and non-dieters, of normal weight, ate breakfast every day 17 (51.5%) and 31 (67.4%), respectively. Amongst those of normal weight a similar number of dieters and non-dieters skipped breakfast everyday, five (15.1%) and six (13.0%) girls respectively.

The mean BMI of the dieters who never ate breakfast was 19.1 ± 3.5 , higher than that of the non-dieter's, which was 18.7 ± 3.7 . The mean BMI of those dieters who missed breakfast occasionally was 18.7 ± 1.5 , higher than that of the non-dieters, which was 17.8 ± 0.9 .

Consumption of morning snacks

Number of girls who eat on the way to school in a morning

Table 3.2.13 The number of girls who eat on the way to school - compared to dieting status.

Eat	Total group No. (%)	Dieter No. (%)	Non-dieter No. (%)
Yes	9 (6.4)	3 (6.4)	6 (6.5)
No	84 (60.0)	30 (63.8)	54 (58.1)
Sometimes	47 (33.6)	14 (29.8)	33 (35.5)

Most girls did not eat on the way to school (60.0%) . Of those who had dieted 6.4%, did eat on the way to school and 29.8%, sometimes eat on the way to school. Regarding those who never eat breakfast, three (15.8%) of these girls eat on the way to school and four (21.1%) sometimes eat on the way to school.

Table 3.2.14: The body weight of the dieters and non-dieters - compared to the number of girls who eat on the way to school.

Eat	Dieter			Non-dieter		
	U No. (%)	N No. (%)	O No. (%)	U No. (%)	N No. (%)	O No. (%)
Yes		2 (6.4)	1 (25.0)	2 (18.3)	4 (8.8)	
No	2 (100)	20 (60.6)	2 (50.0)	6 (54.5)	27 (58.6)	1 (100)
Sometimes		11 (33.3)	1 (25.0)	3 (27.2)	15 (32.6)	

Key; U: underweight, N: normal weight, O: overweight.

A similar number of dieters and non-dieters of normal weight either eat on the way to school, two (6.4%) and four (8.8%) respectively, or sometimes eat on the way to school, 11(33.3%) and 15 (32.6%), respectively.

The mean BMI of the dieters who eat on the way to school was 20.1 ± 4.7 , higher than that of the non-dieters, which was 16.0 ± 2.6 . The mean BMI of those who sometimes eat on the way to school was only slightly higher amongst the dieters than non-dieters, with 17.6 ± 2.2 and 16.9 ± 2.3 .

Consumption of a mid-morning snack

Table 3.2.15: The number of girls who eat a mid-morning snack - compared to dieting status.

Eat	Total group No. (%)	Dieter No. (%)	Non-dieter No. (%)
Yes	42 (30.4)	9 (19.6)	33 (35.9)
No	45 (32.6)	18 (39.1)	27 (29.3)
Sometimes	51 (37.0)	19 (41.3)	32 (33.7)

The overall number of those having a snack and those not, was very similar, 42 (30.4%) and 45 (32.6%) girls. Of those who had dieted nine (19.6%) eat a morning snack and 19

(41.3%) sometimes eat a snack. Of the 19 girls who never ate breakfast (dieters or non dieters) eight (42.2%) of them did have a mid morning snack.

Table 3.2.16: The body weight of the dieters and non-dieters - compared to the number of girls who eat a mid morning snack.

Eat	Dieter			Non-dieter		
	U No. (%)	N No. (%)	O No. (%)	U No. (%)	N No. (%)	O No. (%)
Yes		6 (18.1)	1 (25.0)	5 (50.0)	18 (40.0)	
No	1 (100)	11 (33.3)	3 (75.5)	1 (10.0)	10 (20.0)	
Sometimes		16 (48.6)		4 (40.0)	18 (40.0)	1 (100)

Key; U: underweight, N: normal weight, O: overweight.

Amongst those of normal weight less dieters than non-dieters eat a mid morning snack, six (18.1%) and 18 (40.0%), respectively, thought similar numbers sometimes eat a snack, 16 (48.6%) and 18 (40.0%) respectively.

Perception of own diet with regard to health

Fewer girls who had dieted, 38 (39.2%) said that they eat a healthy diet compared to 59 (60.8%) of those who had not ($p < 0.05$). However, out of the 38 girls who claimed that they eat a healthy diet, 18 (47.4%) either never eat breakfast or missed it on occasions.

Where food snacks were concerned 21 (25.0%) eat confectionery and crisps and 50 (59.5%) eat a combination of crisps, confectionery, fruit, toast/sandwiches and ice cream.

Amongst the dieters, 15 (35.7%) only eat confectionery and crisps for their snack, however, slightly more dieters than non-dieters eat confectionery and crisps for their snacks, 15 (35.7%) and 21 (25.6%), respectively.

Table 3.2.17: The body weight of dieters and non-dieters - compared with how the girls perceive their own diet with regard to health.

Eat healthy diet	Dieter			Non-dieter		
	U No. (%)	N No. (%)	O No. (%)	U No. (%)	N No. (%)	O No. (%)
Yes	2 (100)	28 (87.5)	3 (75.0)	8 (72.2)	33 (71.7)	
No		4 (12.5)	1 (25.0)	3 (27.3)	13 (28.3)	1 (100)

Key; U: underweight, N: normal weight, O: overweight.

A higher percentage of dieters than non-dieters of normal weight felt they eat healthily 28 (87.5%) and 33 (71.7%), respectively.

A greater number of non-dieters who were underweight felt they eat healthily compared to dieters, eight (72.2%) and two (100%), respectively.

The mean BMI of the dieters who felt they eat healthily was 18.1 ± 2.5 , higher than the non-dieters, which was 17.0 ± 2.3 . The results were similar in those who felt they didn't eat healthily, 18.7 ± 3.7 and 17.3 ± 3.2 , respectively.

Perception of dieting

Table 3.2.18: Definition of dieting - a comparison of dieters and non-dieters.

Definition	Total group No. (%)	Dieter No. (%)	Non-dieters No. (%)
Eating healthy food (fruit/veg/salad)	32 (23.7)	8 (17.8)	24 (26.7)
Not eating fat	10 (7.4)	3 (6.7)	7 (7.7)
Eating less/cutting down (calories/fat sugar)	35 (25.9)	15 (33.3)	20 (22.2)
To lose weight	4 (3.0)		4 (4.4)
Eating certain foods to lose weight	3 (2.2)	1 (2.2)	2 (2.2)
Dieting regularly/keeping to a plan/controlling intake	5 (3.7)	2 (4.4)	3 (3.3)
Exercising/no dairy products	1 (0.7)		1 (1.1)
To eat healthy food/exercise	5 (3.7)	3 (6.7)	2 (2.2)
Reduce fat intake/exercise	1 (0.7)		1 (1.1)
Eat hardly anything/don't eat	5 (3.7)	4 (8.9)	1 (1.1)
Eating the right kind/amount of food to be healthy	1 (0.7)		1 (1.1)
Eating healthy/cutting down fat	12 (8.9)	5 (11.1)	7 (7.7)
Eating healthy/losing weight	20 (14.3)	4 (8.9)	16 (17.7)
Following a special food plan to improve your shape	1 (0.7)		1 (1.1)

The most popular definition of dieting amongst the dieters (33.3%) was 'eating less/cutting down (calories/fat/sugar) and amongst the non-dieters (26.7%) was 'eating healthy food (fruit/veg/salad)'. Some non-dieters related dieting to other healthy dietary behaviour: 'to eat healthy food/exercise' - two (2.2%) girls, 'eat the right kind/amount of food to be healthy - one (1.1%) girl, 'eating healthy/cutting down fat - seven (7.7%) girls and 'eating healthy/losing weight' - 16 (17.7%) girls, as did the dieters: 'to eat healthy food/exercise' - three (6.7%) girls, 'eating healthy/cutting down fat' - five (11.1%) and 'eating healthy/losing weight' with four (8.9%) girls. More non dieters perceived dieting as a healthful behaviour than the dieters, 50 (55.5%) and 20 (44.4%), respectively.

Table 3.2.19: The body weight of the girls - compared to their definition of dieting

Definition	Dieter			Non-dieter		
	U No. (%)	N No. (%)	O No. (%)	U No. (%)	N No. (%)	O No. (%)
Eating healthy food (fruit/veg/salad)	1 (50.0)	6 (18.5)	1 (25.5)	1 (10.0)	14 (31.3)	
Not eating fat		3 (9.0)			5 (11.1)	
Eating less/cutting down to lose weight (calories/fat/sugar)	1 (50.0)	10 (30.5)		3 (30.0)	11 (24.4)	
Eating certain foods to lose weight		1 (3.3)			1 (2.2)	
Dieting regularly/keeping to a plan/controlling intake		2 (6.0)		2 (20.0)		
Exercising/no dairy products						
To eat healthy food/exercise		1 (3.0)			2 (4.4)	
Reduce fat intake/exercise						
Eat hardly anything/don't eat		3 (9.0)	1 (25.0)		1 (2.2)	
Eating the right kind/amount of food to be healthy		1 (3.0)				
Eating healthy/cutting down fat		3 (9.0)	1 (25.0)		3 (6.6)	1 (100)
Eating healthy/losing weight		3 (9.0)	1 (25.0)	3 (30.0)	8 (18.0)	
Following a special food plan to improve your shape				1 (10.0)		

Key; U: underweight, N: normal weight, O: overweight.

The most popular definition, 'eating less/cutting down' was given by a similar number of dieters and non-dieters of normal weight, 10 (30.5%) and 11 (24.4%), respectively. The second most popular definition, 'eating healthy food' was more popular amongst non-dieters of normal weight than dieters, 14 (31.1%) and six (18.5%), respectively.

The mean BMI of those who thought dieting meant 'eating less/cutting down' was slightly higher in the dieters than non-dieters, 17.4 ± 2.2 and 16.8 ± 2.4 , respectively. Similar

results were seen in those who thought it meant 'eating healthy food' with the mean BMI of the dieter's being 18.5 ± 2.8 and in the non-dieter's 17.6 ± 2.1 , respectively.

Perception of healthy eating

Table 3.2.20: Definitions of healthy eating - a comparison of dieters and non-dieters.

Definition	Total group No. (%)	Dieters No. (%)	Non-dieter No. (%)
Increasing fruit/veg/salads	43 (31.6)	13 (29.8)	31 (34.0)
Eating no fat	3 (2.2)	1 (2.2)	2 (2.2)
Eating less sugar/fat	7 (5.1)	1 (2.2)	6 (6.7)
Controlling your diet/watching what you eat	3 (2.2)	1 (2.2)	2 (2.2)
Eating healthy food to stay fit	3 (2.2)		3 (3.2)
Eating a modified diet/eating in moderation	3 (2.2)		3 (3.2)
To eat the right food	7 (5.1)	2 (4.4)	5 (5.5)
Eating fruit/veg and foods such as meat/pasta/brown bread/fish/milk/eggs	11 (8.1)	5 (11.0)	6 (6.7)
Eating healthy food/eating healthily	14 (10.3)	3 (6.6)	11 (12.1)
Same as dieting	2 (1.5)		2 (2.2)
Eating regular meals/balanced diet	18 (12.5)	7 (15.0)	10 (11.0)
Eating things that are naturally grown	1 (0.7)	1 (2.2)	
Eating healthy things sensibly - then starting the diet the next day	1 (0.7)		1 (1.1)
Low calorie/low fat food	4 (2.9)	2 (4.4)	2 (2.2)
Increasing fruit/veg, decreasing fat/sugar	16 (11.8)	9 (20.0)	7 (7.7)

Amongst both dieters and non-dieters, most felt that healthy eating meant increasing the amount of fruit/veg and salads consumed, 13 (29.8%) and 31 (34.0%), respectively. A few dieters perceived healthy eating as potentially, restrictive dietary behaviour 'eating no fat' - one (2.2%) girl, 'controlling your diet/generally watching what you eat' - one (2.2%) girl, and eating 'low calorie/low fat foods' with one (4.4%) girls. However, more non-dieters perceived healthy eating in such a light.

Table 3.2.21: The body weight of the dieters and non-dieters - compared to their definition of healthy eating.

Definition	Dieters			Non-dieters		
	U No. (%)	N No. (%)	O No. (%)	U No. (%)	N No. (%)	O No. (%)
Increasing fruit/veg/salads		10 (26.5)	1 (20.0)	5 (71.6)	19 (44.2)	1 (100)
Eating no fat		1 (2.6)				
Eating less sugar/fat		3 (7.8)				
Controlling your diet/watching what you eat		1 (2.6)			1 (2.3)	
Eating healthy food to stay fit	1 (20.0)	2 (5.2)				
Eating a modified diet/eating in moderation	1 (20.0)					
To eat the right food			1 (20.0)	1 (14.2)	1 (2.3)	
Eating fruit/veg and foods such as meat/pasta/brown bread/fish/milk/eggs	1 (20.0)	3 (7.8)	1 (20.0)	1 (14.2)	4 (9.3)	
Eating healthy food/eating healthily		3 (7.8)	1 (20.0)		4 (9.3)	
Same as dieting	1 (20.0)					
Eating regular meals/balanced diet	1 (20.0)	5 (13.3)			6 (14.0)	
Eating things that are naturally grown		1 (2.6)				
Eating healthy things sensibly - then starting the diet the next day		1 (2.6)				
Low calorie/low fat food		1 (2.6)	1 (20.0)		1 (2.3)	
Increasing fruit/veg, decreasing fat/sugar		7 (18.6)			7 (16.3)	

Key; U: underweight, N: normal weight, O: overweight.

The most popular definition, 'increasing fruit/veg/salad' was more popular amongst those non-dieters of normal weight than the dieters, 19 (44.2%) and 10 (26.5%), respectively.

The mean BMI of the dieters and non dieters giving this definition was 18.9 ± 2.6 and 17.4 ± 2.6 , respectively. The BMI of the girl who thought it meant 'the same as dieting' was 14.0.

Perception of dietary fat

Table 3.2.22: The perception of dietary fat - compared to dieting status.

Perception of fat	Total group No (%)	Dieter No. (%)	Non-dieter No. (%)
All types are good	3 (2.1)	1 (2.2)	2 (2.2)
Some are good	122 (87.8)	42 (91.3)	80 (86.0)
All are bad	14 (10.1)	3 (6.5)	11 (11.8)

Overall, most girls, 122 (87.8%) felt that some types of fat are good for you. More non-dieters than dieters felt that all types of fat are bad, 11 (11.8%) and three (6.5%), respectively.

Table 3.2.23: The body weight of the dieters and non-dieters - compared to their perception of dietary fat.

Perception of fat	Dieter			Non-dieter		
	U No. (%)	N No. (%)	O No. (%)	U No. (%)	N No. (%)	O No. (%)
All types are good		1 (3.0)		1 (9.1)	1 (5.4)	
Some are good	2 (100)	31 (94.0)	3 (75.0)	9 (81.8)	41 (89.2)	1 (100)
All are bad		1 (3.0)	1 (25.0)	1 (9.1)	4 (5.4)	

Key; U: underweight, N: normal weight, O: overweight.

A similar percentage of dieters and non-dieters of normal weight believe some 'fats are good,' 31 (94.0%) and 41(89.2%), respectively. Similarly, one (3.0%) dieter and four (5.4%) non-dieters believe all fats are bad.

The mean BMI of those who felt 'all fats are bad' was higher in the non-dieters than dieter's 21.8 ± 4.1 and 16.4 ± 2.1 . In those that thought 'all fats are bad' the mean BMI was lower in the dieters than non-dieters, 15.4 ± 2.6 and 16.8 ± 5.1 , respectively.

Perception of dairy products as a fattening food

Table 3.3.24: Perception of dairy products as fattening foods - compared with dieting status.

Food type	Total group		Dieter		Non-dieter	
	fattening No. (%)	Non-fattening No. (%)	Fattening No. (%)	Non-fattening No. (%)	Fattening No. (%)	Non-fattening No. (%)
Eggs	47 (18.1)	113 (81.9)	12 (26.1)	34 (73.9)	13 (14.1)	79 (85.9)
Milk	21 (15.2)	117 (84.8)	11 (23.9)	35 (76.1)	10 (10.9)	82 (89.1)
Butter	104 (75.4)	34 (24.6)	34 (73.9)	12 (26.1)	70 (76.1)	22 (23.9)
Margarine	59 (42.8)	79 (57.2)	13 (28.3)	33 (71.7)	46 (50.0)	46 (50.0)
Cheese	67 (48.6)	71 (51.4)	29 (63.0)	17 (37.0)	38 (41.3)	54 (58.7)
Cream	90 (65.2)	48 (34.8)	32 (69.6)	14 (30.4)	58 (63.0)	34 (37.0)
Yoghurt	17 (12.3)	121 (87.7)	9 (19.6)	37 (80.4)	8 (8.7)	84 (91.3)

Table 3.2.24 shows which dairy products are considered as fattening or non-fattening by the girls who had dieted and not dieted.

Significantly more girls, thought that eggs, milk and yoghurt (113 (81.9%), 117 (84.8), 121 (87.7%), respectively) non-fattening compared to 47 (18.1%), 21 (15.2%), 17 (12.3%), respectively, who did think they were fattening ($p < 0.05$).

Where butter was concerned, 34 (24.6%) thought it was not fattening compared to 104 (75.4%) who thought it was, $p = < 0.05$. However, regarding margarine and cheese, 59

(42.8%) and 67 (48.6%), respectively, thought them fattening, similar to those who did not think them fattening, 59 (57.2%) and 71 (51.4%), respectively. Less thought yoghurt to be fattening, 17 (12.3%) than did think it fattening, 121 (87.7%) $p < 0.05$. Regarding cream, 48 (34.8%) thought it not fattening as opposed to 90 (65.2%) who did think it fattening ($p = 0.0004$, $\chi^2 = 12.7826$, $df:1$). Significantly more thought that butter was fattening compared to margarine, 104 (75.4%) and 59 (42.8%) ($p < 0.05$). More non-dieters than dieters thought that margarine was fattening, 46 (50.0%) and 13 (28.3%), respectively ($p = 0.02$, $\chi^2 = 5.07$, $df:1$). More dieters than non-dieters thought cheese was fattening, 29 (63.0%) and 38 (41.3%), respectively ($p = 0.02$, $\chi^2 = 4.96$, $df:1$).

Table 3.2.25: Body weight of dieters and non-dieters - compared to whether the girls perceive dairy products as fattening foods.

Ft	Dieter						Non-dieter					
	Under-weight		Normal-weight		Over-weight		Under-weight		Normal-weight		Over-weight	
Ft	F No. (%)	NF No. (%)	F No. (%)	NF No. (%)	F No. (%)	NF No. (%)	F No. (%)	NF No. (%)	F No. (%)	NF No. (%)	F No. (%)	NF No. (%)
E	1 (50)	1 (50)	7 (21.8)	25 (78.2)	1 (25)	3 (75)	2 (18)	9 (82)	7 (15.6)	38 (84.4)		1 (100)
M		2 (100)	9 (28.1)	23 (71.9)		4 (100)	1 (9)	10 (91)	4 (9)	41 (91)	1 (100)	
B	1 (50)	1 (50)	24 (75)	8 (80)	3 (75)	1 (25)	8 (72.7)	3 (27.3)	38 (80.9)	7 (19.1)	1 (100)	
M	2 (100)		9 (28)	23 (72)		4 (100)	4 (36.3)	7 (63.7)	23 (51.1)	22 (49.9)		1 (100)
C	2 (100)		17 (53.1)	15 (46.9)	4 (100)		6 (54.5)	5 (45.5)	20 (44.1)	25 (55.9)	1 (100)	
Cr	2 (100)		21 (65.6)	11 (43.3)	2 (50)	2 (50)	5 (45.5)	6 (54.5)	36 (80)	9 (20)	1 (100)	
Y		2 (100)	7 (21.8)	25 (78.2)	1 (25)	3 (75)		11 (100)	5 (11.2)	40 (88.8)		1 (100)

Key: Ft: type of food, E: eggs, M: milk, B: butter, M: margarine, C: cheese, Cr: cream, Y: yoghurt

More non-dieters of normal weight thought that butter was fattening compared to dieter's, 38 (80.9%) and 24 (75.0%), respectively. More non-dieters of normal weight thought margarine was more fattening compared to the dieters, 23, (51.1%) and nine (28.0%), respectively.

The mean BMI of those who thought butter was fattening was higher in the dieters than non-dieters, 18.2 ± 2.2 and 17.3 ± 2.6 , respectively. The mean BMI who thought margarine was fattening was lower in the dieters than non-dieters, 16.0 ± 1.7 and 17.1 ± 2.3 , respectively.

3.2.2

Discussion

The first study identified a theme which raised questions regarding the actual incidence of dieting behaviour amongst adolescent girls. In order to investigate this issue further, the incidence of dieting was again determined using two differently structured questions. Previous research has shown that because of variations in the wording of questions, wide discrepancies are evident between studies which address the incidence of dieting. It has been found that discrepancies occur when time periods for the behaviour are specified, such as, are you presently dieting? versus, have you ever dieted? (French and Jeffery, 1994).

The results of this follow-up study regarding the dieting practices of adolescent girls, showed that amongst the sample of 12 year old girls who were asked 'have you ever dieted?' the incidence of dieting was found to be 33.6%, which is consistent with the result of 35.3% obtained from the first study in which the same question was used. In the follow-up study the girls were also asked 'are you presently dieting'? The result in that case was 15.8%, which shows the incidence to be much lower. These results show that it is important to be consistent with regard to the wording of questions when repeat studies are undertaken. It may also be suggested that it is important to take into account the wording of the question which determines the incidence of dieting when relating the results to the population at large.

The results of this study are therefore discussed in terms of 'have you ever dieted'? in order to remain consistent with the first study. It may be suggested that this question gives a more accurate reflection of dieting behaviour amongst adolescent girls as it shows that they have engaged in such behaviour at some time. By asking 'are you presently dieting'? does not give an overall picture, it may be that they were dieting up until a week previously, and thus it is not recorded. The results of this study show the importance of identifying 'past' dieting behaviour, but then as was undertaken in the first study, further questioning regarding the frequency and length of their reducing diets, which may indicate

an intention to diet in the future should be carried out. It is important to identify past and present dietary behaviour as both may influence the future health of a person.

Out of the 33.6% of girls who had dieted to lose weight, most (84.6%) were within normal weight limits. Again this is similar to results from the first study, where there were (80.0%) within normal weight limits. The results from this study confirm that body image is of concern, to many adolescent girls, regardless of their weight. The results support those provided by previous work (Fox, 1991) and illustrate the immense pressure that is put upon the female population to conform with the ideals of today's society. Rodin et al (1994) suggest that obesity is a punishable offence, especially for women, the consequences of which may be life destroying. However, it would appear that not only are the lives of the obese affected but also those of normal weight, who are frightened of committing such a crime.

This concern over body image is further highlighted by the girls perception of their own body image. Dissatisfaction was more apparent amongst the dieters than non-dieters, with significantly more dieters (52.2%) than non-dieters (18.3%) feeling 'a bit fat'. This dissatisfaction with body image was evident in those girls who were of normal weight, with significantly more dieters than non-dieters feeling 'a bit fat,' 18 and six girls, respectively. Of concern was the fact that of those dieters of normal weight, 14 felt 'just right' and five felt 'very thin'. Despite these girls not having a weight problem they still felt the need to diet. These results show that despite most girls being of normal weight for their age, many don't feel that they meet the culturally accepted trends and ideals (Michaud & Terry, 1993). The importance of 'thinness' was evident amongst the non-dieters, with 10 girls who were underweight feeling 'just right'. This would maybe indicate the importance placed upon thinness by young girls and that they have to meet this image before they feel that their looks reflect the 'thin ideal of today' (Brownell, 1991).

It has been suggested that peer pressure is factor which influences girls to diet (Lau et al, 1990). However, the results of this study indicate that there was no significant, direct pressure from the friends of the girls to encourage them to try and change their image. Of the total sample 81.2% were considered to be 'just right' by their friends. No girls in any

weight category were considered to be 'a bit fat' or 'very fat' by their friends, whereas with regard to the girls own perceptions, of those of normal weight, 47.3% considered themselves to be 'a bit fat'. Amongst the total number of girls, dieters and non-dieters, who perceived themselves as being 'a bit fat' or 'very fat' was greater than the numbers perceived by their friends. Where the perceptions held by their families were concerned, the picture was similar to those perceptions of the girl's friends. Overall, most girls were perceived to be 'just right' by their families, (76.8%). Amongst the dieters of normal weight, only 4 girls were considered to be 'a bit fat' or 'very fat'.

Results from the first study suggested that many girls of normal weight may perceive themselves as being larger than they actually are. This is supported by the findings in this follow-up study, in that although other people i.e. friends and family perceive the body image of the girls as being perfectly normal, the girls themselves do not.

The findings of this study suggest that although dissatisfaction with body image is evident to some extent amongst both dieters and non-dieters, it does not automatically influence a girls decision to diet. Crockett & Simms (1995) propose that a key element in eating behaviour is cognitive knowledge. Dieters and non-dieters may be separated by different thought processes and that some girls may be more vulnerable to external pressure than others, thus influencing the way in which they perceive their body image and making a conscious decision to diet.

Although these results would suggest that on the whole, friends and families are not critical of the body image of the girls, either of those who diet and those non-dieters, and do not give opinions which would encourage change it may be a case of 'actions speak louder than words'. Links have been reported between dieting mothers and dieting daughters (Hill et al, 1990) and results from the first study found that some girls obtained their reducing diet from their mother. It may be the case that although mothers aren't verbally encouraging, and are not critical of their daughters body image, the fact that they engage in dieting behaviour themselves, or talk about the subject, may be enough to influence their daughters decision to diet. This may cause concern, especially if a girl

follows the same reducing diet as an adult, which may not fulfil the nutritional needs of an adolescent girl.

Further evidence of how some girls may be more vulnerable than others may be seen from the results regarding their emotional experiences regarding appearance. The overall number who had felt upset regarding their appearance was similar to those who had not, although significantly more dieters than non-dieters said they had felt upset, 63.8% and 40.2%, respectively. Amongst those of normal weight, significantly more dieters than non-dieters had experienced upset, 60.6% and 31.2%, respectively. This would suggest that although the girls were not particularly sensitive about their actual weight, certain girls, regardless of weight are more vulnerable and open to suggestion than others, regarding appearance and body image. Although 48.2% of the overall sample had felt upset about their appearance, less had actually been teased about it, 23.7%. In fact a similar number of dieters and non-dieters had been teased, which would suggest that being teased may not be a direct reason influencing the decision to diet, but the way in which a girl reacts towards it is.

The results regarding body image and emotional experiences would suggest that family and friends do not have a direct influence on a girl's decision to diet, however, their own dieting behaviour may affect a girl's decision to diet. Wertheim et al (1997) reported that although girls did not exert direct pressure on each other they did influence each other in other ways and could be quite competitive with each other. In addition to the influence of family and friends, are strong messages from the media (Michaud & Terry, 1993) The media is a major factor in the social environment of an individual, and may have a great influence on behaviour (Lewis et al, 1989). Work by Thomson et al (1988) actually found that adolescents are more likely to receive nutritional advice from the media than from health professionals. It would appear that dieters and non-dieters are just as likely to experience the same pressures, feelings and emotions that may influence dieting behaviour, however, it may be suggested that the decision to actually diet may depend on the way in which some girls interpret cultural messages and apply them to their own situation.

In order to shed further light on the actual incidence of dieting it is important to ascertain if the desire to lose weight and the way in which girls interpret information corresponds with them actually restricting their nutritional intake. Skipping meals is a popular dietary practice, especially amongst dieters (French et al, 1995, Serdula et al, 1993). Indeed, 43.0% of the dieters from the first study had engaged in such behaviour in order to aid weight loss. However, Perry-Hunnicutt & Newman (1993) report that it is common behaviour amongst non-dieters as well as dieters. The findings of this study report that of the overall sample only 60.0% ate breakfast everyday. Of the dieters, 49.0% ate breakfast everyday and 65.9% of the non dieters. Similar numbers of dieters and non dieters never ate breakfast, however, more dieters ate breakfast less frequently than non dieters. These results suggest that non dieters are just as likely to skip meals as dieters, although in some cases it may not be as frequent, however they are making a conscious decision to restrict their dietary intake. It was suggested that dieters and non dieters possess different 'thought processes' which determine the decision to, or not to, consciously diet to lose weight, however, it may be that although non dieters don't make a conscious decision to lose weight they may view food restriction as a way of avoiding weight increase and 'staying healthy'. Both groups are restricting their intake by various degrees, however, to what degree, may depend on the way in which girls interpret the reasons for avoiding obesity i.e. for cosmetic or health reasons. Maybe dieters are more likely to be influenced by media images, whereas, non dieters may be influenced by health messages, but because of a lack of nutritional understanding, both are open to the same health risks as a result of restricted nutritional intake.

However, not all of the 19 girls who skipped breakfast, actually went without food throughout the whole morning, eight girls ate a snack during the morning and three said they ate on the way to school. Not only is adequate nutrition of physiological importance but it is suggested that eating breakfast and eating at regular intervals may improve academic performance (Smith et al, 1994, Vaisman et al, 1996). The results of this study would suggest that not only are some girls (dieters and non dieters) putting their health at risk but they may also be affecting their academic performance and achievement, thus damaging future career plans.

Results from the first study indicated that there appeared to be confusion about the meaning of dieting and many girls perceived it in terms of healthful behaviour. Research by Neumark-Sztainer & Story (1998) reached similar conclusions. Descriptions of dieting given in their study included “eating healthier food,” “not eating any junk food,” “eating balanced nutrition,” “eating more fruit, veg and salads” and “eating less fat”. The findings of this study found that the most popular definition, amongst the dieters was “eating less, cutting down” (calories, fat, sugar) and amongst the non dieters it was “eating healthy food” (fruit, veg, salad), however, this was also the second most popular response given by the dieters. The results found that both groups associated dieting with other ‘healthful behaviours’ such as “to eat healthy food/exercise,” ‘eat the right kind/amount of food to be healthy,’ ‘eating healthy/cutting down fat’ ‘eating healthy/losing weight’. More non-dieters than dieters perceived dieting as a healthful behaviour, 55.5% and 44.4%, respectively, however the results suggest that roughly half of both groups are just as likely to perceive dieting in a healthy light as opposed to being a restrictive and controlled behaviour. Some girls did give definitions which may give cause for concern, such as “not eating fat,” and “eat hardly anything/don’t eat”. Less dieters felt that they ate healthily compared to non dieters, some of these girls may have been those who saw dieting in a more restrictive light. However, it may have been because of restricting their food intake they became hungry, thus, snacking on junk food. Of those who had dieted 35.7% ate crisps and confectionery as snacks, more than those who claimed not to diet, 25.6%.

Many studies, including the first study, have found the incidence of dieting to be quite disturbing (Button et al, 1996, Wardle & Marsland, 1990), however, no previous work has actually asked these girls how they perceive actual dieting behaviour in nutritional terms. This study shows that a small percentage of girls do identify dieting with restrictive behaviour which may be a health risk, in that their nutritional intake could be totally inappropriate to their needs. However, as a result of these findings it may be suggested that although many girls claim to be ‘dieting,’ their actual dietary intake may not be as restrictive as their so called dieting behaviour would suggest.

Further evidence that would suggest that there may be little difference in the intakes of the majority of dieters and non dieters is that the results of this study found that 'healthy eating' is perceived in a similar light to dieting. The most popular definition of 'healthy eating' by dieters and non dieters was "increasing fruit/veg/salads," which is similar to how many girls perceived 'dieting' i.e. eating healthy food (fruit/veg/salads). However, of concern is that some girls perceived healthy eating in a dietary restrictive light, such as 'eating no fat,' 'controlling your diet/watching what you eat,' 'eating a modified diet/eating in moderation' and 'eating low calorie/low fat food,' a finding which was more evident amongst the non dieters. Indeed, two of the non dieters suggested that healthy eating meant the 'same as dieting' and one suggested that it meant 'eating healthy things sensibly, then starting the diet the next day.

On the whole many dieters may be following dietary guidelines that do not vary much from non-dieters. Whether they see their behaviour as dieting or not may depend on how their thought process interprets information and whether they want to believe they are dieting or not. Both 'dieting' and 'healthy eating' are very fashionable terms. Which ever is chosen may depend on the lifestyle a particular girl wishes to emulate i.e. the fashion/show business world, where being 'thin is essential' or the sporty/healthy lifestyle .

These results may indicate that the actual incidence of dieting is not such a cause for concern, as is generally suggested and accepted amongst behavioural studies. However, what is of concern are the confused beliefs that healthy eating is perceived as dieting and vice versa. It may be the case that all adolescent girls are at risk from eating nutritionally inadequate diets and not just those perceived to be dieting. It may be suggested that misconceptions regarding healthy eating are potentially more health threatening than dieting behaviour. Over recent years nutritional recommendations have placed importance on reducing dietary fat (DoH, 1991, 1994). However, Horm & Anderson (1993) suggest that dietary advice, especially that given via the media is subject to distortion. A high dietary fat intake is a major cause of obesity and health problems such as cardiovascular disease and diabetes, however, it may be that the importance placed on dietary fat over recent years has seriously damaged consumer perception of the requirements of healthy

eating (Schwartz & Borra, 1997). The findings of Schwartz & Borra (1997) show that 15.0% of Americans believed it was important to eliminate all types of fat from their diet and 81.0% of children aged 9-15 years incorrectly believed that a healthful diet meant one that is devoid of all fat. These findings suggest that consumers do not understand the role that dietary fat fulfils.

Results from this study shows that 14 (10.1%) of the girls thought that all types of fat are bad for you and in fact more non dieters were of this opinion than dieters, 11 (11.8%) and 3 (6.5%) girls, respectively. Further misconceptions were demonstrated when the girls were asked about whether they saw certain dairy products as fattening foods. With regard to eggs, 47 (18.1%) girls thought they were fattening and 21 (15.2%) thought milk was fattening. The results between dieters and non dieters was similar. However, where butter and margarine were concerned, overall, significantly more thought that butter was more fattening than margarine, 104 (75.4%) and 59 (42.8%) girls, respectively. Regarding butter the results were similar between the dieters and non dieters, but more non dieters than dieters thought margarine was more fattening, as was the case with cheese. Yoghurt was also viewed as fattening by 17 (12.3%) girls, with more dieters than non dieters thinking this.

These results clearly show that confusion exists regarding the concept of healthy eating and the important role played by dietary fat. Interestingly, margarine is viewed as being less fattening than butter and of those girls who were overweight, none perceived margarine to be fattening. In adverts margarine is portrayed to be a healthy product, however, it is still fat, and eaten in sufficient amounts may increase weight. It would appear to be the case that because of the various nutritional messages from both official/educational sources and those relayed by food advertisements, wires have definitely been crossed. It may be the case that young girls and indeed adults as well are overdosed with information and interpret it in a way that suits their own beliefs. The issue of dietary fat appears to be very contentious. On the one hand there are many young girls who are unnecessarily restricting their fat intake, and alternatively some who maybe should be restricting their intake but are inadvertently eating more, because they are under

the impression that it is acceptable to freely eat margarine products but not butter. If it is the case that individuals are more receptive to information given via adverts and more able to relate to actual products than food items, perhaps some nutritional information should be related to food products in an attempt to make things more understandable for the consumer and help prevent them from being misled by advertisements.

Sanders (1994) suggests that greater recognition should be given to the positive aspects of dietary fat. Fat is an important source of energy and is especially important in providing sufficient energy density for young children. It is also necessary for the provision and absorption of fat soluble vitamins and the provision of fatty acids (Gurr, 1993). Fat soluble nutrients are poorly absorbed on a low fat diet (Sanders, 1994) which is of concern because of their role in maintaining health and preventing disease (Calzada et al, 1995). Fat soluble vitamins such as vitamin A is essential for growth and development and vitamin D plays an important role in bone health (Sanders, 1994). Because of the fat content of dairy product and the confusion about the value of dietary fat there is a danger that young girls may not having an adequate consumption of such foods.

A study by Neumark-Sztainer et al (1997) found that adolescent 'dieting' was strongly associated with low consumption of dairy products. It has been reported that the peak periods for calcium retention for girls are in the pre and early pubertal periods and that the current intake of calcium by American girls during this time may not be adequate to maintain maximum retention, which may predispose to the development of osteoporosis in later life (Sentipal et al, 1991, Abrams & Stuff, 1994, Kreipe & Forbes, 1990, Kanis & Pitt, 1992, WHO, 1994)).

The results of this study and the other evidence provided would suggest that there are many young girls who do not understand the concept of healthy eating and the importance of individual nutrients. Although a lack of education may play a part in this it may be suggested that the emphasis that is placed upon dietary fat reduction and the importance of healthy eating in the war against obesity is causing further nutritional problems. Although full fat dairy products are a major source of saturated fat and therefore not recommended

to an overweight person who needs to lose weight, they are, in moderation, an extremely important source of energy to a developing girl.

Research by Shepherd & Towler (1992a, 1992b) looking at nutrition knowledge, attitudes and fat intake, found that females had a positive attitude towards dairy products but their intentions and behaviour were negative, however this work was undertaken using a sample of adults. Because of the way in which young weight watchers interpret advice it may be that they see foods such as dairy products as fattening because of their fat content but don't accept positive/health promoting aspects. However, the potential adverse effects of advice regarding dietary fat is open to so called 'dieters' and 'non dieters' because of the way in which both groups interpret the concepts of healthy eating and adapt them to their own needs.

Limitations of the study

As with the first study the results of this study may have been influenced by certain factors which determined the methodology. A validated questionnaire was not used because the content of the questionnaire was determined by results from the first study. Also, the content of the questionnaire had to conform to the requirements of the schools concerned and the University ethic committee. All information collected was self-reported.

3.2.3

Conclusion

However, despite the limitations associated with this study, the findings demonstrate that establishing whether girls are engaging in dieting behaviour is not a clear cut issue, many factors need to be taken into account. The results show that 'dieting' means different things to different people. It is not enough to ask a girl if she is dieting, it doesn't tell you anything. All girls, dieters and non-dieters may show dissatisfaction with their body image and have a desire to lose weight but it needs to be ascertained whether any dietary/dieting

practices are being undertaken and any measures which will lead to weight loss. Dieting is a fashionable word which is interpreted in a way which suits the needs of an individual. It would appear to be the case that following a reducing diet may include a severe restriction of food intake or alternatively may mean following healthy eating guidelines, depending on the beliefs of an individual.

Great concern has always been expressed about the associated dangers of dieting amongst adolescents, and indeed children. However, It may be the case that serious dieting practices are only evident amongst a minority of girls, some of whom may have a serious eating problem. This group of girls are different to the general teenaged population, they have specific problems and require specific needs. The majority of so called 'dieting' young girls are not at risk from developing a serious eating problem. It is clearly the case that many girls perceive dieting and healthy eating in the same light, whether they be dieters or non-dieters. Evidence would suggest that the majority of young girls, dieters and non-dieters are following the same eating patterns, however, because of the way in which the two groups process information, some think they are dieting and some don't.

Many health risks have been associated with dieting, such as anaemia and osteoporosis, however, it may be the case that non-dieters are also at risk. Both groups follow practices which show dietary restraint i.e. skipping meals and also both groups deprive themselves of essential nutrients by following inappropriate low fat diets. Because many girls, again dieters and non-dieters, perceive dieting as a healthy practice and associate it with healthy eating it may be the case that healthy eating messages are posing more of a health risk than actual reducing diets. Because of the way in which some individuals interpret healthy eating messages there is a danger that other problems may be exacerbated.

It seems to be the case that the subject of adolescent dieting has been, and to a great extent still is a 'taboo' subject. It has been labelled as a very 'sensitive' subject. However, the way in which the subject has been approached may have caused more harm than good. One school of thought may be that to talk about dieting to children may influence their decision to diet, however, from the findings of this research it would appear to be the case that children are already very knowledgeable. Because the official standing has been to

'sweep it under the carpet' young girls have adopted 'bits' of information from various sources and adopted a nutritional intake that is inappropriate to their needs. The fact that adults have been reluctant to speak openly about adolescent dieting may have backfired. Young girls may feel that they can't speak freely about their eating habits, which therefore, may only add to existing problems.

It would appear to be the case that the nation has become obsessed with food, with various sources each advocating their own importance i.e. official advice, the slimming industry, the food industry and the media. However, none of these sources stress the importance of the needs of adolescent girls. All girls are at risk from inappropriate dietary advice, not just those who think they are dieting. It would appear to be the case that dieting is not the real issue anymore, it is the general nutritional intake of all girls. Whilst, official sources have been churning out healthy eating messages and advice to combat obesity, it appears that they have failed to see how their advice has been misconstrued and has led to further problems. Because of the confusion that exists, surely there is an urgent need for better provision of nutrition and home economics lessons in schools. In such an environment all avenues of nutritional advice could be disseminated and information appropriate to the needs of these girls promoted.

Much research needs to be undertaken which looks at how young girls perceive various foods in a nutritional light, and which, determines their reasons for identifying foods as healthy and unhealthy, or fattening and non-fattening. Before the nation is bombarded with another round of nutritional advice it needs to be established what people understand already and then maybe a way forward may be possible.

Section 3.3

Dieting behaviour/practices amongst young women

In today's society obesity is a highly stigmatised condition (Hill & Silver, 1995), with cultural thinking in the Western World now emphasising body thinness as being the 'ideal' and associating it with a successful lifestyle (Michaud & Terry, 1993). Women of age groups beyond the teenaged years are not immune to the pressures associated with dieting and staying attractive (Streigel-Moore et al, 1986). They are influenced by the same factors as younger girls i.e. fashion, the opposite sex, a successful lifestyle and their peers (Rodin et al, 1984, Bull, 1988).

Previous research has shown dieting to be a popular practice amongst female students. In the USA Peters et al (1996) report the incidence of dieting to be 57.0%. Amongst British University students, Bellisle et al (1995) reported that 49.4% of the sample were trying to lose weight, although only 21.4% were supposedly 'dieting' to lose weight. The mean BMI of these students was 21.0, which would suggest that the prevalence of dieting amongst non-obese young women is fairly high. In a study concerning university students, Chery et al (1989) found that the prevalence of misconceptions regarding nutritional knowledge was high even amongst students with extensive education in nutrition. This finding, along with the reported incidence of dieting is of concern when it is considered that students may be a medium for passing on nutritional knowledge.

Although other previous studies have reported the incidence of dieting in this age group before, very little attention has been given to the type of reducing diet they tend to follow and their general dieting practices. This information is important since dieting may have significant effects on the health and well-being of an individual (Brownell, 1993), also because of the influence adults have on children. It has been suggested that society's obsession with dieting and the aim to reduce the risk of coronary heart disease may be effecting the health of children (Pugliese et al, 1987). Therefore, it is necessary to

determine the extent of dieting behaviour amongst young women, and identify the most popular types of reducing diets used.

The results of the data obtained from the self-reported questionnaires completed by the young women are described in the following section, with reference to the BMI of the sample

3.3.1

Results

There were 128 respondents, aged 18-24 years, the mean age being 20.6 ± 1.6 years (range:18-24 years).

Most, 78 (60.9%) of the young women lived in their own flat or house, 28 (21.9%) lived with their parents and 22 (17.2%) lived in self catering university halls of residence.

BMI was calculated from the self-reported height and weight and the results were as shown in table 3.3.1. The largest proportion of these young women (35.9%) fell within the overweight category.

Table 3.3.1: BMI of students (n=126)

Number	%	BMI category	Relation to obesity status
1	(0.8)	>40	Very obese
10	(7.8)	30-39.9	Obese
46	(35.9)	25-29.9	Overweight
37	(28.9)	20-24.9	Desirable range
32	(25.0)	<20	Undesirable

Satisfaction with own body image

Half of the total sample, (50.8%) were indifferent about their own body image, however, 27.3% were satisfied and 21.9% dissatisfied. Significantly more of those who were dissatisfied with their body image, had a BMI above 25 (82.2%) than below (17.8%), $p < 0.05$.

Incidence of dieting

Just over half of the sample, 70 (54.7%) had dieted to lose weight. In comparison to the non-dieters significantly more dieters had a BMI >25, than below, (54.5%) and (45.5%), respectively, ($p=0.03$, $\chi^2 = 4.25$, $df:1$).

Table 3.3.2: Incidence of dieting - compared to BMI of the young women (n126)

Ever dieted	BMI <20	20-24.9	25-29.9	30-39.9	>40
	No %	No %	No %	No %	No %
Yes	10 (14.7)	21 (30.8)	28 (41.2)	8 (11.8)	1 (1.5)
No	22 (37.9)	16 (27.6)	18 (31.0)	2 (3.5)	-

All of those dissatisfied with their body image (28), had dieted, whereas the non-dieters were either indifferent or satisfied with their body image. This was significantly different ($p=0.0000002$, $\chi^2 = 27.4$, $df:1$).

Also, of those who had dieted, significantly more lived in their own house/flat (49) than the non-dieters, who tended to live in the parental home or in University Halls (21), ($p=0.002$, $\chi^2 = 9.42$, $df:1$).

Reason for dieting

Various reasons were given for dieting, however most, (40.0%) wanted to lose weight to improve their appearance (Table 3.3.3). More young women with a BMI over 25 wanted to lose weight to improve appearance than those with a BMI under 25, 60.7% and 39.3%, respectively.

The second most popular reason for dieting was to 'to keep fit and healthy' with 47.1% having a BMI below 25 and 42.9% above. Eleven were dieting because they felt too fat, of whom 45.5% had a BMI below 25 and 54.6% a BMI above 25.

Table 3.3.3: Reasons given for wanting to lose weight

Number	%	Reason
28	(40.0)	To improve appearance
15	(21.4)	To keep fit and healthy
11	(15.7)	Felt too fat
9	(12.9)	To improve self esteem
4	(5.7)	Help tone up
2	(2.9)	Achieve ideal weight for height
1	(1.4)	Peer pressure

Age when first started to diet

Most, 35 (50.0%) of the young women stated that they were aged between 15 and 18 years when they first started to diet, but 25 had started to diet between the ages of 10 and 14 years. The remaining 10 had only started to diet since the age of 18 years.

Of those who had started to diet by the age of 14 years, significantly more had a BMI greater than 25 than below, 28.0% and 9.0%, respectively, ($p=0.01$,

$\chi^2 = 6.12, df:1$). Most, 17 (54.8%) of those with a BMI less than 24.9 had started to diet between the ages of 15-18 years.

Type of diet used

The various types of diets that the subjects used are recorded in table 3.3.4. The most popular type was a low fat diet with 49 (70.0%) using it. The low fat diet was the most popular choice of diet amongst each BMI category. A significant difference was found between the use of a low fat diet and BMI. For those using a low fat diet a greater number had a BMI above 25 than below, 31 (63.2%) and 17 (34.6%) respectively, whereas, for those using diets other than a low fat diet, 13 (62.0%) had a BMI below 25 compared to five (23.8%) with a BMI above 25 ($p=0.01$, $\chi^2 = 5.48, df:1$).

Table 3.3.4: Most popular types of reducing diets used

Number	%	Type of reducing diet
49	(70.0)	Low fat
6	(8.5)	Healthy eating
4	(5.7)	Calorie count
2	(2.9)	Low fat/high fibre
2	(2.9)	Food combination
2	(2.9)	Generally reduce intake
2	(2.9)	Skipped meals
1	(1.4)	Meal replacements
1	(1.4)	Chemical diet
1	(1.4)	Periods of starvation

Most of the dieters, 62.3% tended to always use the same diet, however, 37.7% tried different diets. The majority of those using different diets had a BMI >25 (69.2%). The person who used periods of starvation as a diet had a BMI above 25.

Reasons given for choice of diet

Various reasons were given by the subjects for choosing their reducing diet, (table 3.3.5). The most popular reason (35.7%) being that it was well balanced and healthy.

Table 3.3.5: Reasons for choosing diet

Number	%	Reason
25	(35.8)	Well balanced and healthy
19	(27.1)	Easy to follow/convenient
7	(10.0)	Wanted quick result
6	(8.6)	Because it worked
6	(8.6)	Recommended by friend
4	(5.7)	Wanted a de-tox diet
1	(1.4)	Recommended by health professional
1	(1.4)	Influenced by history of anorexia
1	(1.4)	Because 'fat makes you fat'

Out of the 25 who chose their diet because it was well balanced and healthy 58.0% had a BMI below 25. Of those wanting a quick result five had a BMI above 25 and two a BMI below 25.

Source of diet

The students obtained their diets from various sources (table 3.3.6), however, most, 67.1% made their own up. Of those making their own diet up, slightly more had a BMI above 25 (53.3%) than below.

Table 3.3.6: Source where diets were obtained from

Number	%	Source
47	(67.1)	Made own diet up
12	(17.1)	Got it out of a book
7	(10.0)	Slimming club
2	(2.9)	From a friend/relative
1	(1.4)	Recommended by health professional
1	(1.4)	Recommended by a health club

Frequency of dieting during previous 12 months

Amongst those who had dieted during the previous 12 months, 47 (67.1%) had only dieted occasionally and 18 (25.7%) had dieted for most of the time. Only five (7.1%) dieters had not dieted during the previous 12 months.

The 10 dieters who had a BMI <20, all had dieted during the previous 12 months, 80.0% occasionally and 20.0% most of the time. Of the 21 who fell within the category of having a desirable BMI only 14.3% had never dieted during the previous 12 months. Regarding those with a BMI >25, most dieted occasionally, 21 (56.7%), and 14 (37.8%) had dieted most of the time and only two (5.4%) had not dieted within the past 12 months.

Significantly more of those, with a BMI >25, had dieted for most of the time than those with a BMI <25, 14 (22.0%) and four (6.0%), respectively, ($p=0.01$, $\chi^2 = 5.65$, $df:1$).

Average length of diet (67 respondents)

The average length of diet for most 25 (37.3%), was for 1-2 months, 17 (25.4%) had dieted for 2-4 weeks and 12 (17.9%) for up to 1 week. However some did diet for longer periods of time: 9 (13.4%) dieted for 3-4 months, two (3.0%) for 5-6 months and two (3.0%) for greater than 6 months. Those four young women who dieted for over 5 months at a time all had a BMI below 25. No differences were seen in the length of diets between subjects in different BMI groups. In all BMI groups the most popular length of time to diet was 1-2 months.

Amount weight lost during the previous 12 months

Only 40 dieters had lost weight in the previous 12 months. No overall weight loss had occurred during the previous 12 months in 21 (31.4%) of the dieters, six (9.0%) had gained weight and 1 (1.5%) didn't know the amount lost.

Table 3.3.7: Amount of weight lost by dieters

Number	%	Weight lost
15	(20.8)	1- 2 stone
12	(18.0)	4- 7 lbs
7	(10.4)	7-14 lbs
1	(1.5)	> 2 stone
5	(7.4)	1- 4 lbs

Most had lost between 1-2 stone during the previous 12 months (table 3.3.7), of these, 10 (71.4%) had a BMI >25 compared to those with a BMI <25, 4 (28.6%). Of those that gained weight, five out of the six had a BMI >25.

Most of those who lost weight, 31 (46.3%) said they regained some of their weight and 16 (23.9%) had regained it all. Only 20 (29.9%) hadn't regained their weight.

A comparison of some aspects of dieting behaviour dieting behaviour/practices amongst adolescent girls and young women aged 18-24 years.

Incidence of dieting

The incidence of dieting amongst the young women was significantly higher than amongst the girls, 54.7% and 35.3% respectively, ($p=0.00007$, $\chi^2 = 15.68$, $df:1$).

Reason for dieting

Amongst both groups appearance was the main motivation for wanting to lose weight. The most popular reason for wanting to lose weight amongst the girls was because they 'felt too fat' (42.1%), this was significantly higher than amongst the students, where only 15.7% were dieting for this reason ($p=0.0002$, $\chi^2 = 13.4$, $df:1$). The most popular reason amongst the young women was that most were dieting 'to improve appearance' (40.0%). The second most popular reason amongst the young women was 'to keep fit and healthy' (21.4%), significantly higher than amongst the girls (7.2%) ($p=0.002$, $\chi^2=9.42$, $df:1$).

Age when first started to diet

Amongst the young women the earliest reported age of starting to diet was between 10 and 14 years of age (35.7%). However, 22.4% of the girls had reported starting to diet between the ages of 8-10 years and six (3.0%) by the age of 8 years. No students recalled starting to diet before the age of ten.

Type of diet used

A 'low fat diet' was the most popular type of reducing diet amongst both groups, however, significantly more young women used it than girls, 70.0% and 42.8% respectively ($p=0.0001$, $\chi^2 = 14.35$, $df:1$). 'Healthy eating' was the second most popular diet, with significantly more girls using it (29.6%) than young women (8.5%) ($p=0.001$, $\chi^2=10.27$, $df:1$)

Reason for choice of diet

Amongst both groups, most chose their diet because they believed they were eating healthily, 35.7% of the young women and 39.0% of the girls.

Source of reducing diet

The source of reducing diet was similar for the two groups. Most from both groups made up their own reducing diets, 67.1% amongst the young women and 60.0% amongst the girls. A similar percentage from both groups also obtained their diet from a book/magazine, 17.1% amongst the young women and 17.5% amongst the girls. However, 16.0% of the girls obtained their diet from their mother whereas only 2.9% of the young women obtained their diet from a friend or relative.

Length and frequency of diet

Amongst the girls, most (33.0%) dieted for 2-4 weeks at a time, however, most of the older group, dieted for a longer period of 1-2 months. Significantly more of the young women than girls dieted for over month, 56.7% and 25.5% respectively ($p=0.000005$, $\chi^2 = 20.63$, $df:1$). Most of the young women (92.8%) had dieted during the previous 12 months, however, only 53.7% of the girls had dieted during that time. Most of the girls (30.3%) that had dieted during the previous 12 months had dieted up to two times and 67.1% of the young women had dieted occasionally. Significantly more young women than girls dieted for most of the time, 25.7% and 6.0%, respectively ($p=0.009$, $\chi^2 = 6.67$, $df:1$).

Weight loss during previous diet

The percentage of girls who had lost weight during their previous diet was 75.1% similar to the percentage (68.6%) of young women who had lost weight during the previous 12 months. Most of the young women (46.3%) who said they had lost weight had then regained some of it and 23.9% had regained it all. Amongst the girls 72.1% regained some of their weight and 10.2% regained it all. The percentage who did not regain any weight was 17.8% amongst the girls and 29.9% amongst the young women.

3.3.2

Discussion

The results of this study would indicate that just over half (54.7%) of the young adult female (student) population in the Merseyside area are engaged in dieting practices to lose weight. The results of this study are similar to the findings of Peters et al (1996), who reported an incidence of dieting amongst 57.0% of American College students. However, previous research concerning English University students reports a slightly lower incidence. Bellisle et al (1995), found that amongst English university students, 49.4% reported that they were trying to lose weight, although only 21.4% were supposedly 'dieting' to lose weight. These results indicate that dieting is a common practice amongst the female student population, and a comparison of the results of this study to that of those reported by Bellisle et al (1995), demonstrate that dieting practices amongst students in this country have increased over recent years. The results of this study found that those who had dieted, were more likely to live independently rather than in parental or university accommodation. This may suggest that students who live independently are more able to follow a reducing diet because they are catering for themselves and are not influenced by the dietary intake of others. Many adolescent girls did not have parental approval to diet, therefore the opportunity to diet may be increased when they move away from home. The incidence of dieting amongst the students in this study was higher than in the schoolgirls. This may be due to an increase in the influence of peer pressure with increasing age, or because a greater number of subjects in the sample were overweight. The latter explanation could also account for the increase in the incidence of dieting between this study and that of Bellisle et al (1995).

The popularity of dieting practices amongst the young women in this study are not only confined to the obese, but also extend to those where weight loss is a questionable practice with regard to health indeed, 45.5% of those dieting had a BMI below 25, and 14.7% of those, had a BMI below 20. However, these figures do show a decrease in dieting amongst

the non-obese when compared to the English University students studied by Bellisle et al (1995) where only 8.0% were overweight and 1.0% were obese. Hill (1993) has previously suggested that the desire to be thinner and the experience of feeling fat now extends to women who fall comfortably within medically-set limits for normal weight. However, the evidence presented by the results of this study combined with the results of Bellisle et al (1995) suggest that although this may be the case the number of obese dieters has increased over recent years. These results illustrate how, in recent years, the beauty ideal for women has moved to an increasingly thin standard (Streigel-Moore et al, 1986) and the desire to achieve a slim body shape is not exclusive to the obese but also those who are unhappy about their shape (Wardle & Beales 1986).

Further evidence to show how 'thinness' has become important, especially amongst the non-obese, over more recent years, is highlighted by this study in the age at which this group had started to diet. Most of those young women with a BMI below 25, who it may be suggested were only dieting for cosmetic reasons, had only started to diet recently during their later teens, whereas a significantly larger number of those who had started to diet by the age of 14 years had a BMI above 25. None of the young women recalled starting to diet before the age of 10 years, whereas 22.4% of the girls had started to diet by this age, many of whom were non-obese. The increasing popularity of dieting may predispose to health problems for many women, indeed, it has been suggested that weight loss is not recommended for people of normal-weight and that dieting may expose such individuals to unnecessary health risks (Biener & Heaton, 1995), such as stress (Rosen et al, 1990) and impaired cognitive function (Green & Rogers 1995). Dieting has also been linked with the development of osteoporosis (Barr, 1995, Kriepe & Forbes, 1990, Berg, 1996) and anaemia (Houston et al, 1997). However, despite the risks to health it would appear to be the case that females are not immune to the pressures associated with dieting and staying attractive (Streigel-Moore et al, 1986) and are likely to put appearance before health requirements.

The importance of appearance was reflected in the reasons that were given for dieting. Results showed that 40.0% were dieting to improve appearance, which was the most

popular reason. Most of the students who wanted to lose weight for appearances sake had a BMI over 25, however, despite this 39.3% who had a BMI below 25 were still concerned with their appearance. Appearance was again highlighted, with 11 dieting because they felt too fat, despite five of them having a BMI below 25. The second most popular reason for dieting was to keep fit and healthy, with 15 stating this. Of those giving this reason slightly more had a BMI below 25, than above. Although a number of the students would fulfil medical criteria for the need to lose weight it would appear that appearance may be more of an incentive to lose weight than health reasons. In today's society obesity is a highly stigmatised condition (Hill & Silver, 1995), creating psychological, social and economic penalties (Rodin et al, 1984). The pressure this creates may also be seen in the importance placed upon appearance by the adolescent dieters. It may be the case that the pressure to prevent obesity in those of normal weight is as great as it is for the obese to try and lose weight.

The potential effects to health as a result of dieting may depend on the actual diet that is being followed. There are many different types of reducing diet available, some following healthy guidelines and others that do not, for example meal replacement diets (Which?, 1997). Low fat diets have been a popular method of weight loss for several years (Dwyer, 1992). In 1966 Neumark-Sztainer et al (1996) reported that 64.4% of the sample they studied used such a diet. Similarly the results of this study found that a low fat diet was the most popular in all BMI categories, with 70.0% of dieters using it. This popularity of the low fat diet was also seen amongst the adolescent dieters. The remaining young women used a variety of reducing diets, with most of these students having a BMI below 25. Most dieter's always used the same reducing diet, however, 37.7% tried different diets, with 69.2% of these having a BMI above 25. Although only 10.0% chose their diet in the hope of finding a 'quick result' this result indicates that a number of overweight dieters may change their diet because their desired weight loss does not occur as quickly as they would wish. Although it is well documented that the answer to a weight problem is an overall change of lifestyle, i.e. increasing exercise and eating a balanced diet, it would appear that a number of the dieting population are still convinced that there must be a quicker and easier solution (Dwyer & Lu, 1993). Not only can the type of diet used

predispose to health problems but also where it originated from. This study showed that 67.1% of young women made their own diet up, a result which may cause concern, as it has been found that a high proportion of students hold misconceptions about nutrition and are unaware that their information is incorrect (Chery et al, 1989). Blackburn (1993) suggests that unsupervised dieting may exacerbate potential health problems, especially if the dieter has a concurrent health problem.

Over recent years dietary fat intake has been a major nutritional issue, with recommendations being made to reduce intake in order to combat coronary heart disease and obesity (DoH 1991,1994). Although official recommendations advise a an overall fat intake of 30.0% of total energy intake, it would appear that some low fat reducing diets are much more restrictive. The Rosemary Conley Diet and Fitness Club offer diets which are strictly low in fat and advise that all foods containing more than 4.0% fat should be avoided (Which?, 1997). However, is such a restriction really advisable? From the results of this study it is evident that low fat reducing diets are very popular, but unless women are aware that they need a diet that is well balanced in all nutrients, including fat, then they may be predisposing themselves to health problems. The popularity of a low fat reducing diet was seen amongst both groups of dieters, with many of them choosing this type of diet because they believed they were eating healthily.

Many reasons were given for the dieters choosing their particular diet, however, the most popular reason was because they felt it was well-balanced and healthy, with 35.7% stating this, a result also seen amongst the adolescent dieters. However, what is considered to be healthy for one person may not be for another person. Upritchard & Ball (1993) have expressed concern about these diets because a low fat diet may not meet requirements where mineral intakes are concerned (i.e. iron, calcium, zinc and magnesium). Results from their study found that women consuming a low fat diet, where less than 25.0-30.0% of the total energy intake was from fat, were less likely to meet dietary recommendations than those consuming greater than 30.0-33.0% of their energy from fat.

Because of the increasing incidence of obesity in the UK, advocating a reduction in dietary fat intake is clearly a sensible initiative, however, it is essential that whatever, type of diet is used, it should provide the body with adequate nutrients to meet health needs (Thomas, 1994). Because of the problem of increasing obesity amongst the population there may be some reluctance to admit that a diet which is very restricted in fat may be detrimental to health, in case it is wrongly interpreted by the obese, thus giving them an excuse not to alter their habits. However, there is also a major problem with the non-obese, many of whom, perceive themselves as being overweight and who wish to diet. They are just as likely to misinterpret advice which is aimed at the obese and therefore, not appropriate to their needs. Although obesity is a major health problem predisposing to many health problems, it may also be suggested that there are many people of normal weight who's health may be at risk because of nutritional deficiencies due to inappropriate diets. It is essential that the needs of the non-obese are considered when advice regarding obesity is given and that their health is not compromised in order to reduce the incidence of obesity.

Further results illustrating how dieting is a common behaviour amongst those of normal weight and how appearance is a concern to all women regardless of weight and health consequences are shown in this study. Although 67.1% had only dieted occasionally during the previous 12 months, 25.7% had dieted for most of the time, indicating that they might be depriving themselves of essential nutrients for long periods of time. Most (37.3%) dieted for 1-2 months at a time, however, the four who dieted for over 5 months had a BMI below 25. Indeed, of the dieters who had a BMI below 25 only three had not dieted during the previous 12 months. The detrimental effects that a nutritionally deficient diet has on health may depend on the length and frequency of the reducing diet, however, the pattern of the dieting behaviour itself may predispose to problems. A large percentage (46.3%) of those who had lost weight during the previous 12 months had regained some of their weight and 23.9% had regained it all. Similar findings have been reported previously, Grodstein et al (1996) found that 40.0% of the sample they studied had gained back more weight than they had lost. The pattern of dieting coupled with weight regain, may indicate that some of the dieters in this study are subject to weight cycling, a dieting pattern also identified amongst the adolescent dieters. It has been suggested that the

negative effects of weight cycling, make future weight loss attempts even more difficult, possibly leading to increased obesity and an increased risk of developing coronary heart disease (Wilson, 1995). Various studies have found a significant association with regard to weight fluctuation and the development of coronary heart disease (Hamm et al, 1989, Lissner & Brownell, 1992, Lee & Paffenbarger, 1992). The concept of weight cycling may further demonstrate how the needs of the non obese should be considered when compiling advice for the obese, especially that aimed at younger girls. It may be the case that dieting amongst the non obese may lead to weight cycling and the development of obesity, thus adding to present health problems.

These findings emphasise the fact that weight loss is a serious matter and the decision to diet should not be taken lightly. It is suggested that dieting should not be attempted by those of normal weight, nor by, obese people, if the chance of success is minimal (Rossner, 1989, Beiner & Heaton, 1995).

Limitations

As with the study involving the adolescents a suitable previously validated questionnaire wasn't available and also the design and content of the questionnaire had to be approved the University Ethics Committee. All data was self-reported.

3.3.3

Conclusion

This study has shown that amongst those females, aged 18-24 years, half are engaged in dieting practices and that a number of them have a BMI where weight loss is not recommended. It would appear therefore, that for the sake of their appearance many young women are putting their health at risk unnecessarily.

The results of this study and of the adolescent study show how dieting behaviour has become increasingly popular amongst the female population regardless of BMI. This

would suggest that dieting, in whatever form it may take is fast becoming part of our culture. Although a lot of concern is shown towards dieting practices amongst adolescent girls, an increase in the awareness of such practices amongst adults needs to be made, especially those who are of normal weight.

The implications of dieting behaviour not only effect the health of the female population but must also influence future health and nutritional policy. Although nutritional advice places importance on aiming to reduce the increasing incidence of obesity, more consideration must be given to those who do not need to diet. The health implications for the normal weight dieter may be just as severe as those who are overweight. However, just giving out advice is not enough, more needs to be done to find out what people actually understand about the advice that is given. It seems that too many adults hold misconceptions where nutritional knowledge is concerned, a problem which will reflect in the young.

Section 3.4

Female (adult) dieting study

Introduction

Women of all age groups are not immune to the pressures associated with dieting, indeed it would appear that the physical and psychological campaign against increasing weight lasts a lifetime (Streigel-Moore et al, 1986).

There are many different types of reducing diets available (Which?, 1997), one of which, the low fat diet has been popular over recent years (Dwyer, 1992), amongst both adults (Neumark-Sztainer et al, 1996) and adolescents (French et al, 1995). However, Upritchard & Ball (1993) have expressed concern because low fat diets may not meet requirements for optimal health where mineral intakes are concerned. Indeed, dieting is becoming an increasing concern to health professionals, as it may have significant negative effects on the health and well being of an individual (Brownell, 1993).

There are many potential side effects associated with dieting, which may be as severe as the complications of obesity (McCarger & Yeung, 1991). This gives further cause for concern due to the number of unsupervised dieters, which may exacerbate potential health problems, especially if the dieter has a concurrent health problem (Blackburn, 1993).

Research has linked dieting behaviour with various potential behavioural and physiological health problems (Kirkley & Burge, 1989), such as stress (Rosen et al, 1990, Houston et al, 1997) and impairment of cognitive function (Green & Rogers, 1995), anaemia (BNF, 1995), osteoporosis (Kreipe & Forbes, 1990) and potential reproductive problems (Kirkley & Burge, 1989). Weight change has also been associated with increased mortality rate (Andres et al, 1993).

It is suggested that not enough is known about the effect of dieting in relation to health, especially those who are of normal weight, therefore any studies which investigate the adverse effects of dieting or the process of dieting are urgently needed and must be considered a priority (Biener & Heaton, 1995, Brownell, 1994).

The main aim of this part of the study was to identify the type of reducing diet used by female adult dieters, analyse the nutritional content of the diet and determine the blood nutrient status of these women. Also, to determine if the type of reducing diet could influence nutritional status. A comparison of data was made between the dieting women and also a non-dieting sub-group, in order to identify any differences between the two groups.

3.4.1

Results

Personal/dieting information

There were 50 dieters and 20 non-dieters who participated in the study.

BMI of dieters and non-dieters

(The BMI of the dieters was calculated from their weight and height recorded at the first visit).

Most dieters had a BMI between 25-29.9, whereas most of the non-dieters had a BMI between 20-24.9, (Table 3.4.1)

Table 3.4.1: Distribution of dieters and non-dieters amongst BMI categories.

BMI Category	Dieter No. (%)	Non-dieter No. (%)
<20	-	4 (25.0)
20-24.9	14 (28.0)	10 (62.5)
25-29.9	24 (48.0)	2 (12.5)
>30	12 (24.0)	-

The mean BMI of the dieters (27.7 ± 4.5 kg) was significantly higher than that of the non-dieters (21.7 ± 2.6 kg) $p=0.02$. The mean weight of the dieters (73.9 ± 12.9 kg) was significantly higher than that of the non-dieters (60.8 ± 7.6 kg) $p=0.03$.

Age groups

Most of the dieters (38.0%) fell within in the 31-40 years, age group, whereas most (50.0%) of the non-dieters were aged 18-20 years, (table 3.4.2)

Table 3.4.2: Distribution of dieters and non-dieters within the various age groups

Age group	Dieters No. (%)	Mean BMI + SD	Non-dieters No. (%)	Mean BMI + SD
18-20	3 (6.0)	27.3 ± 4.5	10 (50.0)	21.4 ± 1.8
21-30	14 (28.0)	27.7 ± 4.9	4 (20.0)	20.7 ± 1.6
31-40	19 (38.0)	26.5 ± 2.8	3 (15.0)	21.2 ± 3.8
41-45	14 (28.0)	29.3 ± 5.4	3 (15.0)	24.0 ± 3.7

The mean BMI of the dieters was similar for all age groups. Amongst the non-dieters the mean BMI was slightly higher in the oldest age group, 41-45 year age group, than that of the younger age groups.

Age when subjects first started to diet

Most (40.0%) of the dieters had been dieting since their teens, (Table 3.4.3)

Table 3.4.3: Age of dieters when they first started to diet.

Age when first dieted	No. (%)	Mean BMI + SD
Pre-teens	6 (12.0)	27.0 ± 5.9
Teens	20 (40.0)	28.2 ± 4.1
20's	13 (26.0)	26.6 ± 4.1
30's	7 (14.0)	28.0 ± 5.4
40's	4 (8.0)	29.3 ± 4.9

The mean BMI was lowest in those who had started diets in their twenties (26.6 ± 4.1), but did not differ significantly from those who had started dieting at an earlier or older age (table 3.4.3)

No. of previous years spent dieting

Most (36.0%) of the dieters had been dieting for at least the last 15 years, (table 3.4.4)

Three (16.7%) of these fell within the 21-30 age group, 10 (55.6%) within the 31-40 age group and five (27.7%) within the 41-45 age group.

Table 3.4.4: The number of years the subjects had been dieting for.

No. of years spent dieting	No.	(%)	Mean BMI + SD
<1	7	(14.0)	26.0 ± 3.1
1-2	4	(8.0)	31.2 ± 5.5
3-5	7	(14.0)	28.2 ± 5.0
6-10	9	(18.0)	26.6 ± 4.3
11-15	5	(10.0)	27.1 ± 5.9
>15	18	(36.0)	28.1 ± 4.2

The highest mean BMI (31.2 ± 5.5) was seen amongst those who had only been dieting for 1-2 years.

Frequency/pattern of diets

Most of the dieters (38.0%) dieted for short periods of approximately 1 month on and off throughout the year (Table 3.4.5 : overleaf)

Table 3.4.5: Frequency of dieting

No. of diets/year	No. (%)	Mean BMI + SD
1/yr	2 (4.0)	22.5 ± 2.0
2/yr	7 (14.0)	26.8 ± 4.2
3/yr	1 (2.0)	25.9 ± 4.2
Continual	11 (22.0)	29.9 ± 5.3
Varies	8 (16.0)	26.5 ± 4.7
On/off	19 (38.0)	28.1 ± 4.0
1 st diet	2 (4.0)	26.0 ± 1.4

The highest mean BMI's were seen amongst those who continually diet and those who diet on and off throughout the year, 29.9 ± 5.3 and 28.1 ± 4.0 , respectively. Seven of those who dieted continually had a energy intake below 1400kcal/d and four of these had an intake below 1200kcal/d.

Length of present diet

Most of the dieters (78.0%) wanted to remain on their diet until weight loss was satisfactory, this group had the highest mean BMI (28.2 ± 4.6), (Table 3.4.6)

Table 3.4.6: Intended length of the dieters present diet.

Length	No. (%)	Mean BMI + SD
Up to 1 month	2 (4.0)	24.8 ± 0.8
2-4 months	9 (18.0)	26.6 ± 4.1
Until weight loss satisfactory	39 (78.0)	28.1 ± 4.6

Most popular type of reducing diets used

The most popular type of reducing diet used was a 'low fat' diet, with just over half of the dieters choosing it (56.0%). Twelve others (24.0%) used a low fat diet but in combination with either healthy eating or high fibre, (table 3.4.7).

Table 3.4.7: Types of reducing diets used

Type of diet	No.	(%)	Mean BMI + SD
Low fat	28	(56.0)	28.5 ± 5.2
Low fat/healthy eating	11	(22.0)	26.9 ± 3.3
Low fat/high fibre	1	(2.0)	23.6 ± 3.3
Healthy eating	3	(6.0)	25.3 ± 0.5
Calorie counting	2	(4.0)	28.3 ± 5.7
Food combination	4	(8.0)	27.3 ± 3.1
Different diets	1	(2.0)	24.0 ± 3.1

The highest mean BMI (28.5 ± 5.2) was seen amongst those dieters who used a low fat diet, but this was not significantly different from the mean BMI of any of the other groups.

Dietary survey results

Table 3.4.8 shows that the mean energy, total fat and saturated fat intake was slightly higher amongst the non-dieters than dieters, however, the remaining energy profile was similar for dieters and non-dieters. Most mean vitamin/mineral intakes were higher amongst the dieters than non-dieters.

Table 3.4.8: Energy profile and vitamin/mineral intake: a comparison of dieters (n=43) and non-dieters (n=15) with Dietary Reference Value's (DRV's).

Energy profile	Total group Mean \pm SD	Dieters Mean \pm SD	Non-dieters Mean \pm SD	DRV's 1991*
Energy (kcal)	1447 \pm 321	1390 \pm 323	1611 \pm 264	1940
CHO (%FE**)	47.4 \pm 7.8	48.2 \pm 8.2	45.3 \pm 6.3	50
CHO - Sugars (%FE**)	20.7 \pm 7.4	21.2 \pm 7.6	19.2 \pm 6.8	11
Protein (g)	65.0 \pm 18.2	65.0 \pm 18.3	65.2 \pm 18.6	45
Protein (%FE**)	18.3 \pm 4.7	18.9 \pm 4.6	19.2 \pm 6.8	-
Total fat (%FE**)	30.8 \pm 8.8	29.4 \pm 8.8	35.0 \pm 7.4	35
Saturated fat (%FE**)	11.3 \pm 4.3	10.5 \pm 4.2	13.6 \pm 3.7	11
PS Ratio†	.50 \pm .234	.51 \pm .252	.46 \pm .174	0.6
NSP†† (g)	12.0 \pm 4.5	12.5 \pm 4.9	10.6 \pm 2.9	18

Vitamins/minerals

Retinol Equiv. (μ g)	587.0 \pm 360.2	606.6 \pm 398	530.7 \pm 216	600
Vitamin E (α -tocopherol equiv). (mg)	5.1 \pm 2.1	5.1 \pm 2.1	5.57 \pm 1.9	>3
Vit D (μ g)	2.2 \pm 1.7	1.0 \pm .52	1.0 \pm .00	10***
Vit C (mg)	80.0 \pm 58.1	85.5 \pm 63.0	64.0 \pm 38.2	40
Iron (mg)	8.8 \pm 3.4	9.1 \pm 3.7	8.0 \pm 1.9	14.8
Folate (μ g)	203.0 \pm 72.2	209.9 \pm 76.7	183.2 \pm 54	200
Calcium (mg)	787.2 \pm 1114.2	834.5 \pm 1283.2	651.7 \pm 296	700

* Dietary Reference Values for Food Energy and Nutrients for the United Kingdom (DOH, 1991).

** Percentage of food energy.

*** Increment during pregnancy.

† Ratio of polyunsaturated to saturated fatty acids.

†† Non-starch polysaccharides.

Table 3.4.9: The number of dieters and non-dieters who failed to meet nutrient DRV's

Nutrient (recommended DRV)	Dieters			Non-dieters		
	No.	(%)	(Range of results)	No.	(%)	(Range of results)
Energy (<1940 kcal)	42	(97.7)	(546.90-2042.51)	13	(86.7)	(898.30-2071.0)
CHO (<50%FE**)	26	(60.5)	(36.57-68.03)	12	(80.0)	(37.6-58.27)
CHO - Sugars (>11%FE**)	39	(90.7)	(4.26-36.85)	13	(86.7)	(7.53-32.50)
Protein (<45g)	5	(11.6)	(23.54-122.96)	0		(42.20-104.21)
Total fat (>35%FE**)	12	(27.9)	(13.41-51.50)	5	(27.0)	(20.10-47.55)
Saturated fat (>11%FE**)	19	(44.2)	(3.93-21.71)	10	(66.7)	(8.5-20.19)
NSP (<18g)	39	(90.7)	(4.11-28.54)	14	(93.3)	(6.49-18.43)
Retinol Equiv.(<600µg)	22	(51.2)	(80.94-2092.51)	10	(66.7)	(155.69-968.76)
Vitamin E (αtocopherol equiv). (<3mg)	6	(14.0)	(1.28-11.55)	2	(13.3)	(1.87-8.50)
Vit D (<10µg)	42	(97.7)	(.19- 10.38)	15	(100)	(.45- 4.12)
Vit C (<40mg)	11	(25.6)	(17.80-299.08)	4	(26.7)	(9.20-132.3)
Iron (<14.8mg)	41	(95.3)	(3.66-23.40)	16	(100)	(4.43-12.39)
Folate (<200µg)	21	(48.8)	(75.16-390.92)	9	(60.0)	(97.80-324.77)
Calcium (<700 mg)	28	(65.1)	(350.5-1687.77)	10	(66.7)	(440.67-1203.73)

** Food energy

Although a few differences were noted, on the whole the percentage of dieters and non dieters who failed to meet DRV's for energy and nutrients was similar. The percentage of dieters and non-dieters who had an intake of total fat above the recommended 35.0% was similar, 27.9% and 27.0%, respectively. However, a higher percentage of non-dieters than dieters had a saturated fat intake above recommended limits, 66.7% and 44.2%, respectively. The number who had a total fat intake below 30.0% food energy (FE) was 25 (35.7%) (four non dieters) and 17 (24.2.0%) (1 non dieter) had an intake below 25.0% (FE).

Table 3.4.10: A comparison of nutrient intakes of dieters and non-dieters with results from the The Dietary and Nutritional Survey of British Adults (1991)

Energy profile	Dieters Mean \pm SD	Non-dieters Mean \pm SD	DNSBA* (Dieters) Mean	DNSBA (Non-dieters) Mean
Energy (kcal)	1390 \pm 323	1611 \pm 264	1400	1720
CHO (%FE**)	48.2 \pm 8.2	45.3 \pm 6.3	41.6	43.2
CHO - Sugars (%FE**)	21.2 \pm 7.6	19.2 \pm 6.8	-	-
Protein (g)	65.0 \pm 18.3	65.2 \pm 18.6	61.1	62.1
Protein (%FE**)	18.9 \pm 4.6	19.2 \pm 6.8	18.4	14.7
Total fat (%FE**)	29.4 \pm 8.8	35.0 \pm 7.4	38.2	40.6
Saturated fat (%FE**)	10.5 \pm 4.2	13.6 \pm 3.7	15.6	17.2
PS Ratio	.51 \pm .252	.46 \pm .174	.40	.38
NSP (g)	12.5 \pm 4.9	10.6 \pm 2.9	18	18.7

Vitamins/minerals

Retinol Equiv. (μ g)	606.6 \pm 398	530.7 \pm 216	1567	1476
Vitamin E (α -tocopherol equiv.) (mg)	5.1 \pm 2.1	5.57 \pm 1.9	8.7	8.6
Vitamin D (μ g)	1.0 \pm .52	1.0 \pm .00	3.5	3.0
Vitamin C (mg)	85.5 \pm 63.0	64.0 \pm 38.2	83.3	71.7
Iron (mg)	9.1 \pm 3.7	8.0 \pm 1.9	12.6	12.3
Folate (μ g)	209.9 \pm 76.7	183.2 \pm 54	226	218
Calcium (mg)	834.5 \pm 1283.2	651.7 \pm 296	712	732

* Gregory et al (1990) The Dietary and Nutritional Survey of British Adults.

** Food energy

Differences between this study and the results of the Dietary and Nutritional Survey of British Adults (DNSBA) were seen in respect of total and saturated fat intake, with the mean intake of both dieters and non-dieters in this study being lower. The PS ratio was more favourable in this study. Table 3.4.10 shows that NSP intake was lower in this study than in the DNSBA. With regard to vitamins and minerals, the iron and folate intakes of

this study were lower than that reported by the DNSBA, in the case of both dieters and non-dieters.

Table 3.4.11: Ratio of energy intake (kcal) to calculated metabolic rate.

Total group (n58) Mean \pm SD (Range)	Dieters (n43) Mean \pm SD (Range)	Non-dieters (n15) Mean \pm SD (Range)	DNSBA* Total group (mean)	WHO (1985)
0.95 \pm 0.251 (0.37 - 1.50)	0.88 \pm 0.240 (0.37 - 1.50)	1.15 \pm 0.171 (0.65 - 1.37)	1.22	1.2

* Gregory et al (1990)

The percentage of dieters who had a energy intake: BMR ratio (EI:BMR) less than 1.2 was higher than the percentage of non-dieters, 95.3% and 66.6%, respectively. The DNSBA calculated values of less than 1.2 in 47.0% of women.

Biochemical data

Haemoglobin

Table 3.4.12: Haemoglobin concentration (g/l)

Total group (n70) Mean \pm SD (Range)	Dieters (n50) Mean \pm SD (Range)	DNSBA* Dieter Mean	Non-dieters (20) Mean \pm SD (Range)	DNSBA Non-dieter Mean	Reference Levels**
11.7 \pm 1.1 (8.8-14.8)	11.6 \pm 1.0 (8.8-14.6)	13.3	12.0 \pm 1.4 (8.9-14.8)	13.2	11.5-15.5

* Gregory et al (1990)

** Thomas (1994)

The mean haemoglobin (Hb) level of the dieters in this study was found to be lower than reported in the DNSBA, 11.6 \pm 1.0g/l and 13.3g/l, respectively. The mean Hb was similar in dieters and non-dieters, 11.6g/l and 12.0g/l, respectively. A similar percentage of

dieters and non-dieters had an Hb level below the recommended concentration of 11.5g/l, 44.0% and 45.0%, respectively. A higher percentage of non-obese dieters had a Hb concentration below 11.5g/l than overweight/obese dieters, 57.1% and 38.8%, respectively.

Cholesterol

Table 3.4.13: Total cholesterol concentration above 3.88mmol/l (mmol/l) - Accutrend method

Total group (n37) Mean \pm SD (Range)	Dieters (n30) Mean \pm SD (Range)	DNSBA Dieter Mean	Non-dieters (n7) Mean \pm SD (Range)	DNSBA Non-dieter Mean	Reference Levels
5.0 \pm .70 (3.88-6.60)	5.0 \pm 0.7 (3.89-6.42)	6.03	4.9 \pm 0.8 (3.88-6.60)	5.83	2.5-5.5

All subjects (70) had their total cholesterol (TC) concentration measured using the Accutrend method, however, 33 had a TC concentration below 3.88mmol/l, the lowest recordable concentration. Amongst those who had a recordable result 10 dieters (20.0%) and one non-dieter (5.0%) had a TC concentration above 5.5mmol/l, the recommended upper limit. The mean concentration recorded in this study was lower than that reported in the DNSBA. A higher percentage of overweight/obese dieters, had a TC concentration above 5.5mmol/l, than non-obese dieters, 25.0% and 7.1% respectively.

In those subjects who had provided a venous sample of blood it was possible to test their total serum cholesterol concentration using a reference method (Sigma).

Table 3.4.14: Total cholesterol concentration (mmol/l) - Sigma method

Total group (n20) Mean \pm SD (Range)	Dieters (n11) Mean \pm SD (Range)	Non-dieters (n9) Mean \pm SD (Range)
3.9 \pm 1.0 (2.01-6.33)	4.2 \pm 0.7 (2.59-5.0)	3.6 \pm 1.2 (2.01-6.33)

It was possible to directly compare the results of 12 subjects using both methods. The mean total cholesterol concentration using the accutrend was 5.1 ± 0.6 mmol/l, compared to 4.7 ± 0.5 mmol/l using the Sigma method. Only one non-dieter had a result above 5.5mmol/l.

Table 3.4.15: HDL concentration (mmol/l)

Total group (n59) Mean \pm SD (Range)	Dieters (n41) Mean \pm SD (Range)	DNSBA Dieter Mean	Non-dieters (n18) Mean \pm SD (Range)	DNSBA Non- dieter Mean	Reference levels
1.3 ± 0.4 (0.37-2.39)	1.2 ± 0.4 (0.37-2.01)	1.02	1.4 ± 0.3 (1.03-2.39)	1.16	0.89-2.05

High density lipoprotein (HDL) concentration were measured in 59 subjects, 41 dieters and 18 non-dieters. For the total group the mean HDL concentration was 1.3 ± 0.4 mmol/l. The mean HDL concentration in this study was slightly higher than that reported in the DNSBA, for both dieters and non-dieters. Of the total group ten subjects (all dieters) did have HDL concentration below 0.89mmol/l, the lowest recommended limit.

Table 3.4.16: LDL concentration (mmol/l) - calculated from TC-accutrend results

Total group (n37) Mean \pm SD (Range)	Dieters (n31) Mean \pm SD (Range)	DNSBA Dieter Mean	Non-dieter (n6) Mean \pm SD (Range)	DNSBA Non- dieter Mean	Reference Levels
3.5 ± 0.8 (1.0-5.57)	3.4 ± 0.8 (1.0-4.93)	5.02	3.5 ± 1.1 (2.54-5.57)	4.67	1.7-5.62

Low density lipoprotein (LDL) concentration were calculated by subtracting the HDL concentration from the TC level. LDL were calculated in 37 subjects, 31 dieters and six

non-dieters. For the total group the mean LDL was 3.5 ± 0.8 mmol/l. The mean LDL concentration reported in this study was lower than those reported in the DNSBA, for both dieters and non-dieters. Non of the subjects had raised LDL levels.

Table 3.4.17: LDL concentration (mmol/l) - calculated from TC-Sigma results

Total group (n20)	Dieter (n11)	Non-dieter (n9)
Mean \pm SD (Range)	Mean \pm SD (Range)	Mean \pm SD (Range)
2.6 ± 1.1 (0.5-5.3)	3.4 ± 0.8 (1.45-4.02)	3.5 ± 1.1 (0.5-5.30)

LDL concentration were measured in 20 subjects who provided a venous sample, by subtracting their HDL concentration from their TC concentration. For the total group the mean LDL concentration was 2.6 ± 1.1 . None of the subjects had a raised LDL concentration.

Although the Sigma method was found to be more reliable than the Accutrend method, the Accutrend results were discussed because they provided a larger sample.

Calcium

Table 3.4.18: Blood Calcium concentration (mmol/l)

Total group (59)	Dieter (41)	DNSBA Dieter Mean	Non-dieter (18)	DNSBA Non-dieter Mean	Reference Levels
Mean \pm SD (Range)	Mean \pm SD (Range)		Mean \pm SD (Range)		
1.6 ± 0.69 (0.58-3.8)	1.6 ± 0.64 (0.58-3.80)	2.29	1.6 ± 0.8 (0.73-3.80)	2.29	2.25-2.65

Blood calcium concentration were measured in 59 subjects, 41 dieters and 18 non-dieters. For the total group the mean calcium concentration was 1.6 ± 0.69 mmol/l. Mean calcium concentration reported in this study were lower than those reported in the DNSBA, for

both dieters and non-dieters. Amongst the total group, 52, (88.1%) had a calcium level below that recommended and 12 had concentration below 50.0% of normal. The percentage of non-obese and overweight/obese dieters with a calcium concentration below 2.25mmol/l was similar, 87.5% and 90.0%, respectively.

Table 3.4.19: Blood total iron, TIBC, UIBC, ferritin, transferrin %, total protein, albumin, tocopherol, retinol, beta-carotene concentrations from a subgroup who provided a venous blood sample (n=20)

Nutrient	Total group Mean \pm SD (Range)	Dieter Mean \pm SD (Range) (n=11)	DNSBA Dieter (Mean)	Non-dieter Mean \pm SD (Range) (n= 9)	DNSBA Non- dieter (Mean)	Reference Levels (Sigma- Diagnostics)
Total Iron (μ mol/l)	21.9 \pm 6.9 (11.1-33.5)	20.6 \pm 5.2 (11.1-29.8)	n/a	23.5 \pm 8.7 (11.1-33.5)	n/a	6.25-25
TIBC (μ mol/l)	48.1 \pm 9.6 (31.8-63.5)	51.1 \pm 10.7 (37.6-56.2)	n/a	45.6 \pm 8.4 (36.1-63.5)	n/a	43.8-71.6
UIBC (μ mol/l)	23.4 \pm 7.9 (13.7-41.1)	21.7 \pm 7.9 (13.7-41.1)	n/a	25.4 \pm 7.9 (13.7-41.1)	n/a	23.7-67.1
Ferritin (μ g/l)	55.2 \pm 14.9 (44.0-103.0)	57.3 \pm 18.8 (44.0-103.0)	52.4	52.6 \pm 8.6 (45.0-75.0)	46.0	14-148*
Transferrin %	45.2 \pm 12.9 (24.5-66.10)	44.9 \pm 13.2 (26.5-63.4)	n/a	45.7 \pm 13.2 (24.5-61.9)	n/a	>15
Total protein (g/l)	50.6 \pm 17.8 (25.0-87.5)	45.4 \pm 15.0 (25.0-75.0)	71.4	56.9 \pm 19.8 (37.5-87.5)	71.4	60-80*
Albumen (μ mol/l)	457.1 \pm 74.6 (231.8-579.6)	443.9 \pm 82.2 (231.8- 521.6)	641.9	473.3 \pm 65.2 (376.2-579.6)	640.4	565-738*
Tocopherol (μ mol/l)	17.8 \pm 15.6 (0.14-48.0)	22.5 \pm 14.6 (1.31-48.0)	26.1	12.5 \pm 15.9 (0.14-47.0)	26.2	>11.6
Retinol (μ mol/l)	1.8 \pm 1.4 (0.1-5.5)	1.3 \pm 0.4 (0.54-1.88)	1.95	2.4 \pm 1.8 (0.1-5.54)	1.88	0.7-1.7
Beta- carotene (μ mol/l)	0.31 \pm 0.19 (0.04-0.74)	0.35 \pm 0.17 (0.14-0.68)	0.36	0.27 \pm 0.21 (0.04-0.74)	0.38	0.9-5.6

* Thomas (1994)

Mean total iron concentration were similar between dieters and non-dieters, $20.6 \pm 5.2 \mu\text{mol/l}$ and $23.5 \pm 8.7 \mu\text{mol/l}$, respectively with none below $6.25 \mu\text{mol/L}$. Total iron binding capacity (TIBC) concentrations were also similar for dieters and non dieters, $51.1 \pm 10.7 \mu\text{mol/l}$ and $45.6 \pm 8.4 \mu\text{mol/l}$, respectively, as were unsaturated iron binding capacity (UIBC) concentrations $21.7 \pm 7.9 \mu\text{mol/l}$ and $25.4 \pm 7.9 \mu\text{mol/l}$, respectively. No TIBC levels were above $71.6 \mu\text{mol/L}$ but three non-dieters had UIBC levels below $23.7 \mu\text{mol/L}$. Although ferritin concentrations for the total group were within reference values, results were significantly higher in the dieters than non-dieters, $57.3 \pm 18.8 \mu\text{g/l}$ and $52.6 \pm 8.6 \mu\text{g/l}$, respectively ($p=0.03$). None of the total group had a percentage saturation of transferrin less than 15%. The mean dietary iron intake of this group was 10.2g/d and the mean Hb level was 12.2g/l .

Although not significant, total protein concentrations were higher in the non-dieters than dieters, $56.9 \pm 19.8\text{g/l}$ and $45.4 \pm 15.0\text{g/l}$, respectively, as were albumen levels, $473.3 \pm 65.2 \mu\text{mol/l}$ and $443.9 \pm 82.2 \mu\text{mol/l}$, respectively. Four non-dieters and nine dieters had total protein levels below 60g/l and all of the total group had albumen levels below $565 \mu\text{mol/l}$, apart from one non-dieter.

Beta-carotene concentrations were similar for dieters and non-dieters, however, retinol concentrations were significantly higher amongst the non-dieters than dieters, 1.3 ± 0.4 and 2.4 ± 1.8 , respectively ($p=0.01$). Although not significant, tocopherol concentrations were higher amongst the dieters than non-dieters, 22.5 ± 14.6 and 12.4 ± 15.9 , respectively.

Amongst those dieters who were non-obese, 80.0% had a total protein concentration below 60g/l , similar to the overweight/obese dieters (83.3%). Regardless of weight all subjects had low albumen concentrations, below $565 \mu\text{mol/l}$ and were within recommended concentrations where iron status was concerned. Nothing of any significance was noted with regard to tocopherol, retinol and beta-carotene concentrations and BMI.

Dieters:

Analysis of weight loss during reducing diet

The mean, first recorded weight of the dieters was 73.9 ± 12.9 kg, after one month: 74.2 ± 13.7 kg and after two months: 73.8 ± 12.8 kg.

After one month of dieting 37 out of the 50 volunteers remained on their diet. During this time 21 (56.7%) of the dieters had lost weight with their mean weight loss being 1.4 ± 1.2 kg (range: .2 - 4.5kg). In nine (24.4%) of the dieters there was no weight change and seven (18.9%) gained weight.

At the end of the second month of dieting 34 out of the 50 volunteers had remained on their diet. During the second month, 20 (58.8%) dieters had lost weight, with their mean weight loss being 1.1 ± 0.93 kg (range: 0.1 - 3.7kg). For six (17.6%) of the dieters there was no weight change and eight (23.6%) gained weight.

Only 11 (22.0%) of the dieting subjects continued to lose weight over the entire 2 months.

Type of reducing diet compared to intake of nutrients

The results focus on the low fat, low fat/healthy eating and healthy eating diets and compare the mean intake of those following a low fat diet (28) and those following other types of diet (22). The results are taken from the initial dietary diary.

Energy intake

The mean energy intake in those following a low fat diet was similar to those following other types of diet 1404.9 ± 311.5 kcal/d and 1372.1 ± 344.8 kcal/d, respectively.

Carbohydrate

Carbohydrate intake fell below 50% of food energy (%FE) intake in 15 (62.5%) of those dieters using a low fat diet. A similar percentage was seen in those following a low fat/healthy eating diet and a healthy eating diet, six (66.7%) and 2 (66.7%), respectively.

The mean intake was similar in those following a low fat diet and those following other types of diet 47.8 ± 8.8 (%FE) and 48.6 ± 7.7 (%FE), respectively.

Carbohydrate -Sugars

Most dieters, 22 (91.7%) using a low fat diet had a sugar intake above 11% of food energy, a similar percentage to those following a low fat/healthy eating diet, eight (88.9%). All three dieters following a healthy eating diet, had a sugar intake above 11% of food energy. The mean intake of those following a low fat diet was lower than those following other types of diet 19.8 ± 8.3 (%FE) and 23.0 ± 6.5 (%FE), respectively.

Protein

The majority of dieters following a low fat diet 22 (91.7%) had a protein intake above 45g/d. Amongst the dieters using a low fat/healthy eating diet seven, (77.8%) had an intake above the recommended 45g/d. Such an intake was seen in all three dieters using a healthy eating diet. Mean intakes were slightly higher in those following a low fat diet than those following other types of diet, 67.8 ± 18.6 g/d and 61.5 ± 17.8 g/d, respectively.

Total fat

Amongst the dieters, six (25.0%) following a low fat diet, three (33.3%) following a low fat/healthy eating diet and one (33.1%) following a healthy eating diet had a total fat intake above the recommended 35% of food energy. The mean intake was similar in those following a low fat diet and those following other types of diet, 29.5 ± 8.9 (%FE) and 29.3 ± 9.0 (%FE), respectively.

Saturated fat

Amongst the dieters, nine (37.5%) following a low fat diet, five (55.6%) following a low fat/healthy eating and one (33.3%) following a healthy eating diet had a saturated fat intake above the recommended 11% of food energy. The mean intake was slightly lower in those

following a low fat diet, 10.1 ± 3.7 (%FE) than in those following other types of diet, 11.0 ± 4.8 (%FE).

Non-Starch Polysaccharides (NSP)

The majority of dieters using a low fat diet, 22 (91.7%) had an NSP intake below the recommended 18g/d. All of those following a low fat/healthy eating diet or a healthy eating diet had an intake below 18g/d. The mean intake was similar in those following a low fat diet and other types of diet 12.3 ± 4.3 g/d and 12.6 ± 5.7 g/d, respectively.

Retinol equivalent

Just over half, 13 (54.2%) of those following a low fat diet had a retinol intake below the recommended $600\mu\text{g/d}$. Of those following a low fat/healthy eating diet and healthy eating diet, four (44.4%) and two (66.7%), respectively had an intake below $600\mu\text{g/d}$. The mean intake of those following a low fat diet was $545.1 \pm 308.9\mu\text{g/d}$, slightly lower than those following other types of diets, $684.5 \pm 487.4\mu\text{g/d}$.

Vit E

Most of those following a low fat diet and a low fat/healthy eating diet had a vitamin E intake above the recommended 3mg/d, 22 (91.7%) and seven (77.8%), respectively. All of those following a healthy eating diet had intakes above 3mg/d. The mean vitamin E intake of those following a low fat diet and other types of diet was similar 5.1 ± 2.1 mg/d and 4.8 ± 2.2 mg/d, respectively

Vit D

All of those following low fat, low fat/healthy eating and healthy eating diets had intakes of vitamin D below the recommended $10\mu\text{g/d}$. The mean intake of vitamin D in those following a low fat diet was $2.2 \pm 1.7\mu\text{g/d}$, similar to those following other types of diet, $2.5 \pm 2.2\mu\text{g/d}$.

Vit C

Most of those following a low fat and low fat/healthy eating diet had intakes of vitamin C above the recommended 40mg/d, 18 (75.0%) and 6 (66.7%), respectively. All of those following a healthy eating diet had an intake above 40mg/d. The mean intake of vitamin C was similar in those following low fat and other types of diets, 85.3 ± 70.2 mg/d and 85.8 ± 54.4 mg/d, respectively.

Iron

Most of those following a low fat diet, 23 (95.8%) had a intake of dietary iron below the recommended 14.8mg/d. All of those following a low fat/healthy eating diet, and a healthy eating diet had an intake of dietary iron below 14.8mg/d. The mean iron intake of those following a low fat diet was 9.0 ± 3.3 mg/d, similar to those following other types of diet, 9.1 ± 4.2 mg/d.

Folate

Nearly half, 11 (45.8%) of those following a low fat diet and just over half, 5 (55.6%) of those following a low fat/healthy eating diet had an intake of folate below the recommended 200 μ g/d. Two (66.7%) of those following a healthy eating diet had an intake below the recommended amount. The mean folate intake of those following a low fat diet was 205.8 ± 75.7 μ g/d, slightly lower than those following other types of diet, 213.0 ± 79.1 μ g/d.

Calcium

The majority of those following a low fat diet had a calcium intake below the recommended 700mg/d, 17 (70.8%), as did those following a low fat/healthy eating diet, seven (77.8%). Only one (33.3%) following a healthy eating diet had an intake below 700mg/d. The mean calcium intake of those following a low fat diet was 647.7 ± 321.6 mg/d, lower than those following other types of diet. 1071.2 ± 1898.4 mg/d.

Effect of dieting on blood haemoglobin and cholesterol concentrations

Blood haemoglobin concentrations

The initial haemoglobin (Hb) concentration of the dieters was $11.6 \pm 1.0\text{g/l}$. After one month the mean concentration of the remaining 37 dieters was $11.5 \pm 1.0\text{g/l}$ and after two months the mean level in the remaining 33 dieters was $11.6 \pm 0.8\text{g/l}$. After dieting for one month haemoglobin levels had decreased (mean decrease $0.8 \pm 0.5\text{g/l}$) in 15 (40.5%), increased (mean increase $0.8 \pm 0.5\text{g/l}$) in 20 (54.1%) and remained the same in two (5.4%). After two months levels had decreased (mean decrease $0.8 \pm 0.5\text{g/l}$) in 18 (54.5%) and increased (mean increase $1.0 \pm 0.7\text{g/l}$) in 15 (45.5%) of dieters.

The two dieters who's Hb concentration had remained stable after one month, decreased after the second month. Eleven of those who's Hb concentration had increased during the first month, decreased during the second month and five, who's concentration had decreased during the first month decreased again during the second.

Effect of reducing diet on Hb levels

At the start of the study the Hb concentration was less than 11.5g/l in 11 (39.3%) following a low fat diet, six (54.5%) of those following a low fat/healthy eating diet and two (66.7%) following a healthy eating diet.

After the first month of dieting, in those who followed a low fat diet, the most popular type of diet, Hb concentrations increased in 11 (47.8%), (mean increase being $0.7 \pm 0.5\text{g/l}$), decreased in 10 (43.7%), (mean decrease $0.7 \pm 0.4\text{g/l}$) and remained the same in two (8.7%). In those following a low fat/healthy eating diet five (83.3%) had an increase in Hb concentration (mean increase $1.1 \pm 0.5\text{g/l}$) and one (16.7%) a decrease. The three who followed a healthy eating diet all had a decrease in concentration (mean decrease: $1.0 \pm 0.5\text{g/l}$).

After two months Hb concentration had decreased in 13 (61.9%) and increased in eight (38.1%) dieters who were following a low fat diet. In those following a low fat/healthy eating diet two (33.3%) had an increase and four (66.7%) a decrease in Hb levels. Those following a healthy eating diet all saw an increase.

Cholesterol levels

The mean total cholesterol (TC) concentration of the dieters first measurement using the Accutrend was 5.0 ± 0.7 mmol/l (30 dieters with levels above 3.88mmol/l, 20 had levels below). After one month, the mean was 4.8 ± 0.8 mmol/l (calculated using 19 dieters - 18 had levels below 3.88mmol/l). After two months the mean was 4.9 ± 0.8 mmol/l (calculated using 16 dieters - 18 had levels below 3.88mmol/l).

After dieting for one month the TC concentrations remained below 3.88mmol/l in 12 (32.4%) of those who had recorded that level at the beginning of the study. Concentration increased in 12 (32.4%) dieters (mean increase in 7 was 0.6 ± 0.4 mmol/l) and decreased in 13 (35.2%) dieters (mean decrease in 7 was 0.9 ± 0.7 mmol/l). After dieting for two months the TC levels remained below 3.88mmol/l in 13 (38.2%) of those who had recorded that level at the beginning of the study. Levels increased in nine (26.5%) dieters (mean increase in 4 was 0.63 ± 0.5 mmol/l) and decreased in 12 (35.3%) dieters (mean decrease in 6 was 0.9 ± 0.4 mmol/l).

The mean changes could only be calculated on those with recordable results.

Effect of reducing diet on cholesterol levels

At the start of the study 12 (42.9%) following a low fat diet had a TC concentration below 3.88mmol/l and seven (25.0%) had a concentration above 5.5mmol/l. Two (18.2%) of those following a low fat/healthy eating diet had concentrations below 3.88mmol/l and two (18.2%) had a concentration above 5.5mmol/l. Two of those following a healthy eating diet (66.7%) had concentrations below 3.88mmol/l and one (33.3%) had a level of 4.23mmol/l.

After one month eight (33.3%) of those following a low fat diet had an increase in their TC concentration (mean increase in four was 0.4 ± 0.3 mmol/l), nine (37.5%) had a decrease (mean decrease in six was 1.01 ± 0.74 mmol/l) and seven (29.2%) remained below 3.88mmol/l. Concentrations of TC in those following a low fat/healthy eating diet remained the same in two (33.3%), increased in one (16.7%) and decreased in three (50.0%). In those following a healthy eating diet levels remained the same in two (66.7%) and decreased in one (33.3%).

After two months six (27.3%) of those following a low fat diet had an increase in their TC concentrations (mean increase in three was 0.39 ± 0.3 mmol/l), 11 (50.0%) had a decrease (mean decrease in six was 0.9 ± 0.4 mmol/l) and five (22.7%) remained the below 3.88mmol/l. TC concentrations in those following a low fat/healthy eating diet remained the same in four (66.7%) and increased in two (33.3%). In those following a healthy eating diet the TC concentration of all three remained under 3.88mmol/l.

Analysis of weight loss in those following a low fat diet compared to other types of diet

After one month, seven out of 16 (43.7%) of those following a low fat diet had lost over 1kg. Amongst those following other types of diet, two out of five (40.0%) had lost over 1kg. The mean weight loss was 1.5 ± 1.3 kg in those following a low fat diet, slightly higher than in those following other types of diet, 1.1 ± 1.0 kg.

After two months, eight (61.5%) of those following a low fat diet had lost over 1kg and five (38.4%) had lost under 1kg. Amongst those following other types of diet, three (42.8%) had lost over 1kg and four (57.1%) had lost under 1kg. The mean weight loss was 1.3 ± 0.9 in those following a low fat diet, again slightly higher than in those following other types of diet 0.9 ± 0.8 .

3.4.2

Discussion

The results of this study show that dieting is a popular practice amongst women of all ages, however, most volunteers (38.0%) fell within the 31- 40 age group. Amongst the dieting group 28.0% had a BMI within the normal range (20-24.9). The percentage of normal weight dieters amongst this older group was less than that found amongst the adolescent dieting girls, and students, 80.0% and 59.0%, respectively. Although staying attractive is important to all age groups regardless of weight, it may be that dieting amongst the non-obese is not as prevalent in older women because of their natural susceptibility to weight increase due to hormonal changes during pregnancy and the menopause (Streigel-Moore et al, 1986). It may be suggested that older women may be less susceptible to media influences, with the 'thin ideal' being a younger perception. This is further illustrated by the results as it was found that the mean BMI increased with each age group. Many of the women (36.0%) had been dieting for over 15 years and 40.0% of the group had been dieting since their teens. As Streigel-Moore et al (1986) suggests, it would appear to be the case that the campaign against increasing weight lasts a lifetime.

Despite the weight of an individual the decision to diet should not be taken lightly (Rossner, 1989, Beiner & Heaton, 1995), as dieting practices may have a significant negative effect on the health of the individual (Brownell, 1993). Dieting may predispose to health problems through the actual dieting practices followed by an individual, such as weight cycling and also by restricting nutritional intake (Manore, 1996).

Dieting practices have been described as 'the norm' in the USA (Berg, 1992), which appears to be the case for a number of women in this study as 11 (22.0%) said they dieted continually, although whether they did actually diet continually may be doubtful as seven of these dieters had a energy intake of under 1400kcal/d and four of these having an intake under 1200kcal/d, which would have been incompatible with life if habitually undertaken.

This explanation is also supported by results which showed that only 11 dieters continued to lose weight over the two months of the study. It is probably more likely that these dieters, dieted on and off, as most of the dieters did (38.0%), with the diet usually lasting about one month and then after another month they would diet again. The fact that the majority dieted on and off suggests that many women are engaged in 'weight cycling' behaviour, a term which describes repetitive weight loss and regain (Manore, 1996). Weight cycling, is thought to make future weight loss attempts even more difficult, possibly leading to increased obesity and an increased risk of developing coronary heart disease (Wilson, 1995), coronary heart disease being a major cause of death in women (Kris-Etherton & Krummel, 1993). Indeed various studies have found a significant association between weight fluctuation and coronary heart disease (Lissner & Brownell, 1992). Weight fluctuation appeared evident in this study. Although a similar percentage lost weight in the first and second months of the study, only 22.0% of the dieters actually continued to lose weight over the two months, the rest either gained weight or had no weight change. A study by Grodstein et al (1996) also demonstrated a pattern of weight regain following dieting. It would appear that dieting to lose weight may be successful in the short term, however, more often than not, some or all weight lost is usually regained (NIH, 1992).

The development of Coronary heart disease (CHD) in an individual may also stem from the nutritional status of the mother (Barker et al, 1993). It has been suggested that the reproductive potential of an individual may be at risk because of dieting behaviour (Kirkley and Burge, 1989), indeed Gormican et al (1980) suggest that the greater the weight deficit before pregnancy the greater the risk to the health of the baby. Extensive research undertaken recently has demonstrated how undernutrition during pregnancy may retard the various stages of embryonic growth, thereby, predisposing the baby to cardiovascular risk factors, such as hypertension (Law et al, 1993), increased insulin resistance and abnormal LDL cholesterol metabolism (Barker et al, 1993).

The fact that the dieters had a mean total fat intake of 29.4% of their total food energy intake, which meets the recommended DRV of no more than 35.0% and shows a decrease

in fat intake from 38.2% as reported by the DNSBA (1990) would suggest that the dieters are now consuming a diet which is not conducive to CHD. Although the mean total fat intake was less than the recommended DRV there were 12 (27.9%) of the dieters who had a total fat intake above 35.0%, a similar percentage to the non dieters (27.0%) and also 19 (44.2%) dieters had a saturated fat intake above 11.0% (DRV-1991), these individuals may be at an increased risk of developing CHD. Nine dieters who conceded that they were following low fat or low fat/healthy eating diets had a total fat intake above 35.0% of their total food energy intake. In the case of these subjects it may be possible that a lack of nutritional knowledge may be increasing their predisposition to CHD. A higher percentage of non-dieters had a saturated fat intake above the DRV (66.7%). Although the fat intake of some dieters may predispose to the development of CHD the lipid profile of the majority was favourable, however, 10 dieters had a TC concentration above 5.5mmol/l and an HDL concentration below 0.89mmol/l. Despite having a higher total dietary fat and saturated fat intake the mean TC concentration in the non-dieters was lower than the dieters (4.9mmol/l) and none had HDL levels below the reference levels. It is possible that genetic factors may have influenced cholesterol concentrations. In comparison to results reported by the DNSBA (1990) it would appear that there has been a reduction in the amount of fat consumed over the last 10 years, however, the results of this study show that the amount of fat and type of fat consumed does in fact remain a problem in a number of subjects. It may be demonstrated that although the most popular type of diet is a low fat diet with 56.0% of dieters using it, results from dietary intakes actually suggest that a number are not strictly following such a diet. Recent research has shown that the TC concentration falls when a low fat diet is strictly followed (Dattilo & Kris-Etherton, 1992, Kasim et al, 1993). In those following a low fat diet in this study, after one month eight had a increase in TC concentrations and after two months six had an increase in TC concentrations. These results may also suggest that some subjects were not following their low fat diet strictly.

Although a number of dieters had fat intakes which were more than recommended amounts, the lowest fat intake was 13.41% of total food energy, indeed, 17 (24.2%) of dieters had a total fat intake less than 25.0% (FE). Severely restricting fat intake may also

predispose to health problems. Upritchard & Ball (1993) found that where women consumed a diet where less than 25.0-30.0% of their intake came from fat they were less likely to meet dietary recommendations than those consuming greater than 30.0-33.0% of their energy from fat and expressed concern because low fat diet may not meet requirements where mineral intakes are concerned (i.e. iron, calcium, zinc and magnesium). Previous research (Zwiauwer, et al 1988, van Dale, et al 1989) has shown that a low fat diet may result in low levels of fat soluble nutrients, however, the results of this study show that the mean concentrations of plasma retinol and tocopherol were not below reference levels. Although stressing the importance of reducing fat intake is important it is vital that people still realise that dietary fat is still an important nutrient. Shwartz and Borra (1997) suggested that the importance placed upon dietary fat over recent years has seriously damaged consumer perception of the requirements of healthy eating.

The results of this study highlight the potential health risk of a low fat diet in relation to calcium intake. Although the dieters did in fact have a higher mean calcium intake than the non dieters, those following a low fat reducing diet had a lower mean calcium intake than dieters following other diets, 647.7mg/d and 1071.2mg/d, respectively. The calcium intake of those following a low fat diet fell below recommended amounts, as did the intake of the non-dieters. These results may demonstrate how people may wrongly perceive dairy products as an unhealthy food because of the fat content. Some dieters may eat low fat dairy products because they are perceived as a 'diet food' and are therefore obtaining adequate calcium intake however, because a low fat diet is promoted as being a 'healthy diet' to the general population, those dieters following low fat diets and indeed, the non-dieters may try and eliminate dairy products in all forms, not realising the benefits of these foods to health. Previous research has demonstrated the importance of dairy products to health. Cadogan et al (1997) demonstrated the benefits of increased milk consumption with regard to increased bone mineral acquisition, which is particularly important during adolescence, a peak period for calcium retention (Sentipal et al, 1991). A reduced skeletal mass may lead to the development of osteoporosis in later life (Kreipe & Forbes, 1990, Kanis & Pitt, 1992, WHO, 1994). The results of this study and evidence from previous research would suggest that greater recognition should be given to the positive aspects of

dietary fat. Although plasma calcium status does not generally reflect total body calcium status, animal studies have demonstrated poor mineralisation when serum calcium levels have been 50.0% of normal levels (Brody, 1994). The mean blood calcium concentrations reported in this study are similar for both dieters and non-dieters, however 88.1% of the total group had levels below the lowest reference level of 2.25mmol/l and 12 had levels 50.0% below normal levels. It may be suggested that the low calcium concentrations in this study were related to the low protein and albumin levels which were recorded in 20 subjects. About 40.0% of serum calcium is protein bound, with most of it (80.0%) being bound to albumin. Because of the uncertainty surrounding plasma calcium levels in relation to dietary intake, the results of this study may indicate a need for further research in this area.

The British Nutrition Foundation report (1995) suggests that low energy diets consumed by those trying to lose weight are unlikely to provide adequate levels of dietary iron unless the diet is very well balanced. The results of this study found that all non-dieters and 95.3% of dieters failed to achieve the DRV for iron, indeed mean intakes in the dieters were 9.1mg/d, slightly higher than the non-dieters who had an intake of 8.0mg/d. The dieters also had a higher intake of vitamin C than the non-dieters which facilitates the absorption of dietary iron. These results would suggest that all women, despite dieting status may be at risk from developing iron deficiency anaemia. Iron deficiency is believed to be the most common nutritional disorder in the world (Thomas, 1994), which may predispose to iron deficiency anaemia (Macphail & Bothwell, 1992). Of concern was that the low intake of dietary iron was reflected in low Hb concentrations amongst a number of women, although no direct correlation between intake and Hb concentrations was observed. The mean Hb concentration was higher amongst the non-dieters than dieters, 12.0g/l and 11.6g/l, respectively, however, a similar percentage of dieters (44.0%) and non-dieters (45.0%) had Hb concentrations below 11.5g/dl, the lowest recommended concentrations in females (Thomas, 1994). Amongst the dieters a higher percentage of non-obese than overweight/obese dieters had a Hb concentration below 11.5g/l, 57.1% and 38.8%, respectively. Iron deficiency can be diagnosed by a low serum concentration of ferritin (Hallberg et al, 1993), which accurately reflects the tissue stores of iron. Ferritin

levels were measured in 20 volunteers (dieters and non-dieters) with the all results being within the reference levels, indeed levels were significantly higher in dieters than non-dieters. In addition, none of the volunteers had low TI, raised TIBC and UIBC concentrations and none had a percentage saturation of transferrin below 15% (indicators of iron-deficiency anaemia). These results suggest that these women are not at risk from iron deficiency anaemia, however, their mean dietary iron intake was 10.2mg/d and their mean Hb level was 12.2g/l, both higher than the overall mean results. The results also suggest that there may be a number of women amongst those who only had their Hb concentration measured who might be at risk from developing iron-deficiency anaemia, however, a more complete profile regarding iron status would have to be obtained in order to make a correct diagnosis. The fact that a greater percentage of non-obese than overweight/obese dieters had a Hb concentration below 11.5g/l may indicate that obese dieters are more likely to follow a more well balanced diet than non-obese dieters.

Previous research has expressed concern about dieters following diets which are nutritionally inadequate (Upritchard & Ball, 1993), and Crawley and Shergill-Bonner (1995) have shown that deficiencies, although apparent in both dieters and non-dieters, were more prevalent in dieters. The results of this study show that deficient nutrient intakes were more prevalent amongst non-dieters than dieters, particularly in the case of retinol, iron, folate, calcium and vitamin C and NSP. French & Jeffery (1994) suggested that dieters who follow weight loss programmes usually obtain a diet that is fairly well balanced, which appeared to be the case in this study. It is possible that reducing diets do offer clearer guidelines regarding healthy foods and are easy to understand. There is an abundance of dietary information aimed at the general population, from many different sources, which may be causing confusion and leading to misconceptions amongst those who do not need to diet. From the results of this study it appears that dieters are not at any more risk than non-dieters from potential nutrition related diseases.

Limitations of study

A major limitation associated with a dietary study is obviously the validity of the results. In a study looking at dieting behaviour it is difficult to differentiate between under-reporting and reduced intake due to the actual reducing diet. In order to assess the validity of the information given, the ratio energy intake to calculated metabolic rate was calculated (EI:BMR). Studies by the WHO (1985) have shown that values below 1.2 are unlikely to meet nutritional requirements. The results of this study showed mean values of 0.88 and 1.15 amongst dieters and non-dieters, respectively. Low values such as these may be expected in those following low energy reducing diets, however, regardless of dieting status, an intake such as this could not be maintained without effecting the health of the individual. The mean result of 1.15 amongst the non-dieters would indicate a degree of under-reporting, however, from the results regarding dietary iron and plasma levels (45.0% with a level below 11.5g/l) it may be suggested that their diets were restricted to a certain degree. Limitations are also associated with the collection of biochemical data. Use of the Accutrend to determine total cholesterol measurements is not ideal as it will not identify levels below 3.88mmol/l. However, in a fieldwork situation and where subjects are unwilling to volunteer venous blood there is little alternative.

3.4.3

Conclusion

Despite any limitation associated with this study the results have provided important information regarding dietary behaviour amongst adult women and identified areas which may have implications with regard to their health. The reality of habitually low energy intakes may be questioned because of the unlikelyhood of them meeting the requirements needed to maintain health. However, consideration of the findings that demonstrate that women diet for long periods of time over a number of years may provide evidence that many women do maintain a dietary intake that is inappropriate to their needs and predisposes to health problems. The deficient dietary iron intakes and low haemoglobin levels found in the subjects of this study would lend support to this.

A further conclusion of this study shows that there is very little difference between the quality of diet consumed by dieters and non-dieters. Indeed in many cases nutrient intake is higher amongst the dieters when compared with non-dieters, and within both groups similarly high percentages failed to achieve DRV'S. Amongst those dieters following a low fat diet, 70.8% had an intake of calcium below the DRV. This finding is of concern when the incidence of osteoporosis amongst women in this country is taken into account, especially as low fat diets are popular amongst healthy eating non-dieters. The calcium intake amongst the non-dieters in this study was in fact lower than in the dieters. This would show that the concern that is expressed about the health risks associated with dieting is misplaced and should include the population as a whole as both groups are susceptible to similar nutritional deficiencies.

Previous research regarding the effects of dieting in relation to blood nutrient concentration has been concerned with obese subjects. This study attempted to compare identify any difference between obese and non-obese dieters and found that a higher percentage of non-obese dieters had Hb concentrations below 11.5g/l. This would suggest that non-dieters may have a greater risk of developing health problems. Although no other differences were observed concerning other blood nutrients, sample numbers were small and in view of the HB results, further research should be undertaken

The points of concern that have been highlighted by this study may have implications for the other members of the family. The dietary intake of the mother may influence other members and the health risks exposed may also extend to the rest of the family. The consequences of this may affect the health of children and adolescents for the rest of their lives.

This study not only highlights the nutritional problems associated with dieting but also shows how the rest of the non-dieting population are risking their health to a similar extent.

Section 4.

Conclusion

This study has raised certain issues which may question the results of previous research and have implications for future research regarding dieting practices/behaviour, not only amongst adolescent, but in all age groups.

The incidence of dieting has been reported by many studies, however, there is a great deal of variation in reported results. Because of the degree in variation that exists, the actual incidence of dieting may be questioned. French & Jeffery (1994) suggest that the way in which a person is asked if they are dieting may influence results, for example, are you presently dieting? versus, have you ever dieted? This was found to be the case in the follow-up study involving the adolescents. When the girls were asked have you ever dieted? the result was 33.6%, which is consistent with the result from the first part of the study, in which the same question was used. However, when asked if they were presently dieting? the result was 15.8%, which shows the incidence to be much lower. From this finding it may be concluded that it is important to take into account the wording of a question which determines the incidence of dieting especially when comparing results with other studies and relating the results to the population at large.

The reported incidence of dieting from this study, and indeed previous research, at face value gives cause for concern, especially in the light of the health problems which have been linked with dieting. However, the concern that is expressed about dieting behaviour, especially amongst adolescent girls may be misplaced, as various opinions regarding the meaning of dieting are evident amongst this group. Neumark-Sztainer & Story (1998) found that adolescents view 'dieting' from a much broader angle than do health professionals, and in the majority of cases it was viewed as a healthy eating behaviour. A similar finding was found amongst the adolescents questioned in the first part of the study where 66.0% were of the opinion that dieting was perceived as a healthy practice.

Misconceptions regarding dieting behaviour appeared to be evident amongst a number of adults, as 48.0% of parents were supportive of their daughters dieting practices. Indeed, previous research has found that some parents give children the type of diet recommended by health professionals for adults at risk from cardiovascular disease with the aim of preventing premature atherosclerosis and obesity.

11.6.3

The most popular type of reducing diet used by the adolescent girls and the young women was a low fat diet and amongst the adolescents the second most popular was a healthy eating diet. It may be suggested that the role of such dietary intakes as a reducing diet may be debatable as both may be used by non-dieters who are following general healthy eating recommendations. Unless the overall energy intake is reduced then neither type of diet will result in weight loss. Neumark-Sztainer et al (1997) question actual dieting behaviour and suggest that self-reported dieting may not correlate with actual reported energy intake. Further evidence that would suggest that there may be little difference in the dietary intake of the majority of dieters and non-dieters was presented by the adolescent follow-up study which found that 'healthy eating' is perceived in a similar light to dieting by both dieters and non-dieters. Only a small percentage identified dieting with restrictive behaviour which may be a direct health risk. Therefore, a further conclusion drawn from this study would suggest that actual dieting behaviour amongst adolescent girls is not as restrictive as it seems and perceptions regarding 'dieting' and 'healthy eating' may suggest that adolescents are confused about the meaning of these types of eating behaviour.

11.6.4

Several studies have reported that skipping meals appears to be a popular dieting practice (French et al, 1995, Serdula et al, 1993). However, the findings of this study show that of those adolescents using such practices, 19.0% also reported they were using a 'healthy eating' diet and 28.0% had chosen their diet because they believed they were eating healthily. Further investigation into this issue revealed that similar numbers of dieters and non-dieters never ate breakfast, which may suggest that some non-dieters might also be restricting their dietary intake. Indeed, results from the adults dietary study revealed that the mean energy intake of non-dieters was below the DRV, although higher than the dieters, which suggests that a degree of dietary restriction may exist amongst non-dieters

and supports the hypothesis that the dietary intake is similar between a number of dieters and non-dieters. These findings suggest that concern should be expressed about the dietary intake of young girls, and indeed females of all ages, as a whole, as dieters and non-dieters are likely to be following similar dietary habits.

This study found that 80.0% of the adolescent girls and 45.5% of the young women who reported that they were dieting were within normal weight limits. There is a lack of research which looks at the health risks to those dieters of normal weight. This study found that a higher percentage of non-obese than overweight/obese dieters had Hb concentrations below 11.5g/l, although no differences were seen in other blood nutrient concentrations. However in view of the questions that have been raised concerning the actual incidence of dieting further research needs to be undertaken in non-obese females who can be shown to be definitely dieting to lose weight.

Over recent years nutritional recommendations have placed importance on reducing dietary fat (DoH, 1991, 1994). A high dietary fat intake is a major cause of obesity and heart disease, however, it may be that the importance placed on dietary fat over recent years has seriously damaged consumer perception of the requirements of healthy eating, indeed it has been found that 15.0% of Americans believed it was important to eliminate all types of fat from their diet and 81.0% of children aged 9-15 years incorrectly believed that a healthful diet meant one that is devoid of all fat (Schwartz & Borra, 1997). Results from this study found that 10.1% of the girls felt that all types of fat were bad for you, with this opinion being higher amongst the non-dieters. It may therefore be suggested that misconceptions regarding healthy eating and dietary fat intake are more of a threat to the health of females than actual dieting behaviour, indeed Upritchard & Ball (1993) expressed concern because consuming a low fat diet may not provide dietary recommendations, especially where calcium and iron are concerned. The concerns raised by Upritchard & Ball (1993) are illustrated by the results of the adult dieting study, which 70.8% of those following a low fat diet had a calcium intake below the DRV, however, this figure amongst non-dieters was 66.7%. Iron intake was low regardless of diet type. The study also revealed that in many cases nutrient intake was generally higher amongst

the dieters when compared to the non-dieters, which suggests that some dieters may be consuming a more well balanced dietary intake than some non-dieters. The misconceptions held, regarding dieting in relation to health and also the fact that many females may be following inappropriate low fat diets point towards a serious lack of knowledge amongst a number of the female population. Findings which suggest that an emphasis needs to be placed upon nutritional education. As it has been suggested by Sanders (1994) because of the importance of dietary fat to health a greater recognition should be given to the positive aspects of dietary fat.

In summing up, this study demonstrates that dieting is not a clear cut issue. It is evident that a restriction of dietary intake exists amongst non-dieters, although in some cases to a lesser extent than to dieters. However, it is also the case that a number of dieting females have a more well balanced diet than some non-dieters. The confusion and misconceptions that exist regarding nutritional issues and the concepts held regarding dieting and healthy eating make it impossible to show the exact incidence of dieting amongst the female population. The findings of this study suggest that research that is undertaken in order to determine the incidence of dieting is pointless unless validated by the measurement of nutritional status and knowledge.

It may therefore, be suggested that regardless of dieting status all females are at risk from health problems arising from nutritional deficiencies. A finding which highlights the need to re-assess the way in which nutritional advice is presented. In approaching this matter certain factors may be considered. Firstly, the way in which the subject of dieting is approached when it concerns young girls. It is important that they are allowed to talk about the subject freely. Talking about a subject which they are already familiar with will not lead to them developing eating disorders, contrary to popular opinion. Secondly, despite the rising incidence of obesity it is important to move away from the idea of 'dieting'. The success rates of dieting are not good and are coupled with a stigma that only serves to increase psychological problems in women and young girls who are already very vulnerable about their appearance. A healthy, active lifestyle for all needs to be reinforced to all groups, the obese should not be treated as a problem group. Lastly the nutritional

importance of all food types needs to be emphasised, especially where fat is concerned. It needs to be made clear that fat is an important nutrient, vital to good health, including reducing the risk of coronary heart disease. Advice regarding dietary fat is misinterpreted by many people, including health professionals, a matter that urgently needs addressing. This study has shown that dieting has become a general public health issue, which may have implications for the female population as a whole.

Section 5.

References

Abbey, M et al (1993) Antioxidant vitamins and low density lipoprotein oxidation. *Am J of Clin Nut.* Vol. 58:525-32.

Abrams, S A & Stuff, J E (1994) Calcium metabolism in girls: current dietary intakes lead to low rates of calcium absorption and retention during puberty. *Am J Clin Nut.* Vol. 60:739-43.

Addison, G M et al (1972) An immunoradiometric assay for ferritin in the serum of normal subjects and patients with iron deficiency and iron overload. *J Clin Path.* Vol. 25:326-329.

Alexander, J M & Tepper, B J (1995) Use of reduced calorie/reduced-fat foods by young adults: influence and gender. *Appetite.* Vol. 25:217-230.

Allain, C et al (1974) Enzymatic determination of total serum cholesterol. *Clin Chem.* Vol. 20, No. 4:470-475.

Alleyne, et al (1977) Protein Energy Malnutrition. Edward Arnold Publishers, London.

Altschul, A M (1989) Low-calorie foods. Scientific status summary by the Institute of Food Technologists' Expert Panel on Food Safety & Nutrition. Vol. 43:113-125.

Anderson, A E & Di Dominico, L (1992) Diet Vs. Shape content of popular male and female magazines: a does-response relationship to the incidence of eating disorders. *Int J of Eat Dis.* Vol. 11, No. 3:283-287.

Andres, R et al (1993) Long-term effects of change in body weight on all-cause mortality. *Ann Intern Med.* Vol. 119, No.7, Pt.2:737-743.

Assman, G et al (1983) Quantification of high density lipoprotein cholesterol by precipitation with phosphotungstic acid/Mg/Cl₂. Vol. 29, No.12:2026-2030.

Bauer, et al (1974) Clinical Laboratory Methods, 8th edition. C.V Mosby Co; Saint Louis.

Bardini, L G et al (1990) Energy requirements in obese and non-obese adolescents. *Pediatr Res.* Vol. 27:198-202.

Barker, D J P et al (1992) Relation of fetal and infant growth to plasma fibrinogen and factor VII concentrations in adult life. *BMJ.* Vol. 304:148-52.

Barker, D J P et al (1993) Growth in utero and serum cholesterol concentrations in adult life. *BMJ*. Vol. 307:1524-7.

Barr, S I et al (1994) Restrained eating and ovulatory disturbances: possible implications for bone health. *Am J of Clin Nut.* Vol. 59:82-97.

Beamish, M R et al (1971) A rapid method for the detection of ferritin in serum. *J of Clin Path.* Vol. 24:581-582.

Belfer, M (1983) The development and sustenance of self esteem in childhood. International Universities Press, New York.

Bellisle, F et al (1995) Weight concerns and eating patterns: a survey of university students in Europe. *Int J of Obes.* Vol.19:723-730.

Bellizzi, M C & Dietz, M C (1999) Workshop on childhood obesity: summary of the discussion. *Am J of Clin Nut.* Vol. 70:173s-5s.

Benton, D & Roberts, G (1988) Effect of vitamin and mineral supplementation on the intelligence of schoolchildren. *Lancet.* Vol.i:140.

Berg, F M (1992) Harmful weight loss practices are widespread among adolescents. *Obes & Hlth.* Jul/Aug:69.

Berg, F M (1996) Dieting and weight loss increase osteoporosis risk. *Hlth Wght Journal.* Jan/Feb:10-12.

Biener, L & Heaton, A (1995) Women dieters of normal weight: their motives, goals and risks. *Am J of Pub Hlth.* Vol.85, No.85:714-717.

Bingham, S A (1991a) Dietary aspects of a health strategy for England. *BMJ.* Vol. 303:353-355.

Bingham, S A (1991b) Assessment of food consumption and nutrient intake. Current intake. In: Design Concepts in Nutritional Epidemiology, chapter 6, p153. Eds: Margetts, B M and Nelson, M Oxford University Press, Oxford.

Bingham, S A et al (1994) Comparison of dietary assessment methods in nutritional epidemiology: weighed records v. 24 hr recalls, food frequency questionnaires and estimated-diet records. *Br J of Nut.* Vol. 72:619-643.

Black, A E et al (1991) Critical evaluation of energy intake data using fundamental principles of energy physiology: 2. evaluating the results of published surveys. *Eur J of Clin Nut.* Vol. 45:583-599.

Black, A E et al (1993) Measurements of total energy expenditure provide insights into the validity of dietary measurements of energy intake. *J Am Diet Assoc.* Vol. 93, No.5:572-579.

Blackburn, G L (1993) Comparison of medically supervised and unsupervised approaches to weight loss and control. *Ann Intern Med.* Vol. 119, No. 7, Pt. 2:714-718.

Blisset, J et al (1986) Dieting behaviour and the views of young children in Wales. *Hlth Ed Journal.* Vol. 55:101-107.

BNF (1995) Iron: Nutrition and Physiological Significance. British Nutrition Foundation - The Report of the British Nutrition Foundation Task force. Chapman & Hall, London.

Bone, A (1992) In Kemm, J R & Booth, D Promotion of Healthier Eating. HMSO, London.

Bost L et al (1998) Anthropometric measures and children's iron status, chapter 7. In Health Survey for England 1996. Ed. Prescott-Clark, P & Primatesta, P HMSO, London

Bothwell, T H (1979) Iron Metabolism in Man. Blackwell Scientific Publications, Oxford.

Brabin, L & Brabin, B J (1992) The cost of successful adolescent growth and development in girls in relation to iron and vitamin A status. *Am J of Clin Nut.* Vol. 55:955-8.

Bratteby, L E et al (1998) Total energy expenditure and physical activity as assessed by the doubly labelled water method in Swedish adolescents in whom energy intake was underestimated by 7-d diet records. *Am J of Clin Nut.* Vol. 67:905-11.

Bray, G A (1990) Obesity: historical development of scientific and cultural ideas. *Int J of Obes.* Vol. 14:909-926.

Bray, G A & Atkinson, R L (1977) Factors affecting basal metabolic rate. *Prog Fd Nutr Sci.* Vol.2:395-403.

Brett, E M & Hicks, M K (1981) Total-calcium measurement in serum from neonates: limitations of current methods. *Clin Chem.* Vol. 27, No. 10:1733-1737.

Bridges, N et al (1987) Evaluation of a new system for haemoglobin measurement. *Am Clin Prod Rev.* April:22-5.

Brody, T (1994) Nutritional Biochemistry. Academic press, San Diego - California.

Brownell, K D (1991) Dieting and the search for the perfect body: where physiology and culture collide. *Behaviour Therapy.* Vol.22:1-12.

Brownell, K D (1993) Whether obesity should be treated. *Hlth Psychol.* Vol.12:339-341.

Brownell, K D (1995) The history of obesity. In Eating Disorders and Obesity: A Comprehensive Handbook, chapter 66. Eds. Brownell, K D & Fairburn, C G. The Guildford Press, New York.

Brownell, K D & Rodin, J (1994) The dieting maelstrom: is it possible and advisable to lose weight. *Am Psychol.* Vol.49, No.9:781-791.

Bull, N L (1988) Studies of the dietary habits, food consumption and nutrient intakes of adolescent and young adults. *Wld Rev Nutr Diet.* Vol.57:24-74.

Button, E J et al (1996) A prospective study of self-esteem in the prediction of eating problems in adolescent schoolgirls: questionnaire findings. *Br J of Clin Psych.* Vol. 35:193-203.

Calzada, C et al (1995) Levels of antioxidant nutrients in plasma and low density lipoproteins: a human volunteer supplementation study. *Free Rad Res.* Vol. 23, No. 5:489-503.

Cardogan, J et al (1997) Milk intake and bone mineral acquisition in adolescent girls: randomised, controlled intervention trial. *BMJ.* Vol. 315:1255-60.

Chery, A et al (1987) Nutrition Knowledge and misconceptions of university students. *J Nutr Ed.* Vol. 19:237-241.

Chery, A et al (1989) Nutrition knowledge and misconceptions of university students with different disciplinary backgrounds. *J of Can Diet Assoc* Vol. 50, No.2:113-116.

Coufopoulos, A M (1997) Homelessness, Diet and Health, PhD Thesis. Liverpool John Moores University.

Cormillot, A (1995) Commercial and self-help approaches to weight management. In Eating Disorders and Obesity: A Comprehensive Handbook, chapter 88. Eds. Brownell, K D & Fairburn, C G. The Guildford Press, New York.

Crawford, P B et al (1994) Comparative advantage of 3-day food record over 24-hour recall and 5-day food frequency validated by observation of 9 and 10 year old girls. *J Am Diet Assoc.* Vol. 94:626-630.

Crawley, H (1992) Food Portion Sizes, 2nd edition. London: HMSO

Crawley, H & Shergill-Bonner, R (1995) The nutrient and food intakes of 16-17 year old female dieters in the UK. *J of Hum Nut Diet.* Vol.8:25-34.

- Crockett, S J & Sims, L S (1995) Environmental influences on children's eating. *J Nutr Ed.* Vol. 27:235-249.
- Davis, R et al (1978) Diet and retarded growth. *BMJ.* Vol.1:539-542.
- De Luca, L M (1996) Beta-carotene increases lung cancer incidence in cigarette smokers. *Nut Rev.* Vol. 54, No. 6:178-179.
- Cole, T J et al (1995) Body mass index reference curves for the UK, 1990. *Arch of Dis in Child.* Vol. 73:25-29.
- Dattilo, A M & Kris-Etherton, P M (1992) Effects of weight reduction on blood lipids and lipoproteins: a meta-analysis. *Am J Clin Nutr.* Vol. 56:320-8.
- Davis, D R et al (1978) Diet and retarded growth. *BMJ.* Vol. 1:539-542.
- Davies, K & Wardle, J (1994) Body image and dieting in pregnancy. *J of Psychosom Res.* Vol. 38, No. 8:787-799.
- DHSS (1997) Department of Health and Social Security. Report on Health and Social Subjects No. 31. The use of very low calorie diets in obesity. HMSO, London.
- Dixon, R et al (1996) Parental influences on the dieting beliefs and behaviours of adolescent females in New Zealand. *J of Adol Hlth.* Vol. 19:303-307.
- DoH (1991) Department of Health. Report on Health and Social Subjects No. 41. Dietary Reference Values for food energy and nutrients for the United Kingdom. Report on the Panel on Dietary Reference Values of the Committee on Medical Aspects of Food Policy. HMSO, London.
- DoH (1994) Department of Health. Report on Health and Social Subjects No. 46. Nutritional Aspects of Cardiovascular Disease. Report of the Cardiovascular Review Group Committee on Medical Aspects of food policy. HMSO, London.
- Dornbusch, S M et al (1984) Sexual maturation, social class and the desire to be thin among adolescent females. *Dev and Behav Pediatrics.* Vol. 5, No. 6:308-314.
- Doumas, B (1971) Albumin standards and the measurement of serum albumin with bromocresol green. *Clin Chem Acta.* Vol.31:87-96.
- Duthie, G (1993) Fat soluble vitamins. In Human Nutrition and Dietetics, chapter 13, 9th edition. Eds. Garrow, J S & James, W P T Churchill Livingstone, U K.
- Dwyer, J T (1992) Treatment of obesity: conventional programmes and fad diets. In Obesity, pp:662-676. Eds. Bjornntorp, P & Brodoff, B N J B Lipincott, Philadelphia.

- Dwyer, J T (1993) Childhood, youth and old age. In Human Nutrition and Dietetics, chapter 27, 9th edition. Eds. Garrow, J S & James, W P T Churchill Livingstone, U K.
- Dwyer, J T (1995) Popular diets. In Eating Disorders and Obesity: A Comprehensive Handbook, chapter 87. Eds. Brownell, K D & Fairburn, C G. The Guildford Press, New York.
- Dwyer, J T & Lu, D (1993) Popular diets for weight loss: from nutritionally hazardous to healthful. In Obesity: Theory and Therapy, 2nd edition. Eds: Stunkard, A J & Wadden, T A Raven Press Ltd, New York.
- Enstrom, J et al (1992) Vitamin C intake and mortality among a sample of the United States population. *J Epidemiol.* Vol. 3:194-202.
- Fall, C H D et al (1995) Fetal and infant growth and cardiovascular risk factors in women. *BMJ.* Vol. 310:428-32.
- Feldman, W et al (1986) Adolescents' pursuit of thinness. *AJDC.* Vol. 140:294.
- Feldman, W et al (1988) Culture versus biology: children's attitudes toward thinness and fatness. *Pediatrics.* Vol.81, No. 2:190-194.
- Fidanza F (1991) Nutritional Status Assessment: A Manual for population Studies. Chapman & Hall, London.
- Fogelholm, M et al (1997) Association between weight cycling and bone mineral density in premenopausal women. *Osteoporosis Int.* Vol. 7:354-358.
- Foster, J J (1993) Starting SPSS/PC+ and SPSS for windows - a beginners guide to data analysis, 2nd ed. Sigma Press, Wilmslow UK.
- Fox, M (1991) Adolescent attitudes towards body physique. *Proc Nut Soc.* Vol. 50:115A.
- French, S A & Jeffery, R W (1994) Consequences of dieting to lose weight: effects on physical and mental health. *Hlth Psych.* Vol.13:195-212.
- French, S A et al (1995) Changes in psychological variables and health behaviours by dieting status over a three year period in a cohort of adolescent females. *J of Adol Hlth.* Vol. 16:438-447.
- Fuller, N J et al (1990) Interobserver variability in the measurement of body composition. *Eur J of Clin Nut.* Vol. 45:43-49.
- Garner, D M & Wooley, S C (1991) Confronting the failure of behavioural and dietary treatment for obesity. *Clin Psych Rev.* Vol. 11:729-780.

- Garrow, J S (1980) Combined medical-surgical approaches to the treatment of obesity. *Am J Clin Nutr.* Vol. 33:425-30.
- Garrow, J S (1981) In Thomas, B T (1994) Manual of dietetic practice, 2nd edition. Blackwell Scientific Publications, Oxford.
- Garrow, J S (1995) Validation of methods for estimating habitual diet: proposed guidelines. Editorial, *Eur J of Clin Nutr.* Vol. 49:231-232.
- Garrow, J S & Webster, J (1985) Quetelet's Index (W/H^2) as a measure of fatness. *Int J of Obes.* Vol. 9:147-153.
- Green, M W & Rogers, P J (1995) Impaired cognitive function during spontaneous dieting. *Psychol Med.* Vol. 25:1003-1010.
- Gitelman, H J (1967) An improved automated procedure for the determination of calcium in biological specimens. *Analytical Biochem.* Vol.18:521-531.
- Goldberg G R et al (1991) Critical evaluation of energy intake data using fundamental principles of energy physiology: 1. Derivation of cut-off limits to identify under-recording. *Eur J of Clin Nut.* Vol. 45:569-581.
- Goldie, D J & Thomas, M J (1978) Measurement of serum ferritin by radioimmunoassay. *Ann of Clin Biochem.* Vol. 15:102-108.
- Gormican, A et al (1980) Relationships of maternal weight gain, prepregnancy weight, and infant birth weight. *J of the Am Diet Assoc.* Vol. 77:662-667.
- Gornall, A G et al (1949) Determination of serum proteins by means of the biuret reaction. *J Biol Chem.* Vol. 177:751.
- Gortmaker, S L et al (1993) Social and economic consequences of overweight in adolescence and young childhood. *N Eng J Med.* Vol. 329:1008-1012.
- Green, M W & Rogers, P J (1995) Impaired cognitive functioning during spontaneous dieting. *Psych Med.* Vol.25:1003-1010.
- Gregory, J et al (1990) The Dietary and Nutritional Survey of British Adults. HMSO, London.
- Grodstein, F et al (1996) Three year follow-up of participants in a commercial weight loss program - can you keep it off? *Arch Intern Med.* Vol. 156:1302-1306.
- Guillaume, M (1999) Defining obesity in childhood: current practice. *Am J of Clin Nut.* Vol. 70 (suppl):126s-30s.

- Gurr, M (1993) Fats. In Human Nutrition and Dietetics, chapter 6, 9th edition. Eds. Garrow, J S & James, W P T Churchill Livingstone, U K.
- Hackett, A F et al (1983) Use of dietary diary and intervention to estimate the food intake of children. *Hum Nut Appl Nut.* Vol. 37a:293-300.
- Hallberg, L (1993) Iron, zinc and other trace elements. In Human Nutrition and Dietetics, chapter 12, 9th edition. Eds. Garrow, J S & James, W P T Churchill Livingstone, U K.
- Hamm, P et al (1989) Large fluctuations in body weight during young adulthood and twenty-five-year risk of coronary death in men. *Am J of Epidemiol.* Vol.129, No.2:312-318.
- Harrison, C et al (1987) Solid-phase ELISA for serum ferritin: comparison with an immunoradiometric assay. *Lab Practice.* March.
- HEA (1999) Health Education Authority: Young People and Health - Health Behaviour in School-aged Children (1997). HEA, London.
- Herman, C P & Polivy, J (1991) Fat is a psychological issue. *New Scientist.* Vol. 1795:41-45.
- Higgins, M et al (1993) Benefits and adverse effects of weight loss. *Ann Intern Med* Vol. 119, No. 7, Pt. 2:758-763.
- Hill, A J & Robinson, A (1991) Dieting concerns have functional effects on the behaviour of nine-year old girls. *Br J of Clin Psych.* Vol. 30:265-267.
- Hill, A J (1994) A weight on children's minds: body shape dissatisfactions at 9-years old. *Int J of Obes.* Vol. 18:383-389.
- Hill, A J (1993) Causes and consequences of dieting and anorexia. *Proc Nut Soc.* Vol. 52:211-218.
- Hill, A J et al (1992) Eating in the adult world: the rise of dieting in childhood and adolescence. *Br J of Clin Psych.* Vol. 31:95-105.
- Hill, A J et al (1990) Dieting concerns of 10 year old girls and their mothers. *Br J of Clin Psych.* Vol. 29:346-348
- Hill, A J & Silver, E K (1995) Fat, friendless and unhealthy: 9 year old children's perception of body shape stereotypes. *Int J of Obes.* Vol. 19:423-430.
- Holbrook, T L & Barret-Conner, E (1993) The association of lifetime weight and weight control patterns with bone mineral density in an adult community. *Bone and Min.* Vol. 20:141-149.

Holland, B et al (1995) McCance and Widdowson's 'The Composition of Foods', 5th edition. The Royal Society of Chemistry and Ministry of Agriculture, Fisheries and Food, UK.

Horak, E et al (1975) An accurate spectrophotometric method for serum iron and iron-binding capacity without deproteinization or centrifugation. *Ann Clin Lab Sci.* Vol. 5:303-307.

Horm, J & Anderson, K (1993) Who in America is trying to lose weight? *Ann Intern Med.* Vol. 119, No. 7, Pt. 2:672-676.

Housten, M S et al (1997) Lifestyle and dietary practices influencing iron status in university women. *Nut Res.* Vol.17, No. 1:9-22.

Howard, A N (1989) The historical development of very low calorie diets. *Int J of Obes.* Vol. 13 (supple 2):1-9.

Hsu, L K G (1997) Can dieting cause an eating disorder? *Psychol Med.* Vol. 27:509-513.

Imrahn, S N et al (1996) Can self-estimates of body weight and height be used in place of measurements for college students? *Ergonomics.* Vol. 39, No. 12:1445-1453.

International Committee for Standardization in Haematology (ICSH) (1971): proposed recommendations for measurement of serum iron in human blood. *Blood.* Vol. 37:598-600.

International Committee for Standardization in Haematology (ICSH) (1978), Recommendations for reference method for haemoglobinometry in human blood (ICSH standard EP 6/2:1977) and specifications for international haemoglobincyanide reference preparation (ICSH standard EP 6/3:1977). *J Clin Pathol.* Vol. 31:139-43.

Jacobs, D et al (1992) Report of the Conference on low blood cholesterol: mortality associations. *Circulation.* Vol. 86:1046-1060.

Jeffery, R W et al (1991) Prevalence of overweight and weight loss behaviour in a metropolitan adult population: the Minnesota Heart Survey experience. *AJPH.* Vol. 74:349-352.

Johansson, L et al (1998) Under- and overreporting of energy intake related to weight status and lifestyle in a nationwide sample. *Am J of Clin Nut.* Vol. 68: 266-74.

Johnson, C L et al (1983) A descriptive survey of dieting and bulimic behaviour in a female High School population. *Report of the Fourth Ross Conference on Medical Research HIO Laboratories:* 14-20.

- Kanis, J A & Pitt, F A (1992) Epidemiology of Osteoporosis. *Bone*. Vol. 13:s7-215.
- Kannel, W B (1987) New perspectives on cardiovascular risk factors. *Am Heart J*. Vol. 114:213-218.
- Karr, M et al (1997) Plasma and serum lipid concentrations in preschool children. *Acta Paediatr*. Vol. 86: 667-82.
- Kaplan, R M & Toshima, M T (1992) Does a reduced fat diet cause retardation in child growth? *Prev Med*. Vol. 21:33-52.
- Kasim, S E et al (1993) Dietary and anthropometric determinants plasma lipoproteins during a long term low fat diet in healthy women. *Am J of Clin Nut*. Vol. 57:146-53.
- Katan, M B et al (1998) Effect of Low fat diets on plasma high density lipoprotein concentrations. *Am J of Clin Nut*. Vol. 67:573s-6s.
- Kaufman, H W et al (1990) How reliable can compact chemistry analysers measure lipids? *JAMA*. Vol. 263:1245-1249.
- Kemm, J R & Booth, D (1992) Promotion of Healthier Eating. HMSO. London.
- Kerstetter, J E (1995) Do dairy products improve bone density in adolescent girls? *Nut Rev*. Vol. 53, No. 11:328-332.
- Kessler, G & Wolfman, M (1964) An automated procedure for the simultaneous determination of calcium and phosphorus. *Clin Chem*. Vol. 10:686.
- Key Note (1993) The Slimming Report. Key Not Publications, Hampton UK.
- Keys, A (1965) Dietary survey methods in studies on cardiovascular epidemiology *Voeding*. Vol. 26:464-483.
- Khan, M A (1981) Evaluation of food patterns and preferences. *CRC crit. Rev. Fd Sci Nutr*. Vol. 14:129-153.
- Kinney, P R & Gray, C D (1997) SPSS for windows made simple, 2nd ed. Psychology Press Ltd. Hove UK.
- Kirkley, B G & Burge, J C (1989) Dietary restriction in young women: issues and concerns. *Ann of Behav Med*. Vol.11, Pt 2:66-72.
- Kreipe, R E & Forbes, G B (1990) Osteoporosis: a 'new morbidity' for dieting female adolescents. *Pediatrics*. Vol. 86, No.3:478-480.
- Kretsch, M J et al (1998) Cognitive function, iron status and haemoglobin concentration in obese dieting women. *Eur J of Clin Nutr*. Vol. 52:512-518.

- Kris-Etherton, P M & Krummel, D (1993) Role of nutrition in the prevention and treatment of coronary heart disease. *J of Am Diet Assoc.* Vol. 93:987-993.
- Kuller, L H (1997) Dietary fat and chronic diseases: epidemiologic overview. *J of am Diet Assoc.* Vol. 97:s9-s15.
- Kurzer, M S & Calloway, D H (1986) The effects of energy deprivation on sex hormones in health menstruating women. *Am J Physiol.* Vol. 251:E438-8.
- Lau, R R et al (1990) Development and change of young adults' preventive health beliefs and behaviour: Influence from parents and peers. *J of Hlth and Soc Behav.* Vol. 31:240-259.
- Law, C M et al (1993) Initiation of hypertension in utero and its amplification throughout life. *BMJ.* Vol. 306:24-7.
- Law, M R & Thompson, S G (1991) Serum cholesterol and cancer: conclusions from the analysis of data from all prospective studies. *Cancer Causes and Control.* Vol. 2:253-261.
- Lee, BL et al (1992) High-performance liquid chromatographic method for routine determination of vitamins A and E and β -carotene in plasma. *J of Chrom.* Vol. 581:41-47.
- Lee, I M & Paffenbarger, R S jr. (1992) Change in body weight and longevity. *JAMA.* Vol. 268:2045-9.
- Leibowitz, S F (1992) Brain neurotransmitters and hormones in relation to eating behaviour and disorders. In Obesity, pp:184-205. Eds. Bjornntorp, P & Brodoff, B N J B Lipincott, Philadelphia.
- Levy, A S & Heaton, A W (1993) Weight control practices of U S adults trying to lose weight. *Ann of Int Med.* Vol. 119, No. 7:661-666.
- Lewis, C J et al (1989) Examination of specific nutrition/health behaviours using a social cognitive model. *J of Am Diet Assoc.* Vol. 89:194-202.
- Lissner, L & Brownell, KD (1992) Weight cycling, mortality and cardiovascular disease: a review of epidemiologic findings. In Obesity, pp:653-661. Eds. Bjornntorp, P & Brodoff, B N J B Lipincott, Philadelphia.
- Lowe, M R (1993) The effects of dieting on behaviour: a three-factor model. *Psychol Bull.* Vol. 114:100-121.
- Lowe, G et al (1999) Carotenoid composition and antioxidant potential in subfractions of human low-density lipoprotein. *Ann Clin Biochem.* Vol.36:323-332.

- Lowry, O H (1951) Protein measurement with the folin phenol reagent. *J Biol Chem.* Vol. 193:265.
- Lucas, F et al (1995) Estimation of food portion size using photographs: validity, strengths, weaknesses and recommendations. *J of Hum Nut and Diet.* Vol. 8:65-74.
- Lytle, L A et al (1997) Children's interpretation of nutrition messages. *J Nut Ed.* Vol. 29:128-136.
- MacPhail, P & Bothwell, T H (1992) The prevalence and causes of nutritional anemia. In Nutritional Anemias. Eds. Fomon, S J & Zlotkin, S: Nestl—Nutrition Workshop Series Vol. 30. Nestec Ltd, Vevey/Raven Press Ltd; New York.
- Mallik, M J (1982) Health problems associated with dieting activities of a group of adolescent females. *Western J of Nurs Res.* Vol.4, No.2:167-177.
- Maloney, M J et al (1989) Dieting behaviour and eating attitudes in children. *Pediatrics.* Vol. 84, No. 3:482-489.
- Manore, M M (1996) Chronic dieting in active women: What are the health consequences? *Women's Hlth Issues.* Vol.6, No.6:332-341.
- Marino, D D & King, J C (1980) Nutritional concerns during adolescence. *Pediat Clin North Am* Vol. 27:125-139.
- Marr, J W (1971) Individual dietary surveys: purposes and methods. *World Rev of Nut and Diet.* Vol. 13:105-156.
- Mathews-Roth, M M & Stampfer, M J (1984) Some factors affecting the determination of carotenoids. *Clin Chem.* Vol. 30:459.
- Matousek, J P & Stevens, B J Biological applications of the carbon rod atomizer in atomic absorption spectroscopy. 1. Preliminary studies on magnesium, iron, copper, lead and zinc in blood plasma. *Clin Chem.* Vol. 17, No. 5:363-8.
- McCarger, L J & Yeung, H (1991) The effects of weight cycling on metabolism and health. *J of Can Diet Assoc.* Vol. 52, No. 2:101-106.
- McLaren, D S (1993) Fat soluble vitamins. In Human Nutrition and Dietetics, chapter 13, 9th edition. Eds. Garrow, J S & James, W P T Churchill Livingstone, U K.
- McNeill, G (1993) Energy. In Human Nutrition and Dietetics, chapter 3, 9th edition. Eds. Garrow, J S & James, W P T Churchill Livingstone, U K.
- McNeill, P (1990) Research Methods. Routledge, London.

- Merritt, R J et al (1981) Consequences of modified fasting in obese pediatric and adolescent patients: effect of a carbohydrate-free diet on serum lipids. *Am J of Clin Nut.* Vol. 34:2752-2755.
- Michaud, K K & Terry, R D (1993) Body image and dieting behaviours among school-aged children. *Top Clin Nut.* Vol.8, No. 2:45-50.
- Miles, L E M et al (1974) Measurement of serum Ferritin by a 2-site Immunoradiometric Assay. *Analytical Biochem.* Vol. 61:209-224.
- Milman, N et al (1987) Serum ferritin and iron status in mothers and newborn infants. *Acta Obstet Gynecol Scand.* Vol. 66:205-211.
- Mintel (1998) Slimming products. March:9-22.
- Moore, D C (1988) Body image and eating behaviour in adolescent girls. *AJDC.* Vol. 142:1114-1118.
- Moreno, A B & Thelan, M H (1995) Eating behaviour in Junior High school females. *Adolescence.* Vol. 30, No. 117:171-174
- NIH (1993) National Institute of Health Technology Assessment Conference panel: Methods for voluntary weight loss and control. *Ann of Intern Med.* Vol. 119, No. 7, Pt. 2:764-770.
- NIH (1992) National Institute of Health Technology Assessment Conference Panel: Methods for voluntary weight loss and control. *Ann of Intern Med.* Vol. 116:942-949.
- Nelson, et al (1996) Food photography II: use of food photographs for estimating portion size and the nutrient content of meals. *Br J of Nut.* Vol. 76:31-49.
- Nelson, M & Nettleton, P A (1980) Dietary survey methods. 1 A semi-weighed technique for measuring dietary intake within families. *J Hum Nutr.* Vol. 34:325-48.
- Neumark-Stainer, D et al (1996) Dieting for weight loss: associations with nutrient intake among women. *J Am Diet Assoc.* Vol. 96, No.11:1172-1175.
- Neumark-Sztainer, D et al (1997) Self-reported dieting: How should we ask? What does it mean? Associations between dieting and reported energy intake. *Int J of Eat Dis.* Vol. 22, Pt. 4:37-49.
- Neumark-Sztainer, D & Story, M (1988) Dieting and binge eating among adolescents: what do they really mean? *J Am Diet Assoc.* Vol. 98:446-450.
- Nierenberg, D W (1985) Serum and plasma β -carotene levels measurement with an improved method. *J Chrom.* Vol. 339:273.

- Nowalk, M P et al (1995) Consumption of low fat and low calcium diets among healthy premenopausal women. *J of Women's Health*. Vol.4, No.1:35-44.
- Nylander, I (1971) The feeling of being fat and dieting in a school population. *Acta Socio-medica Scand*. Vol. 1:17-26.
- Ohnishi, S T & Barr, J K (1987) A simplified method of quantitating proteins using the biuret and phenol reagents. *Anal Biochem*. Vol. 86:193.
- Okosun I S et al (1999) Abdominal obesity in the United States: prevalence and attributable risk of hypertension. *J of Hum Hypertension*. Vol.13, No.7:425-30.
- Olsen, A D & Hamlin, W B (1969) A new method for serum iron and total iron-binding capacity by atomic absorption spectrophotometry. *Clin Chem*. Vol. 15:438-444.
- Ortega, R M et al (1998) The importance of breakfast in meeting daily recommended calcium intake in a group of schoolchildren. *J of The Am Coll Nutr*. Vol.17, No.1:19-24.
- Ott, S M (1991) Bone density in adolescents. *N Eng J Med*, Vol. 325:1646-7.
- Patton, G C et al (1990) Abnormal eating attitudes in London schoolgirls - a prospective epidemiological study: outcome at twelve month follow-up. *Psychol Med*. Vol. 20:383-394.
- Paisley, C M et al (1996) Production and validation of a food frequency questionnaire to estimate dietary intake. *J of Hum Nut and Diet*. Vol. 9:189-206.
- Peters, P K et al (1996) Questionable dieting behaviours are used by young adults regardless of sex or student status. *J of Am Diet Assoc*. Vol. 7:709-711.
- Persijn, J P et al (1971) Determination of serum iron and latent iron-binding (LIBC). *Clin Chim Acta*. Vol. 35:91.
- Perry-Hunnicut, C & Newman, I M (1993) Adolescent dieting practices and nutritional knowledge. *Hlth Values*. Vol. 17, No. 4:35-40.
- Pirke, K M et al (1985) The influence of dieting on the menstrual cycle of healthy young women. *J Clin Endocrinol Metab*. Vol. 60:1974-9.
- Pope, H G et al (1987) Eating disorder and socio-economic class: anorexia and bulimia in nine communities. *The J of Nervous and mental Dis*. Vol. 175, No. 10:620-623.
- Prentice, A M (1996) Energy expenditure in overweight and obese adults in affluent societies: an analysis of 319 doubly-labelled water measurements. *Eur J of Clin Nut*. Vol. 50:93-97.

Prentice, A M et al (1986) High levels of energy expenditure in obese women. *BMJ*. Vol. 292:983-87.

Pryer, J A et al (1997) Who are the 'low energy reporters' in The dietary and Nutritional Survey of British Adults? *Int J of Epidemiol*. Vol. 26, No. 1:146-153.

Pugliese, M T et al (1983) Fear of obesity: a cause of short stature and delayed puberty. *The New Eng J of Med*. Vol. 309, No. 9:513-518.

Pugliese, M T et al (1987) Parental health beliefs as a cause of nonorganic failure to thrive. *Pediatrics*. Vol. 80, No. 2:175-182.

Ralph, A (1993) Methods for dietary assessment. In Human Nutrition and Dietetics, appendix 1, 9th edition Eds. Garrow, J S & James, W P T Churchill Livingstone, U K.

Reissman, K R & Dietrich, M R (1956) On the presence of ferritin in the peripheral blood of patients with hepatocellular disease. *J of Clin Invest*. Vol. 35:588-595.

Ricketts, C D (1997) Fat preferences, dietary fat intake and body composition in children. *Eur J of Clin Nut*. Vol. 51:778-781.

Robinson, S et al (1996) Evaluation of a food frequency questionnaire used to assess nutrient intake in pregnant women *Eur J of Clin Nut*. Vol. 50:302-308.

Rodin, J et al (1984) Women and weight: a normative discontent. *Nebraska Symposium on Motivation*. Vol. 32:267-307.

Roodenburg, A J C et al (1992) The influence of vitamin A on iron metabolism in the rat as an animal model. *Voeding*. Vol. 53, July/August:217.

Rosen, J C et al (1990) Life stress, psychological symptoms and weight reducing behaviour in adolescent girls: a prospective analysis. *Int J of Eat Dis*. Vol.9, No.1:17-26.

Rosen, J C & Gross, J (1987) The prevalence of weight reducing and weight gaining in adolescent girls and boys. *Hlth Psychol*. Vol. 6:131-147.

Rosen, J C & Poplawski, B A (1987) The validity of self-reported weight loss and weight gain efforts in adolescents. *Int J of Eat Dis*. Vol. 6, No. 4: 515-523.

Rossner, S (1989) Weight cycling - 'a new risk factor' *J of Int Med*. Vol. 226:209-211.

Sanders, T A B (1994) Dietary fat - weighing up the pros and cons. *Nut and Food Sci*. No. 5, Sept/Oct:9-13.

Schofield, W N (1985) Predicting basal metabolic rate, new standards and review of previous work. *Hum Nut: Clin Nut*. Vol. 39C, Suppl. 1:5-41.

Scholl, T O & Hediger, M L (1994) Anemia and iron deficiency anemia: compilation of data on pregnancy outcome. *Am J Clin Nut.* Vol. 59:492s-501s.

Sentipal, J M et al (1991) Influence of calcium intake and growth indexes on vertebral bone mineral density in young females. *Am J Clin Nut.* Vol. 54:425-8.

Serdula, M K et al (1993) Weight control practices of US adolescents and adults. *Ann of Int Med.* Vol.119, No.7, pt. 2:667-671.

Shepherd, R & Stockley, G (1992) Nutrition knowledge, attitudes and fat intake: application of the theory of reasoned action. *J of Hum Nut and Diet.* Vol. 5:387-397.

Shetty, P S et al (1979) Rapid-turnover transport proteins: an index of sub-clinical protein-energy malnutrition. *Lancet.* Vol. 2:230-2.

Shills, M E & Young, V R (1988) Modern nutrition in health and disease, 7th edition, Lea & Febiger, Philadelphia.

Shwarz, N E & Borra, S T (1997) What do consumers really think about dietary fat? *J of the Am Diet Assoc.* Vol. 97:s73-s75.

Smith, R (1993) Bone Mineral. In Human Nutrition and Dietetics, chapter 11, 9th edition. Eds. Garrow, J S & James, W P T. Churchill Livingstone, U K.

Smith, A et al (1994) Effects of breakfast and caffeine on cognitive performance, mood and cardiovascular functioning. *Appetite.* Vol. 22:39-55.

Smukler, G I (1983) Weight and food preoccupation in a population of English schoolgirls. Report on the 4th Ross Conference on Medical Research - H10 Ross Laboratories. Pages 21-8.

Sobal, J (1995) Social influences on body weight. In Eating Disorders and Obesity: A Comprehensive Handbook, chapter 14. Eds. Brownell, K D & Fairburn, C G. The Guildford Press, New York.

Southgate, D A T (1993) Food composition tables. In Human Nutrition and Dietetics, chapter 15, 9th edition. Eds. Garrow, J S & James, W P T. Churchill Livingstone, U K.

Stampfer, M et al (1993) Vitamin E consumption and the risk of coronary heart disease in women. *N Eng J Med.* Vol. 328:1444-1449.

Stookey, L L (1970) Ferrozine - A new spectrophotometer reagent for iron. *Anal Chem.* Vol. 42:779.

Story, M et al (1991) Demographic and risk factors associated with chronic dieting in adolescents. *AJDC.* Vol.145:994-998.

Story, M et al (1995) Ethnic/Racial and socioeconomic differences in dieting behaviours and body image perceptions in adolescents. *Int J of Eat Disord.* Vol.18, No. 2:173-179.

Streigel-Moore, R H et al (1986) Toward an understanding of risk factors for bulimia. *Am Psych.* Vol. 41:246-263.

Stewart, A L (1982) The reliability and validity of self-reported weight and height. *J of Chron Dis.* Vol. 35:295-309.

Stuff, J E et al (1983) A comparison of dietary methods in nutritional studies. *The Am J of Clin Nut.* Vol. 37:300-306.

Surawicz, B & Waller, B F (1995) The enigma of sudden cardiac death related to dieting. *Can J Cardiol.* Vol. 11, No. 3:228-231.

Thomas, B T (1994) Manual of dietetic practice, 2nd edition. Blackwell Scientific Publications, Oxford.

Thomsen, P A et al (1988) Nutrition information sources used by adolescents. *Home Ec Res.* Vol. 16:215-221.

Treasure, J et al (1997) Ill fitting genes: the biology of weight and shape control in relation to body composition and eating disorders. *Psychol Med.* Vol. 27:505-508.

Truswell, A S & Darnton-Hill, I (1981) Food habits of adolescents. *Nut Rev.* Vol. 39:73-88.

Upritchard, J E & Ball, M J (1993) Adequacy of mineral intakes in women following 'lipid lowering' and 'weight reducing' diets. *Proc of the Nut Soc of NZ.* Vol. 18:109-117.

Vaisman, N et al (1998) Effect of breakfast timing on the cognitive functions of elementary school students. *Arch Pediatr Adolesc Med.* Vol. 150:1089-1092.

van Dale, D et al (1989) Changes in vitamin status in plasma during exercise and dieting. *Int J Vit Nutr Res.* Vol.60, No. 1:67-74.

van Kampen, E J & Zijlstra, W G (1961) Standardization of hemoglobinometry, part II: The haemoglobincyanide method. *Clin Chim Acta.* Vol. 6:538-44.

van Strien, T et al (1986) The Dutch Eating Behaviour Questionnaire (DEBQ) for assessment of restrained, emotional and external eating behaviour. *Int J of Eat Dis.* Vol. 5, No. 2:295-315.

Vanzetti, G (1966) An azide-methemoglobin method for haemoglobin determination in blood. *J Lab Clin med.* Vol. 67:116-26.

- Voet, D & Voet, J G (1995) Biochemistry, 2nd edition. John Wiley & Sons Inc; New York.
- Wadden, T A et al (1989) Dissatisfaction with weight and figure in obese girls discontent but not depression. *Int J of Obes*. Vol. 13:89-97
- Wadden, T A et al (1990) Responsible and irresponsible use of very low calorie diets in the treatment of obesity. *JAMA*. Vol. 263:83-5.
- Wardle, J & Beales, S (1986) Restraint, Body image and food attitudes in children from 12-18 years. *Appetite*. Vol. 7:209-217.
- Wardle, J & Marsland, L (1990) Adolescent concerns about weight and eating; a social-developmental perspective. *J of Psych Res*. Vol.34, No. 4:377-391.
- Wardle, J et al (1995) Social variation in attitudes to obesity in children. *Int J of Obes*. Vol. 19:562-569.
- West, C E & Roodenburg, A J C (1992) Role of vitamin A in iron metabolism. *Voeding*. Vol. 53, July/August:201-204.
- Wertheim, E H et al (1997) Why do adolescent girls watch their weight? An interview study examining sociocultural pressures to be thin. *J of Psychosomatic Res*. Vol.42, No.4:345-355.
- Which? (1997) Winning the slimming battle. *Which? Magazine*. Jan:20-23.
- WHO (1994) World Health Organisation. Report of the WHO study group: Assessment of fracture risk and application to screening for post -menopausal osteoporosis. In World Health Organisation Geneva (eds.): Technical Series 843.
- Williamson, D F & Pamuk, E (1993) The association between weight loss and increased longevity. *Ann Int Med*. Vol. 119, No. 7, Pt. 2:731-736.
- Wilson, G T (1993) Relationship of dieting and voluntary weight loss to psychological functioning and binge eating. *Ann Int Med*. Vol. 119:727-730.
- Wilson, G T (1995) The controversy over dieting. In Eating Disorders and Obesity: A Comprehensive Handbook, chapter 17. Eds. Brownell, K D & Fairburn, C G. The Guildford Press, New York.
- Wones, R G et al (1988) Accuracy of reftotron cholesterol measurements by lab technicians and nurses in 1006 adults. *Circulation*. Oct. Supple 2, Vol. 78, No. 4:II-383.
- Woodward, D R et al (1981) Dietary studies on Tasmanian High School students: intake of energy and nutrients. *J of Aust Paediatr*. Vol. 17:196-201.

Worthington - Roberts, B (1985) Preconceptual and prenatal nutrition: Part 1 - energy, protein and related issues. *J of the Can Diet Assoc.* Vol. 46:169-81.

Xavier Pi-Sunyer, F (1993) Short term medical benefits and adverse effects of weight loss. *Ann Intern Med.* Vol. 119, No. 7, Pt. 2:722-726.

Zeigler, R G (1991) Vegetables, fruits and carotenoids and the risk of cancer. *Am J of Clin Nut.* Vol. 53:251s-9s.

Zwiauer, K et al (1988) Low plasma levels of vitamin A and E during weight reduction. *Acta Paediatr Scand.* Vol. 77:760-761.

Section 6.

Appendices

1. Invitation letter to schools.

Consent form.

Questionnaire.

Parental information letter.

2. Invitation letter to schools.

Questionnaire.

3. Information letter.

Questionnaire.

Consent.

4. Blood results.

5. Published work.

Appendix No: 1.

Invitation letter to schools

Dear Sir/Madam

We are undertaking a major new project into the effects of reducing diets on the health of young teenagers. The initial stage of this study is to determine how often reducing diets are undertaken and what form of diet this usually is.

We have randomly selected your school from the Merseyside area and would like to invite your pupils aged 12-14 years to volunteer for this study. The only requirement is for a questionnaire to be completed, a copy of which I have enclosed.

The study is confidential, and no names or addresses are required. Ethical approval has been given and the work is being supported by Liverpool John Moores University.

If your schools policy is to obtain informed written consent from the pupil's parent/guardian before completion of the questionnaire by the pupil we will supply the relevant forms.

Thank you for taking the time to read this letter. If you require further information or are willing for your pupils to participate I would be grateful if you could contact me at either the above address or by telephone (0151 231 5239).

Yours sincerely

Susan Roberts
(Research Assistant)

encl.
Information letter
Questionnaire

Appendix No: 1.

Survey regarding dietary habits amongst young teenagers

Dear Parent/Guardian

We are currently undertaking a major study at Liverpool John Moores University looking at dietary habits/behaviour in young teenagers. Adolescence is a time when a well balanced diet is essential for growth and development. However, it is also a time when young teenagers are conscious about their appearance and may be restricting their dietary intake in order to lose some weight. In order for dietary advice and information to be appropriate for this age group it is important that we find out the views of teenagers with regard to dietary behaviour. In order for us to address this issue we would like to invite your son/daughter to participate in our study.

We would be grateful if you could give your signed consent for your son/daughter to take part in the study.

Girls and boys aged 12-14 years will be asked to complete a questionnaire about their dietary habits.

All results will be confidential.

The pupils don't have to take part in the study if they don't want to.

The study is sponsored by the Liverpool John Moores University and has ethical approval.

Note regarding the consent form

Signing the consent means that you understand the information about the study and that you don't mind the questionnaire being completed. You only need to fill in the lines which have been marked with a cross.

Many thanks for your help with this project.

Appendix No: 1.

Consent form for carer

LIVERPOOL JOHN MOORES UNIVERSITY

FORM OF CONSENT (B) (CARER)

Title of project/procedure:

I,..... the undersigned being
(Carer/parent/guardian's full name)*
the carer/parent/guardian for ** having read and
(Subject's full name)*

understood the protocol presented to me hereby give consent for the subject named above to take

part in the project/investigation as described in the protocol.

Signed Date
Carer/Parent/Guardian**

I,..... certify that the details of
this
(Investigator's full name)

project/procedure have been fully explained and described in writing to the carer/parent/guardian**

named above and have been understood by him/her.

I,..... certify that the details of
this
(Witness' full name)*

project/procedure have been fully explained and described in writing to the carer/parent/guardian**

named above and have been understood by him/her.

Signed Date
(Witness)

N.B. The witness must be an independent third party. ** delete as appropriate

Appendix No:1

Questionnaire

All information will remain confidential

When you answer the questions, please put a tick in the box which you feel is the right answer. Where there isn't a box to tick write the answer in your own words.

Section A: the questions in this section are to be answered by everybody.

1. What is your sex? Male
Female
2. How old are you?.....
3. How tall are you?.....
4. How much do you weigh?.....
5. Do you play sport? Yes
No
If you have answered yes, what sport do you play and how many times a week do you play it?.....
.....
6. How many hours a day do you spend watching television?
1 Hour
2 Hours
3 Hours
More than 3 hours
7. Do you buy magazines? Yes
No
If you have answered yes, which magazines do you buy?.....
.....
8. Have you ever dieted to lose weight?
(This means, have you ever changed the way you eat to make yourself thinner) Yes
No

If you answered yes to question 8, please **only** answer the questions in section B (page 2 - 4).

If you answered No to question 8, please **only** answer the questions in section C (page 5 - 8).

Section B:

9. Do you think dieting is good for your health?
Yes
No
10. How old were you when you first started to diet?.....
.....
11. Why do you want to lose weight?.....
.....
.....
12. How much weight would you like to lose?.....
.....
13. Do your Parents approve of you dieting?
Yes
No
14. During the last 12 months how many times have you dieted?
1 or 2 times
3 or 4 times
Most of the time
15. Do you know how much weight you have lost during the last 12 months?
Yes
No
If you have answered yes, please say how much.....
.....
16. How do you know if you have lost weight?
weighing yourself
Observing appearance
17. How long do you usually diet for at a time?
Few days
1 week
2-4 weeks
More than 4 weeks
18. Can you choose what you have to eat ?
Yes
No
Sometimes

20. What type of diet do you use?
(This means, how do you change the way you eat to make yourself thinner. What sort of foods do you stop eating and what sort of foods do you still eat).

.....
.....
.....
.....

21. Where did you get this diet from?

- Your mother
- You made it up yourself
- A magazine or book

If you made it up yourself, what made you choose the types of food that you eat on your diet?.....

.....
.....

If you got you diet out of a magazine or book, can you give the name of the magazine or book and the name of the diet?.....

.....
.....

22. Why did you choose to follow this diet?.....

.....
.....

23. Did you lose weight, the last time you dieted?

- Yes
- No

24. After you have lost weight, do you put it back on again?

- No
- Some of it
- All of it

25. Do you miss meals out to try and lose weight?

- Yes
- No

If you answered yes, which meals do you miss out and why do you miss them out?.....

.....
.....

26. Have you ever been to a doctor for help to lose weight?

Yes

No

27. Have you ever used any tablets or medicine to help you lose weight?

Yes

No

If you answered yes, can you give the name of the medicine, and say where you got it from?.....

.....
.....

For girls only:

28. Have you started your periods yet?

Yes

No

Thank you very much for your help. You do not have to answer any more questions. If you need any more information about this questionnaire, please contact me: Susan Roberts, Tel. 231 5239 (I M Marsh, Liverpool John Moores University)

Section C:

29. Can you choose what you have to eat?

- Yes
- No
- Sometimes

30. Do you eat breakfast?

- Yes
- No
- Sometimes

If you do eat breakfast, what type of food do you eat?.....
.....
.....

31. Do you eat lunch?

- Yes
- No
- Sometimes

If you do eat lunch, what type of food do you eat?.....
.....
.....

32. Do you think you eat a 'healthy diet'.

- Yes
- No

33. Can you name 3 different types of food that are good for you and why?

.....
.....
.....

34. Can you name 3 different types of food that are bad for you and why?

.....
.....
.....

35. How many times a week do you eat fruit?

- Every day
- Every other day
- Occasionally
- Never

36. How many times a week do you eat vegetables?
Every day
Every other day
Occasionally
Never

37. How often do you eat meat?
Every day
Every other day
Occasionally
Never

If you do eat meat, what sort of meat do you eat?.....
.....
.....

38. How often do you eat fish?
Every day
Every other day
Occasionally
Never

39. How often do you eat Eggs?
Every day
Every other day
Occasionally
Never

40. How often do you drink milk?
Every day
Every other day
Occasionally
Never

41. How often do you eat cheese?
Every day
Every other day
Occasionally
Never

42. How often do you eat chips?
Every day
Every other day
Occasionally
Never

43. How often do you eat potatoes cooked in other ways? e.g. Jacket potatoes.
- Every day
- Every other day
- Occasionally
- Never
44. How often do you eat bread?
- Every day
- Every other day
- Occasionally
- Never
45. How often do you eat pasta?
- Every day
- Every other day
- Occasionally
- Never
46. How often do you eat crisps?
- Every day
- Every other day
- Occasionally
- Never
47. How often do you eat sweets and chocolate?
- Every day
- Every other day
- Occasionally
- Never
48. How often do you eat cakes?
- Every day
- Every other day
- Occasionally
- Never
49. How often do you eat biscuits?
- Every day
- Every other day
- Occasionally
- Never

50. How often do you eat food from a fast food outlet? e.g. a chip shop or burger bar.
- | | |
|-----------------|--------------------------|
| Every day | <input type="checkbox"/> |
| Every other day | <input type="checkbox"/> |
| Occasionally | <input type="checkbox"/> |
| Never | <input type="checkbox"/> |

51. What is your favourite food and how often do you eat it?.....

For girls only:

52. Have you started your periods yet?
- | | |
|-----|--------------------------|
| Yes | <input type="checkbox"/> |
| No | <input type="checkbox"/> |

Thank you very much for answering these questions . If you need any more information about this questionnaire, please contact me: Susan Roberts, Tel. 231 5239 (I M Marsh, Liverpool John Moores University).

Appendix No: 2.

Invitation letter to schools

Dear Sir

Last year you very kindly volunteered to take part in our study looking at dieting practices amongst adolescent girls. As a result of that study we would like to carry out further work. We would be grateful if you would consider taking part in our work again.

The only requirement is for a questionnaire to be completed, a copy of which I have enclosed.

The study is confidential and has received ethical approval from the University.

If your schools policy is to obtain written consent from the pupil's parent/guardian before completion of the questionnaire by the pupil we will supply the relevant form and information letter.

Thank you for taking the time to read this letter. If you require further information or are willing to participate in the study I would be grateful if you could contact me (tel. 0151 231 5271) or Dr. Maxwell (tel. 0151 231 5290).

Yours faithfully

Susan Roberts
Research Assistant

8. Do you think any of these foods make you fat?
 (please put a tick by those foods which you think make you fat)

- | | |
|-------------|----------------------|
| Eggs | Cheese |
| Milk | Cream |
| Butter | Margarine |
| Yoghurt | Bread |
| Pasta | Fruit |
| Vegetables | Potatoes (not chips) |
| Beef | Chicken |
| Beefburgers | Sausages |
| Chips | Biscuits |
| Chocolate | Crisps |

9. Which is true?

- All kinds of fat are good for you.
- Some kinds of fat are good for you.
- All kinds of fat are bad for you.

10. Which is true?

- It is important to eat some kinds of fat.
- It is important to eat no fat at all.

11. Do you eat breakfast?

- Every day
- Every other day
- Twice a week
- Once a week
- Never

12. Do you eat lunch?

- Every day
- Every other day
- Twice a week
- Once a week
- Never

13. Do you eat tea?

- Every day
- Every other day
- Twice a week
- Once a week
- Never

14. If you miss out any meals, why do you do this?.....

.....

24. Which famous person would you most like to look like.....
.....

25. Do you think fashion models are: Very thin
A bit thin
Just right

26. Why is it important that you don't get fat?.....
.....
.....
.....

Thank you very much for your help.

Appendix No: 3.

Information letter

Dear

I am a research student at LJMU. For my Ph D thesis I am looking at the affects of weight reducing diets on biochemical parameters and their health implications in non-obese young women. Part of this study includes finding out the most frequently used methods of weight reduction and the reasons for following a particular weight loss programme.

Very little research has been done in this area and is therefore very important, as the majority of women, regardless of their weight, diet during their lifetime. The aim of this study is to improve the health of women and assist in the prevention of disease.

I would be very grateful if you could assist me with my research, by completing the enclosed questionnaire and return it to me as soon as possible by using this envelope and the enclosed addressed label. Please use the internal mail system at your school office.

Thank you very much for your time and help.

**If you would like any more information regarding this study please contact me:
Susan Roberts, Tel. No. (231) 5239 (IM Marsh Campus)**

10. If you answered yes to Q.9, at what age did you start dieting?

.....

11. How often have you dieted during the last 12 months?

Occasionally

Most of the time

Never

12. What is the average length of time you diet for?

.....

13. What is the longest time you have dieted for?

.....

14. How much weight have you lost during the last 12 months?

.....

15. Do you always use the same diet or do you try different kinds of diets?

.....

16. Please explain the nature of the diet you usually use?

e.g. is it a low fat diet, or calorie counting, if so, how many per day. Do you use meal replacements such as slim fast or do you attend a slimming club, if so which one?

.....

.....

.....

.....

17. Why did you choose this particular diet?

.....

.....

.....

.....

18. If you obtained your diet from a book or magazine, please give the title of the book/magazine and of the diet.

.....

.....

19. Have you ever used any slimming aids? e.g. diet pills or any other pharmaceutical agents.

Yes

No

20. If you answered yes to Q.19, at what age did you start using them?

.....

21. If you answered yes to Q.19, where did/do you obtain your slimming aids from?

.....

.....

22. Was your last diet successful?

Yes

No

23. Do you tend to regain the weight you lose?

No

Some of it

All of it

24. Between diets do you eat a nutritionally, well balanced diet or revert to an unhealthy diet?

.....

.....

25. Do you have bingeing episodes?

Yes

No

26. If you answered yes to Q.25 what type of foods do you binge on, how often do you binge and why?

.....

.....

27. Do you weigh yourself when you are dieting?

Yes

No

28. If you answered no to Q. 27 how do you monitor your weight loss?

.....
.....

29. What is your reason for dieting?

.....
.....

30. How much weight would you like to lose, and why?

.....
.....

31. In proportion to your height, do you know what your weight should be?
(please state weight)

.....
.....

32. Have you ever sought medical advice with regard to dieting?

Yes

No

Thankyou very much for your help and co-operation. If you require any further information regarding this study, please contact me: Susan Roberts, Tel. No: 231 5239 (I M Marsh, LJMU).

LIVERPOOL JOHN MOORES UNIVERSITY

FORM OF CONSENT TO TAKE PART AS A SUBJECT IN A MAJOR PROCEDURE OR RESEARCH PROJECT

Title of project/procedure:

I, agree to take part in (Subject's full name)*

the above named project/procedure, the details of which have been fully explained to me and described in writing.

Signed Date (Subject)

I, certify that the details of this (Investigator's full name)*

project/procedure have been fully explained and described in writing to the subject named above and have been understood by him/her.

Signed Date (Investigator)

I, certify that the details of this (Witness' full name)

project/procedure have been fully explained and described in writing to the subject named above and have been understood by him/her.

Signed Date (Witness)

NB The witness must be an independent third party.

* Please print in block capitals

Appendix No: 4.

Blood results

Hb g/l	TC- Accutrend mmol/l	TC- Sigma mmol/l	HDL mmol/l	LDL- Accutrend mmol/l	LDL- Sigma mmol/l	Calcium mmol/l
12.9	4.7	4.31	0.98	3.86	3.33	2.2
11.9	4.8	3.16	1.29	4.09	1.87	2.9
11.0	1.0	4.8	1.45	4.42	3.35	1.45
10.5	5.5	5.0	0.98	3.55	4.02	0.73
12.7	5.4	4.8	1.45	4.85	3.35	1.3
10.8	5.0	4.6	0.88	4.0	3.10	1.45
11.7	1.0	4.02	1.7	3.5	2.89	1.3
11.1	4.1	2.59	1.5	3.07	1.45	1.17
12.0	4.3	4.8	1.13	2.29	2.82	1.02
12.1	5.7	4.31	1.89	2.57	2.76	0.58
11.8	1.0	4.6	1.63	3.31	3.52	0.58
11.5	5.7	3.45	1.0	1.0	2.06	1.17
13.6	3.8	2.01	1.14	4.22	0.5	2.9
12.3	4.8	4.6	1.98	4.93	2.95	1.9
11.5	5.0	3.16	0.44	4.51	1.82	2.5
12.0	4.2	4.31	2.01	2.44	2.97	1.17
11.5	4.1	3.16	0.37	2.7	1.34	1.17
11.3	1.0	6.33	1.63	3.37	5.30	1.9
12.5	4.3	3.16	0.94	3.4	1.97	1.75
11.8	1.0	2.59	1.51	4.49	1.04	1.45
12.5	6.2		0.88	3.35		3.22
11.1	5.3		0.50	2.76		1.75
10.0	1.0		0.75	3.38		1.6
11.2	1.0		1.0	2.9		2.05
11.6	1.0		0.69	4.1		3.8
12.5	1.0		0.88	4.32		1.91
12.4	6.2		1.79	3.11		2.20
11.0	1.0		0.81	4.62		2.62
10.7	1.0		1.06	3.09		1.91
10.2	1.0		1.57	2.76		1.75
11.5	5.6		1.45	3.52		0.73
11.0	6.4		1.45	2.56		1.75
11.2	4.2		0.91	3.66		1.02
9.2	1.0		1.38	2.54		1.75
11.7	6.2		0.44	3.35		3.8
11.7	1.0		1.89	5.57		0.73
11.7	1.0		1.32			1.3

Hb	TC		HDL			Calcium
11.7	1.0		1.57			0.73
12.8	4.3		1.55			2.77
12.1	1.0		1.08			1.75
10.9	5.1		1.17			1.75
11.7	6.2		1.38			1.75
13.2	1.0		1.13			2.05
13.1	4.7		1.45			1.17
8.8	1.0		1.25			0.87
12.6	5.9		1.7			0.73
10.8	4.6		1.63			1.45
11.1	4.5		1.51			1.45
11.9	4.8		2.39			1.9
14.6	1.0		1.39			2.2
11.1	3.8		1.51			1.17
11.1	1.0		1.65			1.30
11.3	1.0		1.34			1.02
11.3	1.0		1.82			1.45
12.7	1.0		1.03			1.02
10.5	4.2		1.19			1.91
8.9	1.0		1.55			2.05
11.1	5.2		1.72			2.05
8.9	1.0					1.45
11.1	4.9					1.45
12.9	1.0					
12.0	1.0					
14.3	5.0					
13.1	1.0					
10.9	4.9					
14.2	1.0					
14.8	6.6					
12.2	1.0					
12.2	1.0					
10.3	1.0					
12.7						
12.9						

TI μmol/l	TIBC μmol/l	UIBC μmol/l	% Sat Trans- ferrin	Ferritin μg/l	TP g/l	Albumin μmol/l
22.3	63.5	13.7	35.2	44.0	37.5	434.7
33.5	62.0	16.5	54.9	47.0	37.5	521.6
33.5	62.0	20.6	54.9	74.0	37.5	507.1
22.3	49.9	41.1	44.8	47.0	62.5	478.1
11.1	38.7	27.5	28.8	44.0	75	434.7
11.1	45.6	20.6	24.5	75.0	75	521.6
22.3	43.0	20.6	52	103.0	37.5	376.7
11.1	31.8	27.5	25.1	51.5	75	434.7
22.3	56.7	13.7	39.3	52.5	50	478.1
33.5	62.0	20.6	54.9	46.0	87.5	405.7
22.3	36.1	16.5	61.9	47.0	62.5	579.6
23.8	37.6	27.5	63.4	51.0	50	405.7
17.9	45.4	27.5	39.4	45.0	50	521.6
29.8	50.4	13.7	59	48.0	37.5	434.7
20.8	41.5	27.5	50.2	51.7	62.5	550.6
29.8	38.5	20.6	46.4	49.0	50	231.8
20.8	55.2	41.1	37.7	51.0	37.5	434.7
17.9	40.4	27.5	66.1	75.0	25	478.1
20.8	48.4	27.5	30.8	51.5	25	478.1
14.9	56.2	16.5	26.5	51.0	37.5	434.7

Vit A μmol/l	Vit E μmol/l	β-carot μmol/l
1.52	32.3	0.37
0.35	15.37	0.28
1.6	5.9	0.08
3.1	17.1	0.18
0.1	48.0	0.22
2.59	14.1	0.36
5.54	0.14	0.20
1.36	3.49	0.74
4.2	1.11	0.16
2.3	1.31	0.04
1.46	3.95	0.34
1.03	1.31	0.53
0.54	22.6	0.27
1.88	18.4	0.17
0.70	47.0	0.45
1.25	30.5	0.68
1.88	31.9	0.14

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