EXPLORATORY ANALYSIS OF LOW BIRTHWEIGHT DATA FROM A SURVEY OF BIRTHS DELIVERED DURING 2003 AT FOUR MAIN PUBLIC-HOSPITALS IN PESHAWAR.

by

Sareer Badshah

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

August 2007

Dedicated to:

1. My family who made significant sacrifices during research and development of this thesis; and
2. To all those who work towards the improvement of the maternal and child health.

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LIST OF ABBREVIATIONS

BMI	Body Mass Index
DFID	Department for International Development
DHS	Demographic Health Survey
FATA	Federally Administered Tribal Area (Tribal area)
IUGR	Intrauterine Growth Restrictions
LBW	Low Birth Weight
LMP	Last Menstrual Period
MDG	Millennium Development Goals
MHPH	Maternal Health and Pregnancy History
NHSP	National Health Survey of Pakistan
NWFP	North West Frontier Province
OR	Odds Ratios
PDF	Pakistan Development Forum
PDHS	Pakistan Demographic and Health Survey
PIHS	Pakistan Integrated Household Survey
RHCs	Rural Health Centres
SGA	Small for Gestational Age
TBAs	Traditional Birth Attendants
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Programme
UNICEF	United Nations Children Funds
USA	United States of America
WHO	World Health Organization

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ACKNOWLEDGMENTS

I would like to show my appreciation to my supervisory team, the clinicians and mothers who participated in this study and also the friends for their continued support during the development of this thesis.

I would like to thank my supervisors, Professor Paulo J.G. Lisboa (Director of Studies), Dr. Linda Mason, Mr. Kenneth McKelvie and Professor Roger Payne, who provided me with support and guidance whilst sharing their knowledge and expertise during my studies at Liverpool John Moores University. Special thanks go to Professor Paulo, whose support and guidance started before my admission to Liverpool John Moores University, till completion of this particular project for neonatal health in Peshawar. I also appreciate his help and support during data collection in Peshawar, analysis of the data-set and guidance for writing-up along with other documentation during my studies here in the United Kingdom. Many thanks go to my co-supervisors and especially to Dr. Linda Mason for her guidance, patience and regular feedback during writing this thesis. I also acknowledge the valuable support and expertise of Mr. Kenneth McKelvie, Department of Mathematics and Statistics, University of Liverpool, and Professor Roger Payne, Biomathematics and Bioinformatics Department, Rothamsted Research, Harpenden Herts.

During this project, a number of friends in the CMS helped me in completing this final document. Of them a bundle of thanks goes to Dr. Hane Aung who helped me in the overall writing-up; Dr. Ian Jarman regarding identifying methodological problems during presentation; Dr. Thang Hoang, Dr. Gurlean Arora and Dr. Facyal Bouhafs regarding formatting; Dr. David Llewellyn-Jones and Dr. Paul Fergus for English correction. The support of administrative and technical staff is also appreciated. The encouragement of Dr. Terrence Etchells, Huma Javeed, Inigo Zubizarreta Nafarrate and Dr. Mazhar Iqbal in the last stages of this project is remarkable. In addition, I also appreciate Dr. Barbara Lee and Dr. Helen Wong support and compatibility with system/guidance in the first few months of my studies in CMS. I will remember the time I spent in CMS for the rest of my life.

Much appreciation is owed to the University of Peshawar for funding, clinicians and mothers in the four main public-hospitals in Peshawar. Many thanks also go to the late Professor Hamidullah and other friends (Dr. Fayaz uddin and Dr. Waheed) who helped me in co-ordination with the Health Department in Peshawar, and especially the Heads of the Gynaecology Departments. I would also like to acknowledge the contributions made by my brother Mr. Zahid Ali Shah with regards to the data entry. I also express gratitude to all other colleagues in CMS, LJMU who supported me directly or indirectly during the drafting of this document.

ABSTRACT

Low birthweight (LBW) is a widely used indicator of newborn health. Neonatal mortality is 20 times more likely for LBW babies (<2.5kg) compared to heavier babies (=>2.5kg). In addition to mortality, LBW also indicates poor maternal health, and poor newborn immune function, psychological problems, inhibited growth and cognitive development, and the likelihood of chronic diseases, as morbidity later in life (WHO, 2005, UNICEF 2005, Rahi et al 2005). This study investigates the association of birthweight <2.5kg (LBW) with a wide range of factors related to geo-demographics, maternal health and pregnancy history in public hospitals at Peshawar, North West Frontier Province (NWFP) Pakistan. It is shown that that the observed births with Low birthweight comprise two components, one related to gestational age and the other corresponding to births that are small for gestational age (SGA). Data on geo-demographics, maternal health indicators, pregnancy history and outcome scores for newborn babies and their families (*n*=1039) were collected prospectively between August and November 2003 in a cross-sectional survey of four public hospitals in Peshawar, NWFP-Pakistan. Crude and adjusted odds ratios were used to investigate the factors affecting incidence of LBW, by multivariate logistic regression. Gestational age was included as an explanatory variable, therefore the additional covariates identified by model selection are expected to account for SGA. This was followed by estimating the predicted probabilities of LBW in different significant group of factors. The main geo-demographic risk factors for SGA identified in this study are maternal age, nationality and consanguinity controlling for gestational age of less than 37 weeks. Presentation with anaemia and a history of previous abortion/miscarriage were also found to be significant independent factors. The adjusted odds ratio for gestational age showed the largest effect in explaining the incidence of LBW. The next highest odds ratio was for maternal age below 20 years.

The explanatory model included two pair-wise interactions, for which the predicted incidence figures for LBW show an increase among the Tribal area with presentation of anaemia, and among full term babies with their mothers having a previous history of abortion/miscarriage. It is concluded from this study that, in addition to gestational age, specific factors related to geo-demographics (maternal age, consanguinity and nationality), maternal health (anaemia) and pregnancy history (abortion/miscarriage) were significantly associated with the incidence of LBW observed at the four hospitals surveyed in Peshawar. These results indicate that cultural factors can significantly adversely affect the incidence of SGA in this area of Pakistan.

CHAPTER 1

BACKGROUND TO THE STUDY

This chapter focuses on the background to low birthweight, which is one of the main causes of neonatal morbidity and mortality. The background introduces infant and child mortality, and relates infant mortality with LBW.

1.1 Infant and child mortality

Infant and child mortality is a major issue across the world and especially in the developing countries. Improvements in public health services have decreased child mortality from 1 in 5 in 1960 to 1 in 10 in 1990 in the developing countries. "Yet, every year, almost 11 million children die — that is, 30,000 children a day — before their fifth birthday" (United Nations, 2006). In South-Asia the incidence of child mortality accounts for more than one third of the total deaths, and nearly half of these deaths occurs due to neonatal causes, injuries and other diseases (United Nations, 2006).

Of the total 130 million babies born every year globally, 4 million are stillborn (Lawn et al 2005), 4 million die in the neonatal period (Zupan 2005), and about the same number are born with major congenital anomalies each year (World Health Report 1997). The majority of the neonatal deaths (99%) occur in low and middle-income countries, with the remaining 1% in 39 developed countries (Lawn et al 2005). However, infant and neonatal health is vulnerable in Africa and especially in South-Asia.

Lawn et al (2005) reported that out of the total neonatal and infant deaths worldwide, 67% belong to 10 countries in Africa and South-Asia. In South-Asia, India contributes more than a quarter (27%), China 10%, Pakistan 7%, Nigeria 6%, Bangladesh and Ethiopia 4% each, Congo 3% and Indonesia, Afghanistan and Tanzania contribute 2% each. In the neonatal mortality, Afghanistan tops the list with 60 per 1000 live births followed by Pakistan for 57 per 1000 live births, respectively. The 3rd, 4th and 5th are respectively Nigeria, Ethiopia and Congo (53, 51 and 47 per 1000 live births).

1.1.1 Infant mortality in Pakistan

The infant mortality rate in Pakistan has reduced from 163 per thousand live births in 1960 to 99 per thousand live births in 1990 (Health and Welfare: Pakistan 2004), 82 per thousand live birth in 2001-2 (PIHS 2002), 79 and 80 per 1,000 live births for the year 2004 (Nationmaster 2004, WHO 2006). Moreover, "An estimated 400,000 infants and 16,500 maternal deaths occur annually in Pakistan. These translate into an infant mortality rate and maternal mortality ratio that should be unacceptable to any state." (Siddiqi et al 2004, page 117).

Fikree et al (2002) reported the infant mortality rate to be 100 per 1000 live births in a combined study of the two provinces NWFP and Baluchistan including Tribal areas (Federally Administered Tribal Area). However, of the total infant deaths nearly 70% died in the early neonatal period (Fikree et al 2002). These findings show that the neonatal mortality rate in Pakistan and especially in the two less developed provinces of Pakistan (i.e. Baluchistan, NWFP including Tribal areas) could be higher than the estimated reported mortality rate for Pakistan.

1.1.2 Area and people

Pakistan is one of the developing countries in South-Asia, with India on the east, China on the north-east, Afghanistan and Iran on the west, and the Arabian Sea on the south. The four provinces (Baluchistan, NWFP including Tribal areas, Punjab and Sindh) of Pakistan are different in their ethnic, cultural and economic characteristics (Sathar 1985).

NWFP including Federally Administered Tribal Areas (Tribal areas) is situated with the boundary of Afghanistan. "This is an area of the country, where people are 'Pathans'. Pathans have their own taboos and culture. They are *pardah* observing and are less educated" (Sultana et al 2002, page 15). In the context of this study, pardah mean *less exposure of women outside the home*. In NWFP and Tribal areas the low literacy rates, culture, traditions including other geo-demographic factors differentiate this area from the rest of the country. However, these differentials could make a big difference in the health and health behaviour of the people. Moreover, it is suspected that the influential factors associated with maternal and newborn health in other areas of Pakistan may not be applicable in NWFP and Tribal areas, because "heterogeneity among different populations makes findings related to investigations in one population not applicable to others. Thus it is necessary to design studies that accounts for the geographic, racial, cultural, social and economic context of each country and specific group" (Torres-Arreola et al 2005).

1.1.3 Early neonatal mortality and LBW

"Low birth weight is defined by the World Health Organization (WHO) as a birth weight <2500g." (Kramer 2003, page 1592S). It is well-established that LBW is one of the most important factors leading to neonatal morbidity and mortality (Valero et al 2004, Borja et al 2003). Early neonatal mortality is 20 times more likely for LBW babies than for normal birthweight babies (United Nations, 2004).

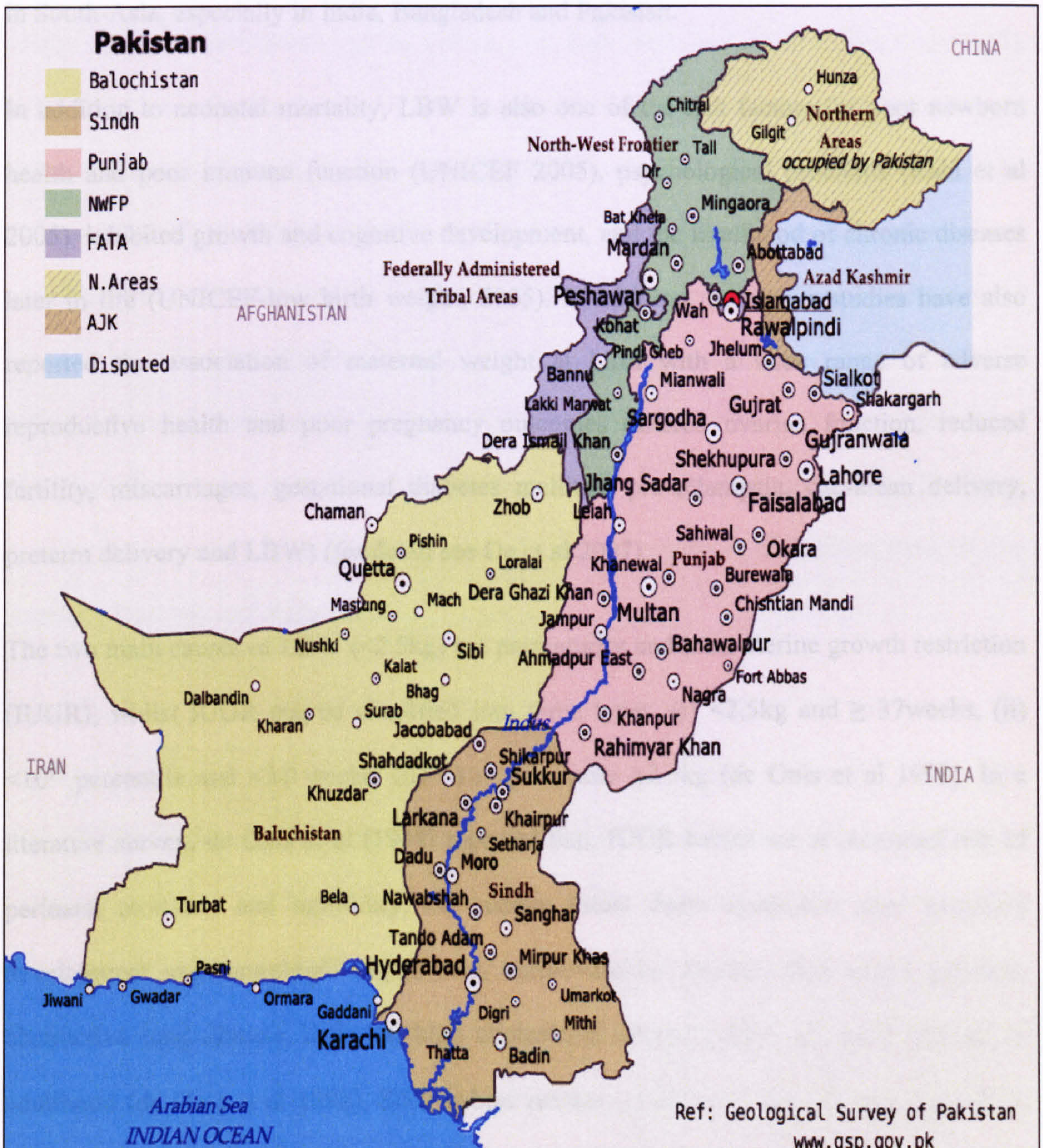

Figure 1.1: Map of Pakistan

Low birthweight contributes nearly to 80% of the neonatal mortality in India (Kanshik et al 1998), 84% Bangladesh (Yasmin et al 2001), and 78% in a hospital-based study in Rawalpidi-Pakistan (Tariq and Kundi 1999). The association of LBW and neonatal mortality showed that nearly 80% of the neonatal mortality could be associated with LBW in South-Asia, especially in India, Bangladesh and Pakistan.

In addition to neonatal mortality, LBW is also one of the risk factors for poor newborn health and poor immune function (UNICEF 2005), psychological problems (Rahi et al 2005), inhibited growth and cognitive development, and the likelihood of chronic diseases later in life (UNICEF-low birth weight, 2005). In addition, numerous studies have also reported the association of maternal weight at birth with a wide range of adverse reproductive health and poor pregnancy outcomes (altered ovarian function, reduced fertility, miscarriages, gestational diabetes mellitus, pre-eclampsia, caesarean delivery, preterm delivery and LBW) (for detail see De et al 2007).

The two main causes of LBW (<2.5kg) are prematurity and intra-uterine growth restriction (IUGR), whilst IUGR maybe classified into three types, (i) <2.5kg and ≥ 37weeks, (ii) $<10^{th}$ percentile and <37 weeks, (ii) $<10^{th}$ percentile ≥2.5kg (de Onis et al 1998). In a literature survey, de Onis et al (1998) reported that, IUGR babies are at increased risk of perinatal mortality and morbidity, i.e. sudden infant death syndrome, poor cognitive development and neurologic impairment, cardiovascular disease, high blood pressure, obstructive lung disease, diabetes, high cholesterol concentrations and renal damage in adulthood (de Onis et al 1998). Such babies remain a burden on government expense in developed countries and a permanent problem for their families in developing countries.

1.1.4 The incidence of LBW and IUGR

The incidence of LBW is estimated to be 16% worldwide, 19% and 16% in the least developed and developed, and 7% in the industrialised countries (UNICEF 2006). The incidence of LBW is highest in South-Asia (31%) followed by Middle East and North Africa (15%), Sub-Saharan Africa (14%) and East Asia and Pacific 7% respectively (UNICEF 2006). Within South-Asia the incidence of LBW is highest in Bangladesh and India (30% each), followed by Pakistan 19% for the year 2000-2002 (UNICEF 2006). The incidence of LBW for Pakistan is nearly three times higher than the industrialised countries, however, a literature search showed that the incidence of LBW varied from 5% to 23% in village based (Northrop-Clewes et al 1998), and hospital-based studies in different cities of Pakistan (Najmi 2000, Naheed and Yasin 2000, Aziz et al. 2001, Khan 2001 and Bhutta et al. 2004). The low incidence of LBW in Budhni village (5%) compared to other studies in Pakistan could be due to the special attention of Pakistan Medical and Research Council, in a study project.

According to a report (de Onis et al 1998), an estimated 11% of all newborn in the developing countries are born with LBW at term (IUGR: <2.5kg, ≥ 37weeks), where 75% of all IUGR babies are born in Asia, 20% in Africa and 5% in Latin America. Bangladesh, India and Pakistan are the three leading countries in Asia, where IUGR needs special attention (de Onis et al 1998). The incidence of IUGR is estimated to be nearly 40% in Bangladesh, 21% in India (de Onis et al 1998), whilst it is reported to be 24.4% in a community based study in Karachi-Pakistan (Fikree and Berendes 1994).

However, a lot is known about LBW in Pakistan, whereas, the influential factors associated with LBW are almost unknown in NWFP. The findings from studies in Pakistan could not be generalised for NWFP due to diversity in ethnic, cultural and economic characteristics (Sathar 1985). Therefore, it is important to investigate the incidence and influential factors associated with LBW/SGA in Peshawar for possible intervention to reduce LBW/SGA.

Conclusion: Low birthweight is one of the important factors that cause neonatal morbidity and mortality especially in the less developed countries including India, Bangladesh and Pakistan. A lot is known about LBW and its influential factors in the above mentioned countries, however, the incidence and associated influential factors of LBW varies from place to place, due to diversity in ethnic, cultural and economic characteristics. In NWFP and Tribal areas, the incidence and influential factors associated with LBW/SGA are unknown, whilst the influential factors in other areas may not be generalised (see section 1.1.3). Hence, it is important to investigate the incidence and influential factors of LBW/SGA, and targeted it for possible intervention, in order to reduce neonatal morbidity and mortality in this region.

1.2 Motivation

The motivation behind this study is two fold: first to estimate baseline statistics for parameters related to geo-demographics, maternal health and pregnancy history; and second, to investigate their influence on the health of newborn babies, characterised by low birthweight in four public-hospitals at Peshawar, North-West Frontier Province (NWFP) Pakistan. Both the baseline statistics and explanatory models are used to find the main influential factors are new for Peshawar at a regional level.

1.3 Thesis structure

The main focus of this thesis is to investigate the incidence of LBW and the influential factors associated with LBW/SGA in the four main pubic hospitals at Peshawar, NWFP Pakistan. Chapter One outlines the importance of neonatal morbidity and mortality in this area of Pakistan. It also introduces LBW or SGA as the main causes of neonatal morbidity and mortality. To achieve the goals of the investigation, the rest of the thesis is structured in five chapters:

Chapter Two reviews the literature for geo-demographics, maternal health and pregnancy history factors and its association with LBW. The literature review is followed by the aim and objectives of the study.

Chapter Three describes the detailed methodological considerations, selection of methodology for the present study, followed by adjustments in the questionnaire and selection of statistical tools through retrospective study. This is followed by prospective data collection from the four public-hospitals after ethical approval from Liverpool John Moores University.

Chapter Four presents the prospective data analysis and results, using univariate and multivariate methods.

Chapter Five discusses the results of this study in Peshawar in relation to other studies in the less developed countries and especially in the South-Asia.

Chapter Six provides the study conclusions along with recommendations for clinical practice, and future studies.

CHAPTER 2

LITERATURE REVIEW

This chapter focuses on reviewing the relevant literature related to maternal geo-demographics factors, maternal health and pregnancy history factors associated with adverse pregnancy outcomes in the developing countries and especially in Pakistan, Bangladesh and India. The relevant literature in the developed countries was also considered as a reference.

For this literature review, Pubmed, Web of Science, Science Direct, Google and Google Scholar were used as the main sources for the literature search. To find out the key emerging issues and existing gaps in the literature, this survey was conducted in two phases. The aim of literature survey phase-1 was to figure out the key categories/groups of factors relevant in the context of this research. In phase-1, the main factors identified regarding newborn health that might be important in NWFP-Pakistan include maternal geo-demographics, maternal physical health, health conditions and pregnancy history.

In phase-2, a detailed literature survey was conducted regarding newborn health using the key areas assessed in phase-1. In this phase the detailed literature review/explanation of the main factors (geo-demographic factors, maternal health and pregnancy history) along with their sub-factors are given below in section 2.1 and 2.2 below.

2.1 Geo-demographic status

Geo-demographic status is one of the main factors important in investigating newborn health. The sub-factors in the geo-demographic group include area of residence, water sources, social-status, consanguinity, maternal age, and ethnicity. These factors are suspected to be interrelated and might also directly or indirectly influence the other main factors (e.g. maternal physical health, diagnosed health conditions and pregnancy history etc.). The details of these factors are as follows:

2.1.1 Area of residence

South Asia: Area of residence is one of the important factors that might affect maternal, infant, neonatal and newborn health (UNICEF 2006). In South Asia, the high maternal mortality ratio (360-740 per 100,000) and high under-5 mortality (30-95 in India, and >96 in Pakistan and Bangladesh per 1,000 live birth) highlight the frail health of the people in this region (DFID, Millennium Development Goals, World Bank 2005). In addition to maternal and under-5 mortality, "nearly one-third of infants in South Asia are born with low birthweight" (UNICEF 2006). The incidence of LBW in South Asia is nearly twice that of developing countries; Middle East, North Africa, and Sub-Saharan Africa; more than 3 times than that of Latin America and Caribbean; and nearly 4.5 times compared to developed countries (UNICEF 2006). However, within South Asia maternal, infant and neonatal mortality and the incidence of LBW varies among countries and within the country (Table 2.1).

Table 2.1: Infant, neonatal and maternal mortality and LBW of Bangladesh, India and Pakistan.

Country	‡Maternal mortality (2000)	†Infant mortality (2004)	†Neonatal mortality (2000)	Low birthweight (2000-2002)
Bangladesh	380	56	36	30%
India	540	62	43	30%
Pakistan	500	80	57	19%

† Per 1000 live births, and ‡ per 100,000 live births.

Source: World Health Organization 2006

India and Bangladesh: A number of studies in India and Bangladesh associated pregnancy outcomes with area of residence (Mehra and Agrawal 2004, Nahar et al 1998, Antonisamy et al 1994, Bhargava et al 1991, Makhija and Murthy 1990, and Singh 1990). For example, neonatal mortality in India was twice as high in the rural areas (76/1000 live births) compared to urban areas (39/1000 live births) (Singh 1990). In a study of birthweight in Tamil-Nadu India, Antonisamy et al (1994) reported that the proportion of LBW was 27.2% in rural and 19.1% in urban areas for the years 1969-1973, and 15.9% in rural and 10.8% in urban for the years 1989-1993. Similarly, in another study of LBW Dhaka Bangladesh, Nahar et al (1998) found that the incidence of LBW was highest in urban slums 36.8% compared to 18.3% to 20.9% in urban affluent and rural areas, respectively. These studies showed that the disadvantageous areas (deprived/rural areas) are at increased risk of neonatal mortality and LBW due to maternal social status, access to adequate health resources and maternal physical health parameters.

Pakistan: Pakistan is one of the three developing countries in the Indian sub-continent, where people face similar issues and health related problems associated with maternal and newborn health (DFID 2006). In Pakistan, neonatal mortality dropped from 180 per 1000 live births in 1950s to 101 per 1000 live birth in 1992 (Agha 2000). According to a recent report (WHO 2006), neonatal and infant mortality is high (57 and 80 /1000 live births, respectively) compared to the two other neighbouring countries Bangladesh and India (Table 2.1). Therefore, it is important to investigate the influential factors associated with neonatal and infant mortality in Pakistan.

A nationally representative sample survey (Pakistan Integrated Household Survey, PIHS 1991), associated the high neonatal mortality with "disparities in wealth and access to resources", "lack of attention to distributional issues", women's lack of autonomy and their low social and economic status, and lack of attention towards under-served women and children (Agha 2000, page 199-200). This study also reported the high odds of infant death in the, (i) first month of life compared to the rest of the post neonatal period, and (ii) less developed provinces (NWFP, Tribal areas and Baluchistan) compared to the developed provinces (Sindh and Punjab) of Pakistan (Agha 2000).

Zahid (1996) in a population based study concluded that, "the differential by place of residence may be an artefact of differences in standard of living, access to health facilities, and economic factors" (Zahid 1996, page 724). These studies show that the main difference between urban and rural areas is public health facilities and access to health resources (for details see antenatal care section 2.2.3). To reduce the poor health of the people, a number of authors' emphasise that essential health facilities need to be available to all in rural and less developed areas addressing the adverse health behaviours and issues related to culture and traditions (Fikree et al 2002, Zahid 1996, Sultana et al 2002).

NWFP and Tribal Areas: NWFP is one of the four provinces of Pakistan, which could be characterised as the least developed and economically backward province compared to two developed provinces Sindh and Punjab (Kurosaki 2002). The Federally Administered Tribal Areas (FATA), known as Tribal areas, warrant further specific attention in this region due to low economic resources and scarce agricultural land due to the landscape (Kurosaki 2002) and low social status of the people, particularly women's education, compared to the rest of the country (see Section 2.1.2). In this region some of the main problems of the residents regarding health appear to be the high proportion of rural areas, poor access to fresh drinking water and health barriers due to culture and traditions.

A number of studies associated the health of the people with quality of drinking water, (Bove et al 2002, Sachdev 2001, Abbasi 1999, Manger et al 1997, Zahid 1996). Abbasi (1999) associated the poor health status of the people in Pakistan with inadequate sanitation and fresh drinking water. In a population-based study in Pakistan, Zahid (1996) reported higher infant mortality in rural and non-fresh water areas compared to urban and fresh-piped water areas. One of the reasons might be that a fresh water supply reduces communicable diseases during or before pregnancy (Sachdev 2001), whilst water contaminants increase the risk of adverse pregnancy outcomes (Bove et al 2002, Manger et al 1997).

The majority of the people in NWFP (83.1%) and Tribal areas (97.3%) live in rural areas compared to 67.5% in the whole of Pakistan (PIHS, 2001-2). 58% to 75% of the people in NWFP and Tribal area drink fresh water compared to 86% in the whole of Pakistan (PIHS 2001-2). In Tribal areas, the proportion of people with access to clean drinking water is 44% compared to 75% in NWFP (Asian Development Bank 2004). However, the population living in rural and non-fresh water areas are at increased risk of high infant mortality in Pakistan (Zahid 1996). In Pakistan fresh water is more readily available in developed areas compared to the less developed/rural areas (PIHS 2001-2). Therefore, it is suspected that due to high proportion of rural and non-fresh water areas, the health of the people in NWFP and Tribal areas could be poorer in the deprived and rural areas of NWFP compared to the rest of Pakistan.

Cultural factors: A number of studies in South Asia and other less developed countries associated maternal and newborn health with cultural factors in the less developed areas. These factors include women's educational and social status (Northrop-Clewes et al 1998), consanguinity preferences (Grant and Bittles 1997, Bittles 2004), early marriages (Hussain 2004), home delivery and traditional birth attendants (Fatmi et al 2005, Miller et al 1995), attitude and perception of the people regarding health behaviour and health issues (Kabakian-Khasholian and Campbell 2005, Makhija and Murthy 1990), and other cultural barriers, e.g. *Pardah* of women (Fikree 2002). The detailed review of maternal social status, consanguinity preferences, and early marriage are presented in section 2.1.2, 2.1.3 and 2.1.4 later. However, in a rural area project in Haryana-India, Makhija et al (1990) concluded that, "there are many socio-biological factors influencing the incidence of low birthweight. The majority of these factors need behavioural changes in peoples' perceptions and attitude." (Makhija and Murthy 1990, page 216). In the context of the present study, one of these cultural barriers in NWFP and Tribal areas might be Pardah of women, which may be one the important factors associated with maternal and newborn health through inadequate access to health resources.

Pardah of women: In a descriptive study in Peshawar, Sultana et al (2002) described that "this is an area of the country, where people are 'Pathans'. Pathans have their own taboos and culture. They are *pardah* observing and are less educated" (Sultana et al 2002 page 15). The people living in rural areas of NWFP and Tribal areas have a more traditional, "*pardah observing*", cultural, being less interested in women's education and employment, and more interested in early and consanguineous marriages (Sultana et al 2002, Hussain 2002). These cultural factors influence the social status of women (for details see Section 2.12), and hence the slow progress towards development and maternal and neonatal health (Northrop-Clewes 1998). In a descriptive study of a rural village near Peshawar, it was also reported that girls are rarely educated, which "may be because the parents are reluctant to send their sons to a school, which is not in the centre of their village and even more reluctant to send a daughter" (Northrop-Clewes et al 1998, page 8). One of the main reasons could be the *Pardah* of women, that is to minimise any sexual activity before marriage (prohibited religiously and culturally), because such activities could affect her and her family life for the rest of their lives.

Cultural factors might influence maternal and newborn health in the less developed areas through poor access to the health care facilities (Hussain et al 2004, Miller et al 1995) and newborn health through genetic problems because of consanguineous marriages (Bittles 2004, Grant and Bittles 1997, Hussain 2004). Such barriers need to be addressed through health awareness regarding maternal and newborn health and simple interventions to increase their chance to attend regular health care facilities as a short term policy, and empowerment of women through education and employment as long term policy (Kabakian-Khasholian and Campbell 2005).

Summary: Area of residence is one of the main factors that influence maternal and newborn health. This literature review showed that, a number of studies in India and Bangladesh highlighted the adverse effect of rural/deprived areas on LBW, however, little is known about the impact of area of residence on birthweight in Pakistan. Moreover, the effect of area of residence is multidimensional and increases the risk of maternal and newborn health through lack of attention and disparities in access to health resources in the rural and deprived areas. The rural and deprived areas also influence maternal and newborn health through cultural factors (e.g. early and consanguineous marriages (for details see Section 2.1.3, and 2.1.4), antenatal care due to the *pardah* of women (for details see Section 2.3.2.3)).

2.1.2 Social status

The social status of the people plays a very important role with regards to their health. According to Murray and Lopez (1997, page 1436) "developed regions account for 11·6% of the worldwide burden from all causes of death and disability, and account for 90·2% of health expenditure worldwide". The expenditure on health for the rest of the world is less than 10%, against 88.4% of deaths and disabilities. The main causes of this morbidity and mortality could be due to (i) small allocation of funding for health by the government (WHO 2006), (ii) low social status of the people in less developed countries, and (iii) diversity in access to health resources within the country (Agha 2000, Zahid 2002).

Developing countries: Valero et al (2004) in a review of studies in developing countries highlighted the importance of maternal social status on newborn health, stating that; "there are many known risk factors, the most important of which are socioeconomic factors, medical risks before or during gestation and maternal life style" (Valero et al 2004, page

3). The effect of social status and especially illiteracy on maternal and newborn health was reported by Harrison et al (1996) in a large study (Zara Maternity Survey) conducted in several developing countries. This study also associated maternal social status with reporting for expert care, education and health awareness (Harrison et al 1996). These findings highlight the importance of maternal social status in the developing countries that could influence a number of factors associated with health care and hence maternal and newborn health.

The social status of people in Asia: According to a report (DFID 2006), Asia is the residence of two-thirds of the World poorest people, where the majority of them (7 out of 10) are women (DFID 2006). The main factor associated with the high poverty of women in the Indian-subcontinent might be the high ratio of non-educated women (i.e. India 61%, Bangladesh 58% and Pakistan 79%) (DHS 1991-4). In addition to poverty and the low literacy rate for women in the Indian subcontinent, the lowest share of government expenditure on health (5%) compared to other countries, and lack of social benefits from the government, further increase the importance of individual's social status regarding health (WHO 2006). Due to low funding from the government, the people are responsible for their own medication. Therefore, in the case of low social status the mothers might not have adequate access to health resources.

Rural/urban disparity, social status and antenatal care: Rural/urban disparity is one of the issues associated with maternal and newborn health through maternal social status and access to health care resources. In the rural areas non-educated mothers are at increased risk of inadequate health care compared to their counterparts in the urban areas (Hirvi et al 1994, Khan et al 1994). In a study of 45 rural villages in India, Hirve et al (1994) associated maternal education with LBW. However, Khan et al (1994) in a population-based study in Pakistan found that maternal education was significantly associated with access to health care services in the rural areas but non-significant in the urban areas (Khan et al 1994).

Maternal education in urban areas may be less important because good quality health care services are easily accessible here, so all women access them irrespective of their education level. In the rural areas access to the few healthcare facilities available is more likely to be used by those women who are educated or better off financially, because of self medication and no social support or free medication for poor mothers/people in Pakistan.

In this literature review, it was also found that when health care facilities are free for all mothers, then the social status matters less (Hosain et al 2006, Dougherty et al 1982). A rural study of 360 mothers in Bangladesh where free health care was provided by a non-governmental organization, found that maternal social status was non-significant for LBW controlling for other important factors (Hosain et al 2006). This study was consistent with a large hospital based study in the west of London, where maternal social status was not significantly associated with adverse pregnancy outcomes due to free health care facilities to all mothers (Dougherty et al 1982). These studies in Bangladesh and London highlight the importance of free health care facilities and access to health care resources regarding maternal and newborn health.

The social status of mothers in Pakistan: Pakistan is one of the developing countries in South Asia, where more than 40% of the people live below the poverty line (World Bank 2000). The social status of Pakistani women is low due to the high ratio of non-educated mothers (i.e. 79%, DHS 1991-4; 83%, Grant and Bittles 1997) (DHS 1991-4). However, the uneven distribution of educational facilities in rural and urban areas and diversity in people attitude towards female education further increases the risk of poverty in rural and deprived areas (Northrop-Clewes et al 1998).

The social status of women in NWFP and Tribal areas is particularly low, due to low literacy rate (NWFP 20% and Tribal areas 3%, respectively) compared to overall Pakistan (female 30-31%) (PDF 2003, UNDP 2001), and high ratio of poverty in the Tribal areas compared to the rest of the country. According to a report, 60% of the households are below poverty line in the Tribal areas compared to 32.1% in the overall Pakistan (Asian Development Bank 2004). The high ratio of poverty in the Tribal areas could be associated with low literacy rate (17%) and low employment opportunities (6% in rural Pakistan) compared to literacy and employment opportunities in the urban areas (45% and 22%, respectively) (Asian Development Bank 2004, World Bank 2000). Due to low maternal social status in this region, paternal social status might be one of the important factors that influence family health awareness, family nutritional requirements and access to health resources.

Bhalero et al (1984) in a large case controlled study in Mumbai-India found that neonatal mortality was significantly lower for the babies, whose fathers were educated with regards to pregnancy complications, compared to those who did not attend the health awareness sessions (Bhalero et al 1984). From this study, it is suspected that, in developing countries like Pakistan, where a strong family system is still intact; low maternal health awareness and low social status maters less, because decisions are taken on a family basis and the husband's income is considered as family income.

The effect of social status on maternal and newborn health in Pakistan: There is a lot of evidence in small, univariate, multivariable and large descriptive studies that low maternal social status affect maternal and newborn health (Begum et al 1991, Khan 2001, Lone et al 2004, Fikree et al 1994, Fikree and Berendes 1994). In small univariate hospital-based studies in Peshawar, Begum et al (1991) and Shaheen et al (2003) associated maternal low social status with maternal nutritional status, and delay in medical help, whereas, Khan (2001) associated it with high ratio of stillbirths in Abbottabad-Pakistan. Lone et al (2004) and Fikree and Berendes (1994) in Karachi, associated low social status with the high ratio of LBW and IUGR respectively, controlling for other important factors. These studies indicate that low maternal social status might be one of the important factors associated with adverse pregnancy outcomes in Peshawar.

Summary: In this literature review many studies associated maternal and newborn health with maternal social status. It was found that low social status increases the risk of adverse maternal health and unfavourable pregnancy outcomes through inadequate access to health care resources required during pregnancy. Studies also showed that, when antenatal care during pregnancy is available to all, maternal social status matters less. However, without sufficient social support from the government, mothers with low social status suffer compared to high income families. One of the main causes of low maternal social status and inadequate access to healthcare resources could be rural/urban disparity in educational and health care facilities. In addition there is strong evidence that low social status mothers are at increased risk of (i) consanguineous and teenage marriages in rural and deprived areas (for details see Section 2.13 and 2.14) that could cause high ratio of adverse pregnancy outcomes.

2.1.3 Consanguinity

In addition to area of residence and social status, consanguinity is another important geo-demographic factor, which is common in developing and especially in Islamic countries (Bittles 1994). Although there is no evidence that the *Quran* emphasises consanguinity (Hussain 1999), it is based on social and cultural reasons (Bittles 1994, Stoltenberg et al 1998, Bittles 2005). Consanguinity affects newborn health through genetic disorders independent of other associated factors (Bittles 2005).

According to Grant and Bittles (1997), "consanguinity is a central feature of marriage system in many parts of the world, including North and sub-Saharan Africa, and Western, Central and Southern Asia" (Grant and Bittles 1997, page 143). In these areas, the attitude of the people towards consanguineous marriages does not change significantly, even if they change their country of origin. This was seen in England and Norway, where the ratio of consanguineous couples of Pakistani origin were reported to be 55% and 31%, respectively (Darr et al 1988, Stoltenberg et al 1998).

Pakistan: In a community based study of the four provinces of Pakistan, the proportion of consanguineous marriages was reported to be 60% (Grant and Bittles 1997). In NWFP, small studies reported consanguinity as 40% in a study in the district of Swat (Wahab et al 1996), nearly 50% in Afghan refugees (Wahab et al 2006), however, 21 to 29% in Sikh-community in Swat, Bunair and Shangla districts (Wahab et al 2005). The low incidence of consanguinity in the Sikh-community could be due to the strict ban on marriage with "Father's Brother daughters", which is not allowed for religious reasons (Wahab et al 2005, page 156). Some of main reasons for the high ratio of consanguinity are outlined below:

Cultural, social and economic reasons for consanguinity: The expected proportion of consanguinity could be higher in Peshawar and Tribal areas, due to common cultural perceptions, (i) where *first and second cousin marriage is categorized as gold and silver, whereas non-consanguineous is considered worthless*, and (ii) *marriages combine families not the couple alone*, that might not be easy in non-consanguineous marriage. Therefore high rates of consanguinity could be due to cultural reasons on one hand and economic benefits on the other.

In a large population-based study in Pakistan, consanguinity was associated with early age at marriage (Grant and Bittles 1997). The main reasons for early marriages could be (i) a desire to see their son's wedding-day as early as possible, (ii) to protect their sons and daughters from the illegal sexual activities that could cause bloody conflicts among families and tribes, and (iii) to marry their daughters to prevent pre-marriage sexual activity which is not allowed culturally and religiously. The pre-marriage sexual activities minimize their chance of marriage, where unmarried girls with low social status living at the parental home face a number of problems (e.g. economic problems, and adjustment with other family members etc.) for the rest of their lives.

In addition to cultural reasons, consanguinity is also preferred in order to; (i) keep the families' land in their own family circles (Grant and Bittles 1997); (ii) to strengthen and maintain family strength, so that in case of any conflict with other tribes, they have a trustworthy and readily available force; (iii) to keep the family problems to a minimum in the absence of a husband. The wife's family remains near by, and is always helped by her family if needed. Sometimes the parents decide on the engagement of their children when they are in the cradle. According to the cultural norms and values, this decision is honoured otherwise the family could split in groups, causing conflicts, which can escalate.

Association of consanguinity with other factors: In developing countries and especially in Pakistan, large community-based studies associated consanguinity with rural residence (Hussain and Bittles 1999 and 2002, Bittles 2004), lower age at marriage, low maternal education (Grant and Bittles 1997, Shami et al 1983, Bittles 1994, Bittles 2005), and overall low social status of the family (Hussain et al 1998). From these associations, it is suspected that the majority of the consanguineously married couples face a number of social and economic problems including the adverse effect of rural residence that could influence pregnancy outcomes independent of the genetic impact due to consanguinity (Section 2.1.1, and 2.1.2).

Effect of consanguinity: There is a lot of evidence, based on the population and large community-based studies that consanguinity is an increased risk for neonatal mortality controlling for other important factors in Pakistan (Grant and Bittles 1997, Hussain and Bittles 1998, Bittles 1994). Bundey et al (1991), and Balarajan et al (1989) also reported the adverse effect of consanguinity on neonatal mortality within a Pakistani community living in UK. In large community-based studies by Fikree et al (1994), Fikree and Berendes (1994) and Hussain (1998) associated consanguinity in Karachi with IUGR and LBW. The effect of consanguinity on birthweight was consistent with Honeyman et al's (1987) large hospital-based study in Birmingham UK. Similarly, Al-Eissa et al (1994) in a case control study in Riyadh-Saudi Arabia associated consanguinity with spontaneous preterm birth. Therefore, in addition to genetic problems, it is also suspected that the high infant mortality in consanguineous couples might be due to the high ratio of LBW, IUGR and spontaneous preterm births.

Summary: Consanguinity is one of the most important cultural factors, which is common in developing countries, due to social and cultural reasons and economic benefits. In addition to adverse pregnancy outcomes, there is strong evidence that consanguinity is associated with low maternal social status, teenage marriages, and rural residence. In NWFP due to culture, tradition, low social-status and high ratio of non-educated women consanguinity is expected to be common, yet, little is known about the incidence and its effect on LBW and IUGR in this region.

2.1.4 Maternal age

Maternal age is one of the most important factors for newborn health in epidemiological studies, particularly in the Arab and Muslim world where due to culture and belief, the parents prefer to marry their daughters close to menarche (Harfouche et al 1983). However, there is evidence that girls close to menarche still need further time to achieve physical and biological maturity for healthy pregnancy outcomes (Moerman 1982, Hayes et al 1979, Elster and Mcanarney 1986, Dot and Fort 1976).

The prevalence of teenage mothers: In South Asia 25%, and 60% girls are married by the age 15 and 18 years (Khan 2003), however, the ratio of teenage marriages in India and Pakistan are one-third and one quarter by the age 15-19 years, respectively (Khan 2003). In Pakistan, nearly one-quarter of teenage women are married, but only 5% of adolescent men are married (Khan 2003). The early marriage of girls compared to boys might be due to a common perception among parents of girls in the poor communities that, "a girl is some-one else's property so why invest on her?" (ICHG 2005). Therefore, parents with low social status try to marry their daughters as soon as possible without spending their family income on her up-bringing. However, in the case of high social status girls (educated and employed), the parents try to delay their marriages, due to her income and property. In addition to culture and traditions, the perception and social status of the parents might be an important factor for the decision to marry at a certain age.

The effect of maternal age: This literature survey found that too young and too old mothers were at a higher risk of LBW, which make a reverse J-shaped curve (Lawoyin and Oyediran 1992). This means that the risk of LBW is highest in the teenager and older age women compared to middle age mothers. In Pakistan data from retrospective histories collected in the Population, Labour Force and Migration Survey of 1979 confirmed that children of the youngest and oldest mothers experienced the highest rates of infant mortality (Sathar 1985). The effects of younger and older mothers on newborn health (LBW/IUGR) are presented below:

There is a lot of evidence regarding the adverse effect of teenage mothers on LBW in the Indian subcontinent (Makhija and Murthy 1990, Malik et al 1997, Deshmukh et al 1998, Karim and Mascie-Taylor 1997, and Nahar et al 1998), however, studies show that teenage mothers are not significantly associated with IUGR (Fikree and Berendes 1994, Mavalankar et al 1992, Kramer et al 1999, Ferraz et al 1990). For example, in a large study of a rural project in Haryana-India, Makhija and Murthy (1990) associated teenage mothers with a higher ratio of LBW compared to that of middle aged mothers. This study was consistent with a number of univariate and multivariate, small and large hospital and community based studies in India and Bangladesh (Malik et al 1997, Deshmukh et al 1998, Karim and Mascie-Taylor 1997, and Nahar et al 1998). However, in Ahmadabad, India

Mavalankar et al (1992) associated maternal age (<20 years) with preterm LBW, but not with full-term LBW (IUGR). The non-significance of teenage mothers in the Mavalankar study was found to be consistent with; a community based study in Karachi-Pakistan (Fikree and Berendes 1994); Ferraz et al's (1990) study in Brazil; and Kramer et al's (1999) study in Canada controlling for other important factors. These studies showed that teenage mothers are at increased risk for LBW and non-significant for IUGR.

Maternal age and associated factors: In addition to maternal age, there is also evidence that the adverse effect of teenage mothers might be due to confounding factors associated with maternal age. For example, in a case-controlled study of 110 adolescent and 102 non-adolescent mothers in Addis Ababa Ethiopia, Ali and Lulseged (1997) associated teenage mothers with a high ratio of preterm births compared to non-teenage mothers (Ali and Lulseged 1997). However, in a case controlled study of primiparas' mothers in the Philippines (214 adolescents and 415 adult primiparas' mothers), Borja et al (2003) found no significant difference, among adolescents and adults women, for average gestation and the ratio of preterm births. Borja's study showed that after controlling for gravidity, maternal age was not significantly associated with adverse pregnancy outcomes. Moreover, the differentials in the findings might be due to areas of residence (urban areas of Ethiopia, and a sample of 17 rural and 16 urban health units in Philippines), and study design. Ali and Lulseged (1997) used a mixed sample of primipara and multigravida women, where Borja et al (2003) used only primipara women of different ages (adolescent and non-adolescent). These findings showed that, in addition to young maternal age, the high ratio of adverse pregnancy outcomes in teenage mothers might be due to other confounding factors (e.g. primiparity and/or diversity in place of residence).

The literature also associated teenage mothers with an increased risk of low pregnancy weight, low body mass index (BMI) (Lima et al 1990), less education (Feleke and Enquoselassie 1999), and more economic dependence compared to non-teenage mothers (Borja et al 2003). The economic dependency further could cause maternal psychological problems (Aris 1996) that cause further adverse pregnancy outcomes (Rahman et al 2007 and 2004). Borja et al's (2003) also reported that "adolescents who become pregnant disproportionately come from socially disadvantaged environments", and are at increased risk of inadequate food, nutrition and antenatal care (Borja et al 2003, page 733).

However, after controlling for poverty and other socio-economic factors Stevens-Simon et al (1995) found that "the negative effect of young maternal age on birthweight weakens or disappears" (see Baroja et al 2003, page 733). These findings show that the effect of maternal age is important, but is not the only factor responsible for the high incidence of LBW. This is due to a number of covariates that simultaneously influence maternal health and pregnancy outcomes in addition to maternal age (e.g. social status, economic dependency and psychological factors, and maternal physical health parameters etc.).

Older mothers: In addition to teenage mothers, there is a lot of evidence that older mothers are also at increased risk of adverse pregnancy outcomes compared to middle aged mothers. For example, in a study of 251 mothers in urban areas of Dhaka-Bangladesh, Karim and Mascie-Taylor (1997) associated older mothers with a higher risk of LBW when adjusted for other important covariates. Tabussum et al (1994) associated older aged mothers with an increased risk of preterm births in a univariate study at Karachi. Similarly, large multivariable studies associated older mothers (>34 years) with high ratio of stillbirth, hypertension and diabetes in Paris (Breart et al 1987), LBW, macrasomic-babies and caesarean section in Austria (Kirchengast and Hartmann 2003), and caesarean section in Taipei-Taiwan (Lin et al 2004).

Numerous studies have also shown that, older mothers are at increased risk of IUGR compared to middle age mothers, controlling for other associated factors in developed and developing countries (Kramer 2005, Kramer et al 1999, Ferraz et al 1990, Mavalankar et al 1992, and Fikree and Berendes 1994). In a large study in Canada, Kramer et al (1999) associated older mothers with IUGR after controlling for a number of maternal health and pregnancy history factors. This study was consistent with Ferraz et al (1990) study in Brazil, Mavalankar et al (1992) study in Ahmedabad India, and Fikree and Berendes (1994) in a community based study in Karachi-Pakistan.

However, the increased risk of adverse pregnancy outcomes (LBW, IUGR and stillbirth), in the old age mothers, one large private hospital-based study in USA found no evidence of increased adverse pregnancy outcomes in older primiparas' (first birth) mothers compared to middle age mothers (Berkowitz et al 1990). The non-significance of older age mothers in the USA could be due to (i) private-hospital patients that are expected to have high social status with best care during pregnancy, and (ii) primiparas mothers not having been exposed to a previous adverse pregnancy history.

Summary: This literature survey on maternal age (teenage and older age mothers) showed that there is a lot of evidence that teenage and older age mothers are at increased risk of adverse pregnancy outcomes. However, the variation in findings (degree of effect) depends upon the covariates associated with maternal age (e.g. social status, area of residence, physical health and access to health care facilities etc). There is also some evidence that after controlling for these covariates (e.g. poverty and socioeconomic factors), the impact of maternal age weakens or disappears. However, the effect may vary from country to country, and place to place depending upon the associated covariates.

2.1.5 Ethnicity/Nationality

Ethnicity is one of the important factors associated with newborn health. People move from place to place and leave their country of origin for a number of reasons (e.g. political instability and wars, droughts, earthquakes, business, employment and opportunity for better life).

Studies in the UK and USA associated ethnicity with neonatal and newborn health through maternal physical health, health awareness and maternal social status/education (Acevedo-Garcia et al 2005, Margetts et al 2002, Terry et al 1980 and Fuentes et al 1998). In a community-based study in England and Wales (1982-85), Balarajan et al (1989, page 716) reported that, "postneonatal mortality was highest in infant of mothers born in Pakistan (6.4/1000 live births) followed by infants of mothers born in the Caribbean (4.5) and the United Kingdom and Republic of Ireland (4.1)". However, the infant mortality in children of mothers born in Pakistan was significantly higher 17/1000 compared to 10/1000 live birth in children of mothers born in the United Kingdom (Balarajan et al 1989). It is suspected that the high infant and neonatal mortality in the Pakistani community in England and Wales could be due to low social status, low health awareness, and genetic problems due to consanguinity (see Section 2.2 and 2.3) compared to the local Caucasian population.

LBW in Asian mothers: Margetts et al (2002) found that the newborn weight of the immigrants from the Indian-subcontinent in the UK is declining from generation to generation. The newborn weight and incidence of LBW were 3133 g and nearly 8% for the first generation babies and 3046 g and nearly 12% for the second generation babies (Margetts et al 2002). It is suspected that the decrease in the birthweight and increased ratio of LBW might be because of, (i) consanguinity and teenage marriages (see Section 2.1.3 and 2.1.4) in successive generations, and (ii) cultural issues like arranged marriages that could affect the newborn health through maternal mental health (Rahman et al 2004).

In a community-based study in Netherlands, Drooger et al (2005, Page 115) concluded after a study of ethnic differences in prenatal growth in different ethnic groups that, "there are ethnic differences in fetal growth, which to a large extent may be attributed to differences in maternal weight, height, age and parity". The differential in neonatal and newborn health in different ethnic groups could be through maternal physical health and social status controlling for other important factors. Such effects of ethnicity were also observed in other large studies in Birmingham, UK and North Carolina, USA (Terry et al 1980, Michielutte 1994).

Low birthweight in refugee camps: Mostly, people migrate to their neighbouring countries as refugees due to wars and political instability in their country of origin. The majority of the refugees get facilities including health care in refugee camps mostly from the United Nations and the host country. However, the refugees could face a number of social, cultural, economic and health problems during their stay in the foreign country.

There is strong evidence that living in refugee camps might influence maternal and newborn health. In a large study of refugee camps, Hynes et al (2002) reported that majority of the refugee camps (7 out of 9) had lower percentages of LBWs than in the country of origin, whilst 5 out of 9 refugee camps had lower percentages of LBWs than the host country. Therefore it seems that incidences of LBW in refugee camps are lower than in the home country, and seem comparable (5 out of 9) with those in the host country. However, evidence regarding LBW in the camps compared to the host country is not consistent and may vary from country to country depends upon ethnicity and facilities in the camps (e.g. adequate health care and, food and nutrition during pregnancy etc) (Hynes et al 2002).

Afghan refugees in Pakistan: Since 1979, Afghan refugees have migrated to Pakistan due to the Afghan civil war, and they are now one of the largest refugee populations in the world (Bartlett et al 2001). Affluent refugees have moved to the main cities of Pakistan and started living like affluent local people, whilst the poorer refugees live in the camps and are provided with food, shelter and health care facilities with the help of United Nations. In a study of Afghan refugee mothers in the camps, Bartlett et al (2002) reported a high ratio of maternal deaths and a life time risk of death in Afghan-refugee camps compared to Pakistan mothers due to multiple barriers; the majority (nearly 70%) of these were preventable. The authors reported that very limited mobility of the refugee mothers was a cause of inadequate access to health care resources and adverse maternal health (e.g. haemorrhage, sepses and induced hypertension and anaemia) (Bartlett et al (2002). This study suggested access to family planning, health awareness and establishing an additional labour and delivery suite with all facilities in the more remote settlements was necessary to minimise maternal deaths in Afghan refugee (Bartlett et al 2002).

The high maternal mortality and adverse maternal health in Afghan refugees camps reflects the poor maternal health, and non-adequate health care facilities in the camps compared to local Pakistani mothers. Due to inadequate health care facilities in the camps, the refugee mothers use public hospitals for health care at their own expense. In this scenario, where sufficient health care facilities are not available, maternal and newborn health of the poor refugees attending public hospitals are expected to be at higher risk compared to Pakistani mothers and newborn children.

Summary: This literature review shows that there are two types of ethnic minorities, i.e. (i) ethnic minorities/immigrants to developed countries, and (ii) refugees in the less developed countries, e.g. Afghan refugee in Pakistan. In the developed countries the newborn health in ethnic minorities might suffer from maternal physical health, mental health and social-status compared to the local population. However, in the less developed countries the refugees could suffer due to maternal physical health, mental health, social status and inadequate access to health care facilities required during pregnancy. There is evidence that maternal health of Afghan refugee mothers are at higher risk compared to Pakistani mothers for a number of barriers, the majority of which are preventable through adequate health care. The incidence of LBW/IUGR in Afghan refugee mothers is unknown, however, it is suspected that, Afghan refugee mothers could be at higher risk of LBW compared to local Pakistani mothers.

2.1.6 Summary of geo-demographic factors

This literature review found that maternal area of residence and water sources, social status (education and income), maternal age, consanguinity, and refugee-status are the important geo-demographic factors that influence pregnancy outcomes. In this group of factors, area of residence and social status of the mothers further affect neonatal health/LBW through cultural factors (consanguinity and teenage marriages), and maternal health and pregnancy history due to non-adequate access to health resources (for details see section 2.2).

In NWFP and Tribal areas, it was found that a majority of the residents live in rural areas with less access to fresh drinking water compared to other parts of Pakistan. There is also evidence that the majority of the mothers in NWFP and Tribal areas are less educated, also in this region consanguineous and teenage marriages are expected to be common in this part of Pakistan. This literature review finds no evidence of an investigation into the effect of maternal geo-demographics on LBW in Peshawar or any other part of NWFP. However, investigating these factors regarding LBW controlling for maternal health and pregnancy history could add more to the present knowledge on neonatal health in this region.

2.2 Maternal health and pregnancy history

In addition to maternal geo-demographic factors, the literature survey also highlighted the importance of maternal health and pregnancy history (MHPH) regarding LBW. Therefore, this section of the literature survey will review the effect of maternal physical health (height, weight and BMI), and health conditions (hypertension, diabetes and anaemia) regarding maternal and newborn health. The direct effect of MHPH on maternal health could be maternal morbidity and mortality, where "585,000 women die each year-one every minute-from pregnancy related causes" (WHO-World Health Day-Safe Motherhood 1998), however, the effect of MHPH on LBW is described below.

2.2.1 Physical health parameters

In maternal physical health parameters, authors have associated maternal height, weight and the combination of both height and weight (BMI) with newborn health in many different studies (Hosain et al 2006, Khan and Jamal 2003, Begum et al 2003, Pickett et al 2000, Malik et al 1999, Deshmukh et al 1998, Nahar et al 1998, Karim and Mascia-Taylor 1997, Malik et al 1997, Skjaerven et al's 1997, Anwar 1996, Hirve and Ganatra 1993 Amin et al 1993, Dougherty et al 1982, Duignan et al 1975). The details of maternal height, weight and BMI on LBW are as follows.

2.2.1.1 Maternal height and weight

The importance of maternal physical health parameters start from maternal physical health at birth. Skjaerven et al (1997) studied maternal weight at birth in relation to newborn weight in an extensive population-based study in Norway (Skjaerven et al's 1997). This study found that mothers who weighed less at birth had infants at higher risk of LBW compared to those mothers who's weight was normal at birth (Skjaerven et al 1997). This study was consistent with a number of large studies in United States (De 2007, Simon et al 2006, Emanuel et al 1999, Sanderson et al 1995, Hackman et al 1983, Bakketeig et al 1979 cited in De 2007). Therefore, on the basis of above evidence, it is concluded that, a baby-girl's health at birth is also one of the important factors for her next generation's health.

Maternal height: The effect of maternal height on birthweight is conflicting. A number of studies in Indian, Bangladesh and Pakistan (Hosain et al 2006, Khan and Jamal 2003, Deshmukh et al 1998, Karim and Mascia-Taylor 1997, Nahar et al 1998, Malik et al 1997, Hirve and Ganatra 1993) associated maternal height with LBW in large univariate studies. However, the effect of maternal height on LBW disappeared (Hosain et al 2006, Malik et al 1997, Karim and Mascie-Taylor 1997, Hirve and Ganatra 1993) when adjusted for other important covariates, such as maternal age, weight, parity and education. These findings show that maternal height might be one of the important factors, but its effect might not be consistent in the presence of other important influential factors associated with LBW.

However, in developed countries, there is evidence that maternal height influences LBW when adjusted for other important factors. In an extensive study of LBW in San Francisco, Pickett et al (2000) studied the effect of maternal height on newborn weight in four ethnic groups. This study found similar significant effect of maternal height on newborn weight for three ethnic groups (White, Black and Asian), but not for the Hispanic women. The diverse relationship of maternal height with LBW in Hispanic women compared to the other three ethnic groups was reported to be due to unknown confounding influential factors (Pickett et al 2000). However, this study reported that, one of the main reasons for the high ratio of LBW in the case of short mothers might be due to the fact that "shorter women avoid high level of weight gain to reduce the risk of excessive fetal size" (Pickett et al 2000 page 685).

Maternal physical health also varies with ethnicity. In one study on maternal height Duignan et al's (1975) in Birmingham UK, found that Asian mothers were, (i) significantly shorter than white and black mothers, and (ii) the infants of Asian mothers were significantly lighter than white and black mothers (Duignan et al 1975). These studies show that adverse pregnancy outcomes in different ethnic groups might be due to short maternal height.

Maternal weight: Numerous studies in the developed and developing countries highlight the importance of maternal weight with and without adjusting for other important factors (Hosain et al 2006, Khan and Jamal 2003, Karim and Mascia-Taylor 1997, Nahar et al 1998, Malik et al 1997, Amin et al 1993, Dougherty et al 1982). Dougherty et al (1982) in a large hospital-based study in west of London associated maternal height and weight with newborn weight controlling for other important factors. This study was consistent with a case controlled study in a rural village of Tamil Nadu-India (Amin et al 1993), and a large prospective community-based study of mothers from urban affluent, slums and rural mothers in Bangladesh (Nahar et al 1998). In two of these studies (Dougherty et al 1982, Amin et al 1993), it was found that social factors were not significantly associated with LBW. It is suspected that the non-significance of social factors in these studies could be due to the social benefits including free access to health care in London, and benefits from health project RUHSA's intervention in Tamil Nadu India (Dougherty et al 1982, Amin et al 1993). These studies show the importance of maternal height and weight on birth weight independent of maternal social status and access to health care facilities. However, a number of studies in India and Bangladesh (Hosain et al 2006, Malik et al 1997, Karim and Mascie-Taylor 1997) have associated maternal weight adjusted for maternal height, age, parity and education. These studies highlighted maternal weight as one of the important factors independent of maternal social status and height of the mothers.

2.2.1.2 Maternal body mass index (BMI)

A number of studies (Veena et al 2004, Khan and Jamal 2003, Deshmukh et al 1998, Karim and Mascie-Taylor 1997, Cogswell et al 1995, Al-Eissa et al 1994) independently associated low BMI with LBW. In an extensive study of eight states in the USA, Cogswell et al (1995) studied the effect of BMI on newborn health, and found that low BMI was independently associated with adverse pregnancy outcomes. The effect of maternal BMI on LBW was consistent with other large studies in Islamabad, Pakistan (Khan and Jamal 2003), Riyadh, Saudi Arabia (Al-Eissa et al 1994), Nagpur and Karnataka, India, respectively (Deshmukh et al 1998, Veena et al 2004). However, in one study the effect of BMI disappeared due to the significance of maternal weight gain during pregnancy with LBW (Hosain et al 2006).

In addition to LBW, the effect of low BMI on child mortality was also seen in two large studies in the Matlab region of Bangladesh (Bhuiya et al 1993, Ahmed et al 1998). However, these studies associated maternal physical health parameters (i.e. maternal height, weight and BMI) with maternal social status and especially with maternal education (Bhuiya et al 1993 and Ahmed et al 1998). Therefore, low maternal BMI might be one of causes of high infant mortality and could be associated with low social status.

Summary: There is evidence that maternal physical health parameters (maternal height, weight and BMI) influence LBW independent of other important factors. However, many studies showed that the effect of low maternal weight and BMI independently are at increased risk of LBW, whilst the effects of maternal height disappear or weaken when adjusted for other important factors, especially maternal weight. In the context of the present study in Peshawar, it is suspected that, maternal weight and BMI might be the two important physical health parameters for LBW when adjusted for maternal height and maternal social status.

2.2.2 Diagnosed health conditions

There are a number of maternal health conditions that influence maternal and newborn health independent of maternal geo-demographic factors and physical health parameters. Studies reported that pregnancy outcomes are at increased risk when the mother has diabetes (Dune et al 2000), hypertension (Steer et al 2004) and/or anaemia (Khalida et al 1997). The details of these health conditions (i.e. diabetes, hypertension and anaemia) and correlation with pregnancy outcomes are as follows:

2.2.2.1 Diabetes

There is a lot of evidence in the literature regarding the adverse effect of diabetes on maternal and newborn health (Ehrenberg et al 2004, Dunne et al 2003, Vangen 2003, Schmidt et al 2001, Sibi et al 2000, Hanson et al 1998, Lauszus et al 1999, Usta 1995 and Fraser 1990). In a study in Birmingham UK, Dunne et al (2003) associated maternal diabetes with newborn health (stillbirth, perinatal mortality, neonatal mortality, and congenital malformation) compared to non-diabetic mothers delivered between 1990 and

2002. Schmidt et al (2001) in Brazil associated maternal diabetes with macrasomic babies and perinatal death along with adverse maternal health like pre-eclamsia compared to normal mothers. Similarly, a wide range of studies reported diabetic mothers at higher risk of LBW, preterm birth, and macrasomic baby (Vangen 2003, Sibi et al 2000 and Hanson et al 1998), births large for gestation (Ehrenberg et al 2004, Fraser 1990), and increased risk of delivery complications like caesarean section compared to healthy mothers (Vangen 2003, Lauszus et al 1999, Usta 1995) in different studies. The incidence of diabetes and its association with newborn health in Pakistan is described below:

Diabetes in Pakistan: In a National Health Survey of Pakistan (NHSP 1990–1994), Jafar et al (2004) investigated the prevalence of diabetes in different ethnic groups (age ≥ 15 years). This study found that the incidence of diabetes significantly varied among different ethnic groups, "being highest among the Muhajirs (men 5.7%, women 7.9%), then Punjabis (men 4.6%, women 7.2%), Sindhis (men 5.1%, women 4.8%), Pashtuns (men 3.0%, women 3.8%), and lowest among the Baluchis (men 2.9%, women 2.6%)" for un-known reasons (Jafar et al 2004, Page 716). This study showed highest incidence of diabetes in the two developed provinces (Sindh and Punjab) compared to two less developed provinces of Pakistan (Baluchistan and NWFP including Tribal areas).

The effect of maternal diabetes was associated with adverse pregnancy outcomes in Lahore, Islamabad and Karachi. Randhawa et al (2003) in a small hospital-based study (n=50) in Lahore-Pakistan, and Alam et al (2006) in a combined sample of 40 patients from Islamabad and Karachi reported that diabetic mothers are at increased risk of macrasomic babies (40% to 45%) and caesarean section (50% to 55%). In addition to macrasomic babies and caesarean section Randhawa et al (2003) also reported 10%

preterm and 16% miscarriage, whereas Alam et al (2006) associated diabetes with birth asphyxia (15%) and congenital abnormality (25%). Alam et al's (2006) concluded that high adverse pregnancy outcomes among diabetic mothers could be reduced through registering pregnancy in the hospital, antenatal follow-up, and access to adequate neonatal services including general awareness of the problem.

There is evidence that the incidence of maternal diabetes is lower in NWFP and Baluchistan compared to the rest of the country, however, the literature search did not locate any studies on diabetes and LBW in Peshawar and other part of NWFP. On the basis of evidence (Jafar et al 2004), it is suspected that the incidence of maternal diabetes might be lower in Peshawar, however, diabetic mothers might be at higher risk of adverse pregnancy outcomes in the deprived/rural areas due to inadequate access to health resources due to low maternal social status compared to other parts of Pakistan (for details see Section 2.1.2 and 2.3.2.3).

2.2.2.2 Hypertension

Hypertension is another maternal health condition that influence pregnancy outcomes independent of other important factors (Prakash et al 2006, Steer et al 2004, Shaheen et al 2003, Sibai et al 2000, Yadav et al 1997, Mavalakar et al 1992). For instance, in a large study of 15 maternity units in London Steer et al (2004) reported maternal blood pressures during pregnancy at increased risk of small babies and high perinatal mortality. In another large study of hypertensive mothers in the United States, Sibai et al's (2000) reported that chronic hypertension is significantly associated with preterm births 21.9%, against 3.4% in non-hypertensive mothers. These two studies in UK and USA show that hypertension is one of the important factors associated with adverse pregnancy outcome independent of other important factors (e.g. access to adequate health care resources, area-status etc).

Many studies in India reported the incidence of maternal hypertension and its association with LBW, IUGR, stillbirth, and perinatal mortality compared to non-hypertensive mothers (Prakash et al 2006, Yadev et al 1997, Gupta et al 1996, Mavalakar et al 1992). The incidence of maternal hypertension in Varanasi and Shimla was 5.38% and 4.1% respectively (Prakash et al 2006, Gupta et al 1996) and caused 17.4% LBW and 8.7% stillbirths, respectively. However, in a poor community of Varanasi, two-third of the babies were reported to be LBW due to high ratio of preeclampsia and eclampsia (an advance stage of chronic hypertension) (Prakash et al 2006).

The effect of hypertension was also studied in case controlled studies in New-Delhi and Ahmedabad India (Yadav et al 1997, Mavalankar et al 1992). In new-Delhi hypertensive mothers were at increased risk of preterm births (28.8% against 3%), stillbirth (4.8% against 0.25%) and perinatal mortality (14.8% against 1%) compared to non-hypertensive mothers, respectively (Yadev et al (1997). However, in a large study in Ahmedabad-India, hypertension was associated with IUGR and preterm LBW controlling for other important covariates (Mavalankar et al 1992). These findings show that maternal hypertension might be one of the influential factors associated with preterm births, LBW, IUGR, stillbirth and perinatal mortality.

Hypertension in Pakistan: According to a report (Jafar et al 2003), the proportion of diabetes varies from place to place/ethnic groups in Pakistan. Jafar et al (2003) studied the incidence of hypertension in different ethnic groups in Pakistan. This study found ethnic differences regarding the incidence of hypertension (10% to 25%) in Pakistan: highest for Baluchis (men 25.3%, women 41.4%), and Pashtuns (men 23.7%, women 28.4%) in Baluchistan and NWFP provinces, compared to Muhajirs (men 24.1%, women 24.6%), Punjabis (men 17.3%, women 16.4%) and Sindhis (men 19.0%, women 9.9%) in Punjab and Sindh province. These findings show that the ratio of hypertension varies in different parts of Pakistan, which is highest in Baluchistan and NWFP compared to other two provinces, Punjab and Sindh.

In small hospital-based studies in Lahore and Peshawar, hypertension during pregnancy was seen in 26% to 28% of the total mothers delivered (Akbar et al 2002, Ashraf 2003, and Shaheen et al 2003). However, in a case controlled study in Islamabad hypertension was independently associated with LBW compared to non-hypertensive mothers (Khan and Jamal 2003). In addition hypertension was reported to be a cause of premature babies, and stillbirth in two small univariate studies, respectively in Peshawar and Multan (Shaheen et al 2003, Naseer 2000). These findings show that hypertension is an important factor regarding newborn health, however, large community/population and hospital based studies might be helpful to understand the degree of its effects on newborn health in different geographical locations in Pakistan.

2.2.2.3 Anaemia

Anaemia is a global health problem, where an estimated two-billion people suffering from it. It accounts for nearly 20% of the total maternal deaths worldwide (United Nations: Standing Committee on Nutrition, 25th session) and influences newborn health through short gestational age and LBW (Allen 2000). Anaemia is more prevalent in pregnant women in Oceania, Asia and Africa (75%, 59%, 51%) than non-pregnant women (70%, 44%, 43%), respectively compared to America (pregnant 39%, non-pregnant 30%) and

Europe (pregnant 16%, non-pregnant 11%) (United Nations: Standing Committee on Nutrition, 25th session).

According to the United Nations (2000), 800 million people in Asia (two-third in South Asia) live in poverty and have no access to adequate food required for a healthy body (United Nations 2000). In the Indian subcontinent, the estimated prevalence of anaemia among children under 5 years of age is 75%, 55% and 56%, in India, Bangladesh and Pakistan respectively (MI/UNICEF 2004, Proceedings 2004). This reflects the poor health of the future parents and hence a future generations health. One of the main reasons for high ratio of maternal anaemia could be iron deficiency due to dietary inadequacy, and especially a vegetarian diet due to poverty and beliefs (Sharma et al 2003, Yaqoob and Abbasi 2002). For a healthy new generation, Hallberg (2001) recommended the prevention of iron deficiency in non-pregnant and pregnant women, so as to minimize adverse pregnancy outcomes (Hallberg 2001).

Indian-subcontinent: The effect of maternal anaemia was investigated by a number of authors in the Indian-subcontinent (Khalida et al 1997, Hosain et al 2006, Lone et all 2004, Sharma et al 2003, Mumtaz et al 2000, and Khan 2001). For example, in a large hospital-based study of pregnant women in Srinagar, Khalida et al (1997) associated maternal anaemia with LBW and neonatal mortality. In Srinagar the prevalence of mild, moderate and severe maternal anaemia was 36.70%, 18%, and 4.3%; however, the respective LBW were 32.11%, 49.80%, and 69.05% that resulted in neonatal mortality of 1.84%, 6.72% and 28.57%, respectively (Khalida et al 1997). This study establishes a relationship of maternal anaemia with neonatal mortality through LBW babies that is significantly high in the case of severe anaemia than in moderate and mild.

In one such small univariate hospital-based study in Delhi, Sharma et al (2003) associated adverse pregnancy outcomes in the anaemic compared to non-anaemic mothers consistent with another large study in rural Bangladesh (Hosain et al 2006). The main reason reported in Sharma's study was vegetarianism in the poor Indian mothers, whereas, it was multipara and physically weak mothers in the Hosain (2006) study in Bangladesh.

There is also conflicting evidence regarding the effect of maternal anaemia on IUGR and LBW (Fikree et al 1994, Fikree and Berendes 1994, Mavalankar et al 1992). For example, anaemia was not associated with IUGR babies in Karachi (Fikree et al 1994, Fikree and Berendes 1994); whilst Mavalankar et al (1992) associated anaemia independently with IUGR and LBW babies adjusted for other important covariates.

The proportion of maternal anaemia varies from place to place due to a number of reasons. In large hospital-based studies the prevalence of anaemia was 45% in Islamabad (Saeed et al 2002); and 60% to 66% in Lahore (Yaqoob and Abbasi 2002, Sohail et al 2004). In Pakistan, iron-deficiency anaemia might be one of the major problem, where daily iron supplementation for pregnant women were recommended in a large study in Islamabad and Taxila-Pakistan (Mumtaz et al 2000). One of the main reasons of maternal anaemia might be poor diet during pregnancy (Awan et al 2004), more likely due to poverty and low social status (Lone et al 2004). Maternal anaemia was also associated with maternal age (<20 years), low BMI, illiteracy and low family income (Lone et al 2004).

Iron deficiency anaemia was reported to be one of the major problems associated with LBW and stillbirth in a small hospital-based study in Abbottabad-Pakistan (Khan 2001). This study was consistent with two other studies in Karachi where anaemia was associated with (i) LBW and fetal mortality (Rehman et al 2005), and (ii) short gestational age, LBW, and low Apgar scores (Lone et al 2004).

However, maternal anaemia could be more prevalent in rural areas and in poor families due to insufficient food and nutrition required during or before pregnancy and inadequate access to health resources due to low social status (Fikree et al 2002). In addition to that, one of the main problems of people's health in the rural areas could be the health behaviour of the people, where they do not see the doctors until they are seriously ill and unable to do heavy physical work (Yaqoob and Abbasi 2002).

Summary: Many studies have associated maternal hypertension and diabetes with adverse pregnancy outcomes. However, in Pakistan studies have reported the high incidence of hypertension and lower incidence of diabetes in NWFP and Tribal areas for unknown reasons compared to the other two provinces of Punjab and Sindh. There is also evidence that maternal anaemia influences maternal and newborn health and might be associated with low social status, vegetarian diet, maternal age and physical health parameters. Further studies on a regional basis are warranted to investigate the incidence and influence of maternal diabetes, hypertension and anaemia on maternal and newborn health; along with the main causes of these important health conditions.

2.2.3 Pregnancy history

Pregnancy history helps in understanding the maternal health for the present pregnancy and hence the expected health of the newborn. This section focuses on the relationship with any previous abortions, the gap between the present and preceding pregnancy, antenatal care during the present pregnancy, and gestational age.

2.2.3.1 Abortion/miscarriages

Abortion is one of the five leading causes of maternal mortality worldwide (Population Council 2004). WHO estimated one in eight maternal deaths due to unsafe abortions (cited in Singh 2006), and 2-12% of the total deaths in Paksiatn (WHO 1995). In Pakistan maternal hospitalization due to abortion related problems are more than doubled (7/1000) compared to overall hospitalization in the South Asia (3/1000) (Singh 2006). One of the main problems could be high ratio of induced abortions are performed through inadequately trained persons (Rehan et al 2001). These findings show that abortion is one of the main influential factors associated with maternal health directly and newborn health through weak maternal health (Rehan et al 2001, Karim et al 1998).

Abortion could be spontaneous and induced. "A *spontaneous abortion* or miscarriage is the termination of a pregnancy without exogenous causes, an unintended abortion that is due to natural or accidental causes; internationally, a time limit (before the 20th or 28th week, differing across countries) or size of the fetus (less than 35 cm length) may also be used to define a spontaneous abortion and to distinguish it from a still birth" (Population Council 2004). Whilst "an *induced abortion* is the intentional termination of a pregnancy before the embryo or fetus have reached extra uterine viability, through use of a range of procedures, including safe methods such as surgical and pharmacological methods, and unsafe methods that range widely in type and effectiveness." (Population Council 2004).

A number of studies have associated spontaneous abortion with maternal age (Kline 1978, Naylor and Warburton 1979, Harlap et al 1980; cited in Coste 1991), area of residence, previous spontaneous abortions and psychological problems during pregnancy (Coste et al 1991). In the Indian-subcontinents, studies have also highlighted consanguinity (Shami et al 1989, Hussain et al 1998), vaginal bleeding in the second trimester (Karim et al 1998), previous history of abortion (Awan and Mubashir 1975).

However, due to legal restrictions and social stigma in many countries, sufficient data is not available to identify the main causes of induced abortion (Singh 2006), especially in the Muslim world. Abortion is a direct threat for maternal health and indirect threat for newborn health through weak maternal health (e.g. anaemia and haemorrhage) (Singh 2006, Salem and Fikree 2001, 2005, Population Council 2004, Pahari et al 1997) and preterm delivery and LBW in the next pregnancy (Karim et al 1998).

Abortions affect maternal health through anaemia and haemorrhage (Salem and Fikree 2001 and 2005, Pahari et al 1997), and pregnancy outcomes through gestational age and LBW (Karim et al 1998). The effect of abortions on maternal and newborn health in the Indian-subcontinent is as follows:

India and Bangladesh: In a review of the literature in India, the effect of abortion on maternal and newborn health was reported to be due to social, environmental, cultural and biological factors (Bhargava et al (1991), that also causes inadequate access to essential health services due to socio-cultural barriers in this region (Islam 1992). In a large hospital-based study in Kurseong-India, Ray (1996) reported 17.02% of the total admitted pregnant mothers had had a previous abortion (induced and spontaneous). This study found that septic abortion was one of the main factors associated with high maternal mortality (Ray 1996). In another hospital-based study in Calcutta-India, of the total complicated pregnancies (32.6%), abortion was reported to be one of the main causes of adverse pregnancy outcomes in addition to anaemia and hypertensive disorder (Pahari et al 1997).

These studies show that abortion affects maternal health through a number of health conditions (e.g. anaemia and haemorrhage) and hence the newborn health; due to inadequate access to health care services.

Pakistan: In Pakistan, an estimated 890,000 induced abortions are conducted, and nearly one-quarter of these women suffer from pregnancy complication and morbidity later in life (Population Council 2004). Some of the reasons for the abortions is the desire for small family (Saleem and Fikree 2001), unplanned pregnancy due to limited use of contraception and awareness (Ashraf et al 2004), sex selective abortions (Fikree et al 2004), and maternal high education (Hussain 1998).

In addition to the social and cultural factors, the restrictive legal status in Pakistan (Rehan 2003) means that the majority of the induced abortions (80%) are attended by untrained birth attendants in un-sterilised environment (Khan 2005, Hussain et al 2004). These unsafe abortions through untrained attendants affect, (i) maternal health (e.g. anaemia due to haemorrhage and infectious diseases like hepatitis etc. due to un-sterilised and un-clean environment), and (ii) hence the next pregnancy likely to result in a LBW (Zhou et al 2000) or miscarriages due to weak maternal health (Hussain 1998).

A number of studies in Pakistan associated abortion with maternal and newborn health (Ashraf 2004, Saleem and Fikree 2001 and 2004, Korejo 2003, and Karim 1998). In a community-based study in Karachi, the incidence of abortion was reported to be 8.2% of all pregnancy outcomes, with no change since 1968 to 1995 (Hussain 1998). However, abortion/miscarriages were associated with previous abortion/miscarriages, older mothers

(>34 years), grand-multigravida and no or less exposure to contraception (Hussain 1998).

Saleem and Fikree (2001) reported induced abortion for 25.5 per 1000 women of the reproductive age group in a hospital-based study, consistent with another hospital-based study in Karachi (Korejo et al 2003). Abortion was reported to be a cause of 68.5% of maternal health complications, mostly fever and haemorrhage in a large study in Karachi (Saleem and Fikree 2001). However, in a case controlled study haemorrhage was significantly associated with fetal loss in Karachi (Karim et al 1998). Korejo (2003) found that among mothers with a history of abortion, the majority were from a low income group, 60% of them were illiterate, nearly 44% were attended by traditional birth attendants (TBAs) and 75% had never used contraception. These two studies in Karachi show that previous adverse pregnancy history might be due to low maternal education, inadequate access to health resources, use of TBAs, and less exposure to contraception.

Summary: Studies in the Indian sub-continent showed that the post abortion complications affect maternal and newborn health. An estimated one quarter of the mothers suffers from induced abortion in Pakistan. However, the main factors associated with adverse pregnancy outcomes in the case of abortion could be low maternal social status, inadequate access to essential health resources, and cultural and legal barriers. Due to the low maternal social status and lack of health awareness in NWFP and Tribal areas, it is suspected that abortion/miscarriage might be one of the influential factors associated with adverse pregnancy outcomes.

2.2.3.2 Gap or spacing in birth

Inter-pregnancy interval is another issue that could affect infant survival irrespective of maternal education, and area-status (rural or urban) (Cleland and Sathar 1984), most likely due to the increased risk of preterm births, LBW and small for gestational age (Norton 2005, Smith et al 2003).

Numerous studies in the developed and developing countries showed the impact of a gap between pregnancies on pregnancy outcomes. In the United States and the United Kingdom large studies investigated and associated inter-pregnancy interval with newborn health (Zhu et al 1999 and 2001, Smith et al 2003). In a large study in Scotland, Smith et al (2003) associated a short inter-pregnancy interval with increased risk of preterm birth and neonatal death controlling for other important factors. In Utah and Michigan, Zhu (2005, page s25) found that "the risk for adverse birth outcomes is lowest, when the inter-pregnancy interval was 18-23 months, and increased when the interval departed from 18-23 months". Studies also associated short inter-pregnancy interval with LBW and short gestational age (Norton 2005, Smith et al 2003), and severe anaemia (Salik et al 2004). These large studies in the developed countries showed that inter-pregnancy interval is one of the important factors that affect pregnancy outcome directly, or cause other factors associated with poor maternal health.

In the developing countries a number of authors studied the association of gap in pregnancies with pregnancy outcomes in both small and large studies (Salik et al 2004, Shah and Ohlsson 2002, Grant and Bittles 1997, Alam 1995, Rani 1993, Bhargave et al 1991, Cleland and Sathar 1984, Sathar 1983, Tibrewala et al 1980). According to Sathar (1983), the evidence of a strong direct relationship between gap among pregnancies and survival of the newborn has been known since 1923 (Hughe 1923, cited in Sathar 1983).

A number of studies (Shah and Ohlsson 2002, Grant and Bittles 1997, Alam 1995, Bhargave et al 1991, Tibrewala et al 1980) associated short inter pregnancy interval with adverse pregnancy outcomes. Of these studies, Shah and Ohlsson (2002) in a literature review concluded on the basis of epidemiological evidence that short inter-pregnancy intervals <18 months are associated with increased risk of adverse pregnancy outcomes compared to 18-23 months. The adverse effect of short gap was also reported in a review of literature in the developing countries (Tibrewala et al 1980) and an extensive study of slums in New Delhi, Calcatta, Madras, Hyderabad, Varanasi and Chandigarh (Bhargave et al 1991). However, in a recent large study of rural areas in Bangladesh (Hosain et al 2006) found it non-significant due to high significance of maternal physical health parameters and anaemia with newborn health rather than inter-pregnancy interval. These findings show that inter-pregnancy interval might be one of the influential factors for birthweight whilst its effect may be conflicting due to diversity of maternal physical health and health conditions.

In a population-based study in Pakistan, Grant and Bittles (1997) independently associated short gap of <18 months with an increased risk of neonatal mortality, consistent with a large study in Bangladesh (Alam 1995), and a review of studies in the developing countries (Tibrewala et al 1980). These findings show that inter-pregnancy interval is one of the important factors that should not be ignored whilst investigating pregnancy outcomes/neonatal health.

2.3.2.3 Antenatal care

"Antenatal care is a branch of preventive medicine dealing with pre-symptomatic diagnosis of general medical disorder, nutrition, immunology, health education and social medicine in addition to prevention and early detection of pregnancy disorder" (Hibbard 1988, cited in Sultana et al 2002, page14). Antenatal care might be one of the important factors that help in minimizing the adverse effect of maternal health conditions including maternal poor pregnancy history (United Nations 2006). The United Nations (2006), also suggested that "better care for mothers and babies before and after birth would address the challenge of the one third of the deaths that occur in the first day of life".

The independent effect of antenatal care on pregnancy outcomes is conflicting. Two reviews of studies on antenatal care showed no independent association of antenatal care on gestational age (Bloudel et al 1995), LBW and perinatal mortality (Carroli et al 2001). However, Valero et al (2004) in a recent review of studies concluded that "adequate prenatal care prevents LBW, regardless of the existence of possible confounding variables" (Valero et al 2004, page 10). Valero et al (2004) study was consistent with another case control study of 108 mothers in Hungary, where Orvos et al (2002) associated high incidence of preterm births (three-fold) in mothers without prenatal care compared to controlled mothers with some prenatal care. These findings show that the antenatal care maybe important but its effect might not be consistent from place to place.

India and Bangladesh: Many studies in India and Bangladesh studied the effect of antenatal care on maternal and newborn health (Hossain et al 2005, Bloom et al 1999, Nahar et al 1998, Malik et al 1997) but the findings were conflicting. For example, in a large hospital-based study in Mumbai-India, Malik et al (1997) independently associated inadequate access to health resources with a high ratio of LBW. This study was consistent with another large univariate study in urban, urban slums and the rural area of Dhaka in Bangladesh (Nahar et al 1998). However, Hosain et al (2006) found no association of antenatal care with LBW in a large study of pregnant women in rural Bangladesh adjusting for other important factors. One of the reasons for the non-significance of antenatal care could be due to the home visits by health-workers of a non-governmental organization (Gonoshasthaya Kandra) providing primary health care service in the study areas to all mothers (Hossain et al 2005). Such facilities are not available to all mothers; therefore, inadequate antenatal care might be one of the important covariate that should not be ignored whilst investigating pregnancy outcomes.

Pakistan: In a nationally representative survey in Pakistan (Pakistan Demographic and Health Survey (PDHS)), Zahid concluded that "antenatal care during pregnancy increases the child's chance of survival" (Zahid 1996, page 724). He also associated urban residence and paternal high education with the use of modern medical professionals, delivery in the hospital and healthcare during pregnancy. However, in a sub-sample of the same survey (PDHS 1991), non-educated mothers in the rural areas were less likely to avail good quality health care services compared to educated mothers (Khan et al 1994). In the rural areas, educated mothers are likely to access good quality healthcare facilities due to health awareness and expected high income compared to illiterate mothers in the rural areas.

Barriers: The government was trying to increase the number of trained health staff and health care units to increase the ratio of antenatal care. However, in spite 5000 health care units and 650 Rural Health Centers (RHCs), the expected goals of regular antenatal care during pregnancy in Pakistan, set by the government were not achieved (Siddiqi et al 2001). It has been suggested that this results from mismanagement from the government side (Siddiqi et al 2001) or low health awareness due to low literacy and rural residence (Fikree 2002). Antenatal care was reported to be only 30% in a population-based study in

Baluchistan, NWFP and Tribal areas (Fikree 2002). The low interest in health care could affect maternal and newborn health. For example, in a small univariate hospital-based study in Peshawar, Shaheen et al (2003) reported high maternal mortality and adverse pregnancy outcomes due to a delay in accessing medical help (Shaheen et al 2003). The delay in medication and late access to health care facilities might resulted from untrained TBAs practicing in the rural areas, and a late decision to access the hospital by family members.

According to a report the maternal pregnancy problems in Afghan refugee's camps in Pakistan reduced, when TBAs were trained (Miller et al 1995). Lessons could be drawn from TBAs training in the camps and its impact on maternal health. Trained TBAs could reduce maternal and newborn health problems in the rural areas of Pakistan.

In addition to TBAs, there are a number of barriers that could affect the use of antenatal care services. For example, cultural barriers like *pardah of women,* low health awareness due to low female literacy rate (Fikree 2002), low social-status and economic-status dependency of women due to low literacy rate (Fatimi 2000), and private transportation to hospital and arrangement of medicine.

Summary: There is conflicting evidence reporting the association of antenatal care with pregnancy outcome, however, it might be more helpful in case of maternal weak physical health or in case of any health condition. Therefore, antenatal care was recommended by United Nations to take appropriate measures in case of any problem during pregnancy to reduce adverse pregnancy outcomes. In the case of NWFP and Tribal areas, mothers are expected to face a number of barriers (low social status and health awareness, more traditional and using TBAs, and cultural norms "*Pardah observing")* compared to other parts of Pakistan (Sultana et al 2002, Fikree 2002). Therefore, considering these barriers in this region, the ratio of pregnancy registration in the hospital (a proxy for antenatal care) is expected to be low in NWFP and Tribal areas. Studies are conflicting in findings related to antenatal care so it would be useful to consider its impact at regional level.

2.3.2.4 Gestational age

In the neonatal deaths worldwide (4 million in the first 4 weeks of life); three quarters of infants die in the first week, whilst the risk of death on day one is highest compared to the other 6 days of life. Preterm birth (28%) is highest direct cause of death compared to other causes, such as severe infections (26%), birth-asphyxia (23%) tetanus (7%) and other reasons (16%) (Lawn et al 2005).

The incidence of preterm deliveries in the developed countries were reported to be less than 12% (i.e. 10% and 11.2% for Mexican and US mothers in United States, 4.5% and 4.3% in France for the North African and French women, and 3.9% and 4.8% for North African and Belgian women in Belgium) (Guendelman 1999). The incidence of preterm births (4% to 11%) in different ethnic groups shows that the ratio of preterm births could vary with ethnicity as well as area of residence even in the developed countries (Guendelman 1999).

In a large study of Caucasian women in London, Peacock et al (1995) associated preterm births (<37 weeks) with LBW babies. However, this study reported that "lower social class, less education, single marital status, low income, trouble with "nerves" and depression were all significantly associated with an increased risk of preterm birth" (Peacock et al 1995, page 531). The effect of maternal social status, education and income on preterm births shows that the burden/ratio of preterm births could be higher in the developing countries compared to developed countries. The main reasons for the expected high ratio of preterm births in the developing countries could be due to high ratio of low maternal social status (i.e. poverty and illiteracy) along with limited access to adequate healthcare in the rural and deprived areas caused by low investment or public funding for health. The effect of social status on health in relation to area of residence was studied by Murray and Lopez (1997). They reported that the "developed regions account for 11·6% of the worldwide burden from all causes of death and disability, and account for 90·2% of health expenditure worldwide". These figures show the effect of expense on health is inversely associated with health problems; however, mothers with low social status (low education and income) could suffer more compared to high social status mothers.

India and other developing countries: In a large hospital-based study of high risk newborn in Srinagar-Kashmir, nearly 70% of the total perinatal deaths were associated with preterm gestation and LBW (Malik and Mir 1992). However, in a large case control study in Ahmedabad India, Mavalankar et al (1992) associated preterm LBW independently with maternal weight, poor obstetric history, short inter-pregnancy interval, lack of antenatal care, anaemia and hypertension. In a case controlled study in Riyadh, Al-Eissa and Ba'Aqeel (1994) associated short gestation with vaginal bleeding, previous preterm birth, inadequate prenatal care, consanguinity, low BMI and short inter-pregnancy interval. Similarly in other case controlled studies preterm births were associated with short birth spacing in Arab Emirates (Al-Jasmi et al 2002), and teenage mothers in Addis Ababa Ethiopia (Ali and Lulseged 1997). These findings show that the influential factors associated with short gestation are not consistent in different studies/areas and they vary from place to place due to unknown reasons.

In addition, the effect of maternal education and antenatal care on preterm births and LBW were also seen in a large hospital based study in South Kanara area of India (Prasad et al 1994). In this study, the low incidence of preterm birth (7.5% compared to 11-31% in different studies in India, Aris 1992), and LBW (13.3% compared to 30-40% in different studies in India, Aris 1992) in South Kanara were reported to be due to a high ratio of maternal literacy (73%) and high proportion of prenatal care (90%), respectively (Prasad et al 1994). It is therefore concluded that in India and other developing countries, antenatal care, adverse pregnancy history, anaemia, and maternal social status especially maternal education are some of the important factors that could affect newborn health through short gestation.

Pakistan: In hospital-based studies the proportion of preterm birth in Pakistan were reported to be nearly three times (15% to 30%) that of the incidence of preterm births (3.9% to 11.2%) in Europe and America (Najmi 2000, Guendelman 1999). A number of large hospital-based studies in Pakistan associated short gestational age with previous spontaneous and induced abortions (Hussain 1998, Population Council 2004), anaemia (Lone et al 2004, Saeed et al 2002), previous preterm delivery (Talsania et al 1994) and antenatal visits (Tasnim et al 2005). However, small hospital based studies associated eclampsia (Shaheen et al 2003), and vaginal bleeding (Karim et al 1998) with short gestation in Peshawar and Karachi, respectively. These findings show that the main causes of short gestational age in different studies are not consistent and hence need to be investigated at a regional level.

Conclusion: Gestational age is one of the most important factors that contribute more than a quarter of the total neonatal deaths worldwide. Studies associated short gestation with, (i) low social status, teenage mothers, consanguinity and malnutrition, and (ii) maternal health condition and pregnancy history including inter-pregnancy interval, vaginal bleeding, anaemia, hypertension and inadequate access to health resources in different studies. However, the influential factors associated with short gestational age are not consistent in all studies. Therefore regional studies, could add more to the present knowledge on gestational age and its association with pregnancy outcome.

2.2.4: Summary of MHPH

This literature review found that maternal physical health parameters (height, weight and BMI), diagnosed health conditions (hypertension, diabetes and anaemia) and pregnancy history (abortion/miscarriage, inter pregnancy interval, antenatal care, and gestational age) are important factors that might affect LBW independent of geo-demographic factors. The poor geo-demographics of the mothers further increase the effect of these factors. However, this literature review did not find any study that investigated the effect of maternal health and pregnancy history on birth weight controlling for maternal geo-demographics in NWFP or in the Tribal areas of Pakistan. Therefore, investigating the effect of maternal health and pregnancy history on LBW adjusting for other important factors in Peshawar, might be helpful in targeting the influential factors to reduce the adverse pregnancy outcomes in this region.

2.3 Summary of the literature review

Infant mortality is one of the important health issues worldwide, whilst low birthweight (LBW) is one of the main causes of neonatal morbidity and mortality. The incidence of LBW is highest in South-Asia. However, it varies from place to place due to the diversity in maternal geo-demographics, maternal health and pregnancy history.

The literature survey shows that little is known about LBW and its influential factors in NWFP and Tribal areas of Pakistan. To study the influential factors regarding LBW in NWFP and Tribal areas, the literature survey helped in identifying the main groups of factors (i.e. maternal and paternal geo-demographic factors, maternal physical health, health conditions and pregnancy history) that are likely to have an effect on LBW and thus should be explored further. The details of these factors and their interrelationship are as follows:

Maternal geo-demographic factors: Pakistan is one of the larger developing countries, where the Human Development Index is low compared to other developing countries. Within Pakistan, NWFP including Tribal areas is one of the more traditional, cultural and less developed regions, where the majority of people reside in rural areas and have less access to clean water (deprived areas), and the social status of women is vulnerable due to their low literacy rate compared to the overall rate in Pakistan. In addition to the above factors in NWFP and Tribal areas, the Afghan refugees living in this region may suffer from socioeconomic problems.

The deprived and rural areas might affect maternal and newborn health through a number of related issues (e.g. non-fresh water sources, non-adequate food and nutrition, and access to health resources etc.). However, the low social status in the rural areas might further increase the risk of non-adequate health care and consanguinity that affects newborn health through genetic problems and generates several other problems through high risk of other important factors (e.g. teenage marriages, low social status etc). The teenage mothers influence newborn health through maternal poor physical health, and low health awareness.

This literature survey identified that all geo-demographics including antenatal care are interrelated, and a change in one factor could influence one or more geo-demographic factors within the group. Similarly, the expected pathway of geo-demographic factors on LBW starts from area of residence and affect maternal and newborn health through social status, consanguinity, teenage and old age mothers, and maternal health and pregnancy history. The interrelationship of geo-demographic factors and expected pathway of geo-demographic factors are as shown in Figure 2.1.

Maternal health and pregnancy history: In maternal health and pregnancy history the published literature highlights the importance of maternal physical health (i.e. height, weight and BMI), maternal health conditions (i.e. diabetes, hypertension, and anaemia) and adverse pregnancy history (i.e. abortion/miscarriage, birth-spacing) and gestational age and antenatal care in relation to their offspring's health considering different maternal characteristics, e.g. areas of residence, social status, maternal age etc. The effect of maternal health and pregnancy history was reported to be important for newborn health, however, this varies form place to place, ethnicity, and age group etc. For example, in pregnancy history the adverse effect of induced abortion is one of the influential factors that affects maternal and newborn health, however, induced abortions conducted through specialists using advanced knowledge and equipments may not be as harmful for the mother and newborn health, as those conducted by an untrained attendant.

In maternal health and pregnancy history, gestational age is the most important factor for newborn health independent of all other factors mentioned in the literature. This literature survey found that, unfavourable geo-demographics (e.g. teenage mothers, low social status etc), poor maternal physical health (e.g. low maternal weight etc), health conditions (e.g. diabetes, hypertension etc), and adverse pregnancy history (e.g. abortions etc) may increase the risk of short gestational age and hence the adverse pregnancy outcomes.

Conclusion: This literature survey shows that neonatal mortality is one of the important health issues worldwide and LBW is one of the main causes of neonatal mortality. The literature survey found that the incidence of LBW in NWFP province and Tribal areas of Pakistan has not been investigated and it may vary from other parts of Pakistan. It is also the case that influential factors associated with LBW in other parts of Pakistan may not generalise to this region, due to diversity in ethnic, cultural and economic characteristics in the four provinces of Pakistan (Sathar 1985).

Therefore, while there is much information published about influential factors in different parts of Pakistan and in the two neighbouring countries (i.e. India and Bangladesh); little is known about LBW in NWFP and Tribal areas of Pakistan. The present study will focus on the incidence of LBW and the factors associated with LBW in Peshawar, to fill the gaps in knowledge regarding LBW in this region.

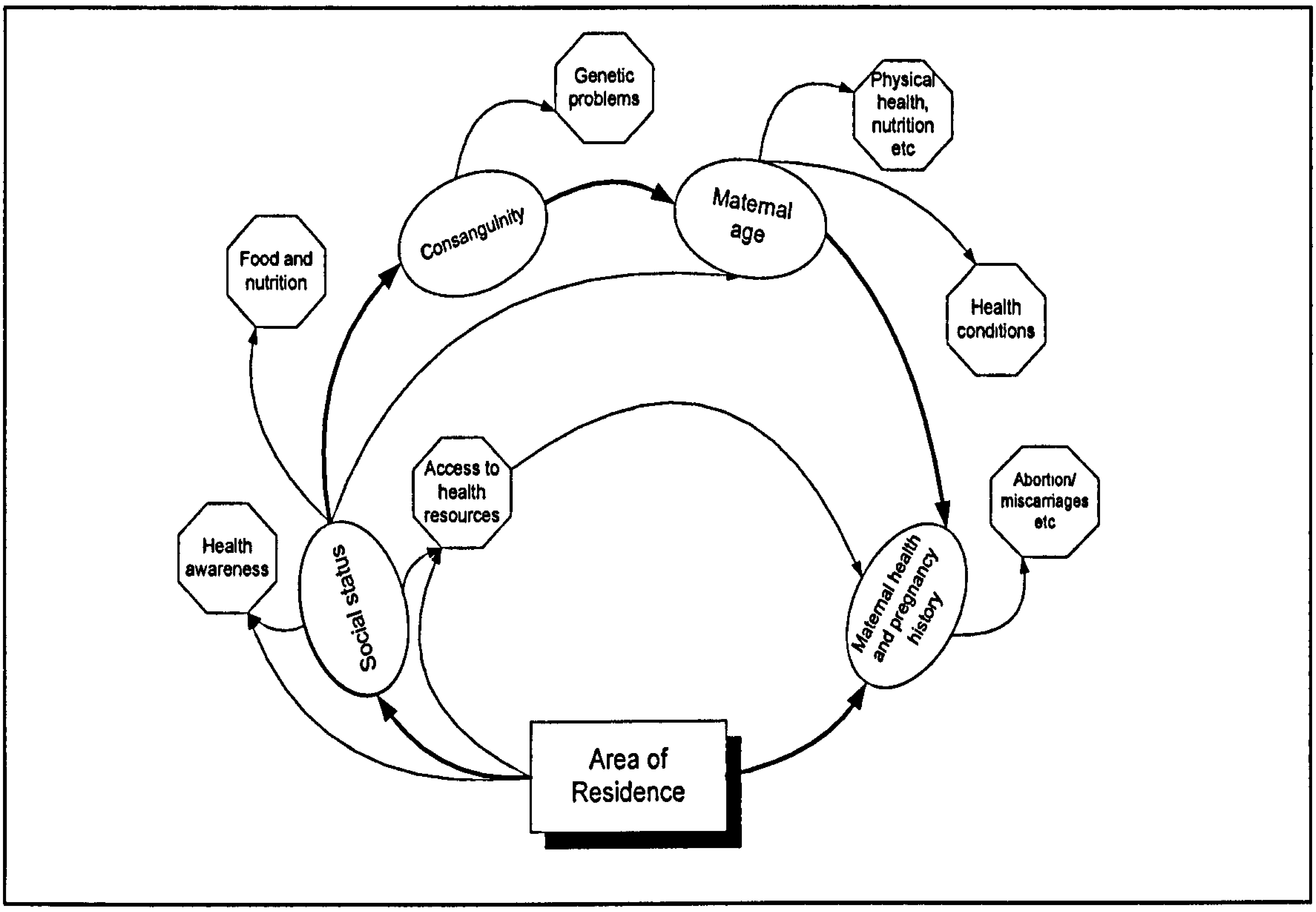

Figure 2.1: The expected interrelationship of geo-demographic-factors and maternal health and pregnancy history in NWFP and Tribal areas of Pakistan.

2.4 Aims and objectives of the present study

The aims and objectives of the investigation are:

Aims of the investigation: To collect baseline data and investigate the influence of maternal geo-demographics, and health and pregnancy history on the health of newborn babies, at government hospitals in Peshawar, NWFP Pakistan

Objectives of the investigation: The specific objectives of this study are: (i) to collect statistics for a range of factors related to maternal and newborn health including an accepted indicator of birth health i.e. birthweight, at four public-hospitals in Peshawar, NWFP-Pakistan, in order to establish base-line statistics, for comparison in the future with national and international studies; (ii) to examine the effect of geo-demographics, and maternal health and pregnancy history in the government-hospital on newborn health; (iii) to identify the key factors affecting birth-weight, which will inform policy developments in public health management at a regional level.

CHAPTER 3

METHODOLOGY

This chapter focuses on the methodology used for investigating the newborn health, measured by LBW, in four public-hospitals at Peshawar. In this chapter, justification for the use of quantitative research techniques and data collection using face-to-face survey is explained, which is followed by an overview of the data collection and methodology used in the prospective study.

3.1 Context of the study

The literature review revealed that little is known about the incidence of LBW and factors associated with LBW in Peshawar. The present study examines the incidence and associated influential factors of LBW in relation to maternal geo-demographic factors and maternal health and pregnancy history, to establish base-line statistics. This chapter describes the data collection process and provides descriptive statistics about each of the covariates. This information will enable the baseline statistics from this region to be compared with those from other parts of the developed and developing world.

3.2 Research methods

In the context of the present study the research method can be either qualitative, quantitative or the combination of qualitative and quantitative-triangulation (Casebeer and Verhoef 1997, Bergsjø 1999). The selection of the method depends upon the nature of the study (McDowell and Maclean 1998). The strength and weaknesses of quantitative and qualitative methods were considered in the context of the present study. As a result, quantitative methods were chosen for this study for the reasons outlined below.

i. The category of LBW is observed by a specific quantitative measurement (<2.5kg), therefore, it was more suitable for quantitative than qualitative method (Frankfort-Nachmias and Nachmias 1992).

ii. Earlier studies, for example Khan and Jamal 2003, Kramer et al 1999, Fikree et al 1994 and Mavalankar et al 1992, used quantitative methods, therefore, a statistical analysis of the numerical data is appropriate for comparison with the previous results.

iii. Within quantitative methods the investigation is conducted within a value free framework (Casebeer and Verhoef 1997). This allows the researcher to gather data of high level of reliability compared to qualitative data (Matveev 2002, Balsley 1970). Using quantitative methods the subjectivity of the researcher was minimised by collecting data through trained neutral clinicians (Kealey and Protheroe 1996).

iv. There is sufficient sample size to support a quantitative analysis using a significant numbers of covariates. This point is briefly discussed under the number of events per variable used in the present study in section 3.5.

In quantitative methods, several techniques were considered in the context of the present study, for instance (i) investigating all births and their maternal health delivered in public/private hospitals/clinics and home deliveries, (ii) a sample from all the mentioned births in (i), and (iii) using survey methods targeting a specific group of mothers and their newborn's health. In the absence of electronic data-bases of all births with all the relevant information in hospitals/clinics and home deliveries, the researcher was unable to survey all births, or a significant and representative sample from all births retrospectively. In this scenario, it was decided that this study will be conducted in public-hospitals only.

There were two possible options for data collection from the hospitals: retrospective records, and prospective data collection. Some of the reasons for the poor generality of retrospective research and justification for the prospective study are outlined in the next section.

3.2.1 Justification of the prospective study

In the retrospective data collection, it was found that some important information relating to geo-demographic factors were not available. However, according to the literature, geo-demographic factors can lead to poor maternal health, adverse pregnancy history, and antenatal care which affect the risk of adverse pregnancy.

The main reasons for the missing information were that the important questions had not always been asked, did not appear on the record sheet, or no answer had been recorded. For example, maternal education was generally not recorded although printed in the history sheet, whilst the record sheet did not ask for area-status, water-sources, father education, family income, and consanguinity. The clinicians record all the relevant information about her pregnancy and are less interested in her geo-demographic background.

In addition to the missing information, it was also found that maternal records in the hospital were not systematically stored. After discharging mothers from the hospital, the medical records are dumped in the store, and this information is often not used during follow-up of the mothers. The only evidence of the previous maternal pregnancy history and any other relevant information is based on a maternal statement, which is recorded at the time of admission in the hospital for any medication.

It was not possible to accurately or comprehensively back-fill the missing data retrospectively due to, (i) limited time and resources for data collection, (ii) the incomplete home address of the patients, and (iii) the difficulties of arranging female staff to contact the patients at their home address, (due to culture barriers, men are not allowed to contact women). Therefore, it was not possible to achieve the goals of the study through a retrospective data-set.

In such a scenario, where retrospective data did not serve the purpose of this project, more systematic data was required including all the important factors relevant to the newborn health. For this, several possible methods include telephone calling, hard mail, email, and face-to-face survey were considered. Face-to-face surveys through trained personal (Graham et al 2004) in reproductive and newborn health are common from small hospital-based studies (Begum et al 2003, Shaheen et al 2003) to large studies in several countries (Graham et al 2004, Hynes et al 2002). A face-to-face prospective survey was found to be the best option for the present study to collect all the relevant information. It was decided to conduct a time bound survey for prospective data collection, carried out by clinicians at the time when the mother reports to the hospital for delivery, using a pre-designed questionnaire.

3.2.2 Development of the questionnaire

The aim of the questionnaire was to collect data about a large sample of mothers and their newborn babies delivered in the public hospitals in order to examine the incidence and associated factors of LBW. In the previously published literature, no standard questionnaire was used across studies of LBW, therefore, a draft questionnaire was designed for the present study from the published literature. This questionnaire consists of maternal geo-demographics, maternal physical health and health conditions, and pregnancy history and antenatal care. The questions that were thought to be important regarding newborn health in Peshawar, for instance area-status (tribal/settled) were also included (see Table 3.1).

The number of the questions was kept to a minimum so that the clinicians would have no problems in accurately recording the responses from the mothers. Further, the questions were kept simple and any ambiguities regarding questions were avoided. In Table 3.1, the indicial factors considered for the questionnaire are shown under the heading FUD (factors used in the draft questionnaire).

The draft questionnaire was modified and adjusted with the help of local clinicians in Peshawar (Table 3.1). For this purpose, two meetings were held in the Gynaecology Department, Hayatabad Medical Complex, Peshawar. In these meetings the clinicians were briefed about the project, prospective data collection, relevance of the variables in the questionnaire to newborn health, and participation of staff in prospective data collection.

Table 3.1: Factors considered in the construction of questionnaire and used in the present study at Peshawar (2003)

Group No.	Group	No.	Factors	FUD	FUP	FUMS
1	Geo-demographic factors	1	Area status (Tribal area/Settled area)	*	*	*
		2	Water sources(non-fresh/fresh water sources)	*	*	*
		3	area (rural/urban/urban slums)	*	*	
		4	if rural (Plain area/hilly area)	*	*	
		5	distance from the hospital	*	*	
		6	Maternal education	*	*	*
		7	Paternal education	*	*	*
		8	Family income	*	*	*
		9	Family status (independent or combined)	*	*	
		10	Maternal profession (house wife /employed)	*	*	
		11	Nationality	*	*	*
		12	Consanguinity	*	*	*
		13	Maternal age	*	*	*
		14	Age at marriage	*		
		15	Marriage duration		*	
		16	Father age	*	*	
2	Maternal physical health	17	Maternal height	*	*	*
		18	Pregnancy weight	*	*	*
		19	Weight before pregnancy	*		
		20	Body mass index (BMI)†			*
	Maternal health conditions	21	Diabetes	*	*	*
		22	Hypertension	*	*	*
		23	Anaemia	*	*	*
		24	Infectious diseases	*		
		25	Any other‡		*	*
3	Pregnancy history and antenatal care	26	Gestational age	*	*	*
		27	Total Abortion/Miscarriage	*	*	*
		28	Abortion/Miscarriage Before This Pregnancy		*	*
		29	Gap between the start of this and the end of the previous pregnancy	*	*	*
		30	Total Preterm Delivery		*	
		31	Gravida (total number of previous pregnancies)	*	*	
		32	Para (number of children born)	*	*	
		33	Maternal registration (booked/un-booked)	*	*	*
		34	Status of entry in the hospital (Normal/emergency)		*	
		35	Number of maternal visits to the hospital	*	*	
		36	Mode of delivery	*	*	

† Estimated from weight and height, i.e. BMI = weight/(height)^2, ‡ health conditions other than diabetes, hypertension and anaemia (for example, hepatitis, tuberculoses, haemorrhage), FUD (factors used in the draft questionnaire), FUP (factors used in the prospective questionnaire), FUMS (factors used for model selection in the analysis of LBW).

Note: Initially the questionnaire was designed for birthweight, birth length, head circumference and Apgar scores.

3.2.3 The reliability and validity of factors for this study

The reliability and validity of the questions were discussed with the clinicians who agreed to take part in the study, one by one in order to gather a set of reliable data-set regarding maternal and newborn health. The reliability of the questions in the questionnaire for each of the three sections: maternal geo-demographics; maternal health and pregnancy history; and pregnancy outcomes is discussed.

In the geo-demographic-section, all variables including area-status, water sources, nationality, consanguinity, maternal and paternal education were thought to be reliable except the maternal age. In maternal age, two types of misreporting could happen, (i) when the mothers do not know their exact age and (ii) when they do know. Firstly, when the mothers don't know their exact age, they are more likely to report their age in a multiple of five. If a mother reports that she doesn't know, then the clinicians estimate her age, and relate it to certain national events, (e.g. 1965 war, 1971 war, Mr. Bhutto assassination 1977, Afghan war 1979, and Mr. Zia-ul-haq plane crash 1988 etc). This method is common in Indian sub-continent, where Karim and Mascie-Taylor (1997) used the same method in a similar study at Dhaka Bangladesh. The estimated age is more likely to be rounded to multiple of 5, but it could be 1-2 years on both sides (left or right) of the spikes. Secondly, if the mothers know their actual age, they are expected to round it to nearest multiple of five, more likely to the left, e.g. the mothers could report 21 years as 20 and 26 as 25 years.

To minimise the possible errors due to these artefacts/spikes (for details see Appendix I), maternal age was decided to be banded as per published work in the literature. The thresholds were decided on the bases of evidence from the literature as <20 years, 20-34 years and >34 years (Yaqoob et al 1998, Fikree et al 1994) for maternal age due to comparison with the previous work. In this section 'age at marriage' was estimated: Age at marriage = present maternal age minus duration of marriage.

In the maternal health and pregnancy history group, the data collected from the patients were maternal pregnancy registration in the hospital for regular monthly check-up, also known as booked (Malik et al 1997), height, weight, abortions/miscarriages, gap between the start of this and the end of previous pregnancy, diabetes, anaemia (<10gm/dl), hypertension (>140mmHg), and gestational age. In this section, an accurate estimate of gestational age was thought to be difficult, because of non-availability of ultrasound confirmation of all mothers and non-applicability of ultrasound during delivery in the labour room (third trimester). However, in this scenario, gestational age was estimated by the clinicians after maternal information, clinical examination of the mother and newborn health after birth as practised by another study in Karachi Pakistan (Parveen 2001). An indication of the reliability of the estimates of gestational age used in this study is given by the close agreement between the statistics of LBW in relation to gestational age derived from these data, with comparable figures published elsewhere. This is discussed in more details in section 5.1.

In addition, body mass index (BMI) was calculated using the standard formula: BMI=Weight (kg)/height (meter) ^{2}

Three hospitals had height and weighing scales in working order when checked. In one hospital (Maternity Hospital, Peshawar), a weighing scale was produced and height scale was painted for the purpose of this study.

In the birth health section, the variables: newborn weights; Apgar-scores; birth status (stillbirth/live-birth) were thought to be reliable. In addition, we also wanted data on length and head circumference of the baby. However, in other such studies in NWFP and Baluchistan provinces, "respondents willingly completed the interview but refused to allow anthropometric measurements to be taken" (DHS 1990-1991). Some mothers believe that once the length and head-circumference is measured, the baby will never grow. In the context of the present study, it was believed that the mothers might not be willing to measure their baby height and head-circumference. Therefore, it was decided that tape measures would be provided to the clinicians, and the entries be made only when the mothers provide consent for these measurements.

Newborn weight was thought to be reliable; however, it was fund that the frequency of 2.5kg was significantly higher than 2.3kg and 2.4kg on the left and 2.6kg and 2.7kg on the right side (Figure 2, Appendix-I). However, it is believed that the clinicians rounded 2.6-2.7kg as 2.5kg and banding for <2.5kg against ≥2.5kg will make no significant in this study.

The validity of factors: The questions in the questionnaire were also discussed one by one considering the local set-up of the area, text of the questions and their relevance to newborn health. The changes made in the questionnaire are described below (also see Table 3.1).

1. Status of entry (emergency/normal), abortion/miscarriages before this pregnancy, and total pre-term delivery before this pregnancy were added. It was thought that emergency entry compared to normal entry for delivery could affect Apgar score. Abortion/miscarriage just before the present pregnancy was introduced in the questionnaire, because it could affect maternal health through other infections, anaemia and haemorrhage. History of previous preterm babies could also be helpful in understanding the previous pregnancy outcomes and hence might be useful in predicting the present one.

2. The 'age at marriage' was replaced by 'marriage duration' because it is believed that mothers can recall their marriage duration more correctly than the age at which they were married.

3. The factor 'any infectious disease' was replaced by 'any other health condition' to cover all other problems, such as hepatitis, tuberculoses and severe bleeding during pregnancy.

4. The 'weight before pregnancy' was omitted, because it was not possible to estimate and the mothers in this area tend not to know their weight before pregnancy.

5. In 'maternal and paternal education' the two categories (college and university) were merged in one category, (college/university), because it was thought there might be no significant difference between the two groups college and university.

6. Birth-status was restricted to three categories, i.e. live birth, stillbirth and any other. In 'any other' category those births were included that died just after birth.

Therefore, considering the validity of the covariates, a total of two factors were replaced in the draft questionnaire, one omitted and three new were introduced for the prospective data collection (see column FUMS in Table 3.1; see complete questionnaire as Appendix V).

3.3 Ethical approval from Liverpool John Moores University

The application along with the edited questionnaire was submitted to the university ethics committee (Liverpool John Moores University) on June 17, 2003. The ethical approval for this study was given on August 06, 2003 for a period of five years (expiry date October 2007). The mothers who participated in this study were asked for their verbal consent. A copy of this consent form is presented in Appendix II. The mothers who participated in this study remained anonymous throughout the data process and thesis writing.

3.4 Schedule of the data collection

The data collection process started in the last week of May 2003 until the last week of November 2003. The details of time and events are as follows.

Meetings and preparation for the data collection:	May 2003
Modification in the questionnaire:	June-July 2003
Ethical approval for the prospective data:	August 2003
Printing of questionnaire for the prospective data:	August 2003
Prospective data collection:	August 20, 2003 to November 20, 2003
Data entry:	November 2003.

Table 3.2: The structure of the four public hospitals and the estimated number of deliveries.

S. No	Name of hospital	Gynaecology Department	Permission *	Total babies per month (2003)	Time of data collection (in months)	Estimated number of deliveries during data collection period.
1	Hayatabad Postgraduate Medical Complex (HMC)	One unit	Yes	3312/12 =276	3	828
2	Khyber Postgraduate Teaching Hospital (KTH)	A	No	-	-	-
		B	Yes	2160/12=180	3	540
3	Government Maternity Hospital Hashtnagri, Peshawar (MH)	One unit	Yes	3432/12=286	2	572
4	Lady Reading Postgraduate Teaching Hospital (LRH)	A	No	-	-	-
		B	Yes	4150/12=345	1	346
		C	No	-	-	-
Total						2286

* Permission from the head of the department/hospital regarding data collection and participation in the study.

Note: MH and LRH joined data collection after one and two months, respectively.

3.5 Prospective study: Data description, methods and statistical tools

Data were collected in a cross-sectional prospective survey on maternal and paternal geo-demographic factors, maternal health and pregnancy history, and neonatal outcome in four main public hospitals: Hayatabad Medical Complex (HMC), Khyber Teaching Hospital (KTH), Lady Reading Hospital (LRH), and Government Maternity Hospital (MH) in Peshawar during August to November 2003 through clinicians on duty. The clinicians who participated and collected data include the: Gynaecology Department A and B (HMC); Department B (KTH); MH hospital; and Department B (LRH) (for details see Table 3.5).

In KTH the head of the gynaecology (Department-A) refused to participate in the study due to shortage of staff. However, the head of (Department-B) agreed and fully participated in this study. In LRH the head of the gynaecology department also refused to participate in the study, however, the administrator agreed and helped the researcher in arranging a head nurse to collect data from department –B.

The data comprise questionnaire responses collected from 1,039 single birth mothers from a total of 2286 mothers delivered during the study period irrespective of birth-status (live or stillbirth) and gestational age not less than 24 weeks. The volunteer clinicians for this study recorded 47.75% (45.5% single births and 2.25% twins) of the available data for the expected 50%, due to their duty timing (day time one week and night time next week). However, it is unknown whether the remaining 2.25% women refused to participate in the study, missed during data collection, or the doctors were busy in emergency and were unable to collect data.

Moreover, of the total 1039 mothers and newborns studied, only 78 (7.5%) records have at least one missing value that were not included in the logistic regression model.

Women were interviewed by clinicians in local languages at admission in the reception, with the exception of emergency admissions, when they were interviewed in the labour room. The factors were recorded on a pre-designed questionnaire validated by health professionals during a pilot study in the same hospitals.

Five factors were collected as continuous measures, which were later banded into categorical measures according to the previous literature. These measures include maternal age (Khan and Jamal 2003, Yaqoob et al 1998, Sathar 1985), gestational age (Lone et al 2004, Khan and Jamal 2003), height (Torres-Arreola et al 2005, Picket 2000, Fikree FF, Berendes 1994) and the gap between this and the previous pregnancy (Grant and Bittles 1997). However, the threshold for maternal pregnancy weight during analysis was decided to be 57 kg for this study, as this value had the highest significance in the univariate sense for LBW.

Gestational age was categorised such that any delivery from 24 and <37 weeks termed as preterm birth (Smith et al 2003), and the category of LBW was defined as less than 2.5kg (Smith et al 2003).

Methods and statistical tools: From the covariates originally collected, twenty were used for the initial analysis (see column FUP and FUMS respectively, Table 3.1), to keep at least 5 events (LBW) per factor, as there are 101 occurrences of LBW in the data. This ratio of events per variable is on the threshold of acceptability for the size of the pool of covariates prior to initiating the variable selection process, as recommended in the literature (Peduzzi et al 1996).

There were three levels of data analysis, i.e. (i) baseline descriptive statistics, (ii) multivariate logistic regression, followed by predicted probabilities of LBW for adjusted independent factors and interactions, and (iii) univariate association splitting for the effect of gestational age (Preterm and full term).

In baseline statistics, cross tabulation and crude odds of LBW babies in different categories were calculated to identify the incidence of LBW and significant factors at univariate level (Dunn and Everitt 1995). Multivariate logistic regression (Allison 1999, Kleinbaum 1994) was applied to uncorrelated groups of factors (Pearson's, Spearman's correlation with thresholds of 0.6, see Appendix III for details), fitting the models using the software package SPSS (Field 2003) to assess the independent effects of factors on SGA (Fikree FF, Berendes 1994) based on a backward stepwise approach. Wald's test was used for the significance of the factors in multivariate models (Machado and Hill 2003) and chi-square was used for univariate models.

The interpretation of main effects and interactions was aided by calculating a one-way table of predicted means for each significant main effect, and a two-way table of predicted means for each significant (two-way) interaction, using the statistical package GenStat (Payne et al 2005). These were constructed by first forming a table containing fitted values for every combination of the seven factors in the model, then averaging over the factors that are not in the required table of predictions. This averaging was weighted using estimated population weights, formed by multiplying together a one-way table of weights for each factor, containing the proportions of cases recorded in each of its levels.

The effect of geo-demographics was further studied in preterm and full term gestational age splitting data for the significant maternal health and pregnancy history factors identified in multivariate logic regression analysis. Similarly the effect of significant maternal health and pregnancy history was estimated in preterm and full term gestation splitting for data for significant geo-demographics at univariate study.

CHAPTER 4

RESULTS

This chapter focuses on findings from the analysis of prospective data collected in the survey. Univariate and multivariate analyses were made, to find out the proportion of low birthweight (LBW) including influential factors associated with LBW (<2.5kg) and SGA irrespective of birth-status. The details of the results are as follows.

4.1 Univariate associations of low birthweight

The incidence of LBW was found to be 9.9% of the total births irrespective of birth status, whilst, it was 7.4% (=69/934) in the live births babies and 36.4% (=32/88) in the stillbirth babies. However, LBW was treated irrespective of birth status (live births or stillbirth). In the univariate study, the proportion of different geo-demographics, maternal health and pregnancy history and its effects on LBW were studied using crude odds ratios. The crude odds of LBW in all geo-demographic factors (Table 4.1), and seven other factors from MHPH (gestational age, hypertension, anaemia, maternal pregnant weight, total abortion/miscarriage, abortion/miscarriage before this pregnancy, and maternal pregnancy registration), were found to be statistically significant at the univariate level (Table 4.2). The details of these factors are as follows.

4.1.1 Geo-demographics

In geo-demographics group, 8 maternal and paternal characteristics were studied (i.e. area of residence, water sources, nationality, consanguinity, maternal age, family income, maternal and paternal education) (Table 4.1). It was found that the ratio of no maternal education 69.5%, low family income of less than 5000 rupees per month 69.4%, and consanguinity 60% was higher compared to 30.5%, 30.6% and 40% for non-illiterate, income ≥5000 rupees, and non-consanguineous couples, respectively. Similarly, the ratio of paternal illiteracy 37.6%, mothers from less developed areas (non-fresh water areas) 36.8%, Tribal areas 24% and Afghan refugees 11.7% was found to be low compared to paternal literacy, mothers from developed areas, Settled area and Pakistani mothers (62.4%, 63.2%, 76%, and 88.3%, respectively). The ratio of teenage and older mothers was found to be 7.5% and 16.8% compared to 75.6% in the middle age mothers respectively (Table 4.1). These findings highlight the vulnerable social status of the mothers (i.e. education and family income) that accounts for 70% of the total mothers, which could be one of the important influential factors in this study.

Table 4.1 shows that the proportion of LBW was found to be significantly higher in illiterate 11.4% compared with literate mothers 5.8% (OR=2.1, $p<0.01$), low family income 11.4% compared with normal family income 6.8% (OR=1.8, $p<0.05$), and consanguineous 12.0% compared with non-consanguineous mothers 6.4% (OR=2.0, $p<0.01$), respectively. Similarly, the incidence of LBW for illiterate fathers was 12.3% compared to 8.2% for literate fathers (OR=1.6, $p<0.05$), non-fresh water areas (deprived areas) 13.1% compared with 8% in developed areas (OR=1.8, $p<0.05$), Tribal areas 14% compared to 8.6% in the Settled areas

(OR=1.7, p<0.05), and Afghan refugees 19.2% compared to 8.6% for the local Pakistani mothers (OR=2.5, p<0.01), respectively. The incidence of LBW in teenage mothers was significantly higher 32.5%, than 7.3% for the middle age mothers. However, older mothers were not significantly associated with LBW.

Table 1 These results showed that in the geo-demographic-group, the adverse effect of teenage mothers and Afghan refugee mothers were found to be significantly higher compared to other significant factors in this group. However, teenage and Afghan refugee mothers were followed by maternal illiteracy, consanguineous births and mothers from deprived areas, respectively.

4.1.2 Maternal health and pregnancy history (MHPH)

Table 4.2 shows the proportion of different MHPH characteristics, incidence of LBW and association of LBW with maternal and paternal characteristics. In the MHPH, 7 of the 12 factors were found to be significantly associated with the higher incidence of LBW. In MHPH the proportion of un-booked pregnancies in the hospital, maternal anaemia, low maternal weight, abortion/miscarriages and hypertension were found to be 54%, 38.5%, 24.4%, 23% and 18%, respectively.

The incidence of LBW varied from 12.3% to 14.2% in the non-registered pregnancies, anaemic mothers (<10 gm/dl), low pregnancy weight, history of abortion/miscarriages and hypertensive mothers (>140 mmHg) compared to 7.3% to 9.1% in registered pregnancies, non-anaemic-mothers, normal pregnancy weight, no history of abortion/miscarriages and non-hypertensive mothers, (OR=1.8, p<0.01; 1.5, p<0.05; 1.8, p<0.01, 1.8, p<0.05; and 1.6,

Table 4.1: Univariate analysis of geo-demographic maternal risk factors for LBW in Peshawar, 2003.

Variable		Birthweight		OR	95% CI
		<2500grs.	≥2500grs.		
	(N=1039)	(n=101)	(n=938)		
Area of residence					
Tribal	243(24.0)	34(14.0)	209(86.0)	1.7	[1.1, 2.7] *
Settled	770(76.0)	66(8.6)	704(91.4)		
Water sources					
Non-fresh	373(36.8)	49(13.1)	324(86.9)	1.8	[1.2, 2.7] **
Fresh	641(63.2)	51(8.0)	590(92.0)		
Nationality					
Afg. refugees	120(11.7)	23(19.2)	97(80.8)	2.5	[1.5, 4.2] **
Local people	903(88.3)	78(8.6)	825(91.4)		
Consanguinity					
Yes	611(60.0)	73(11.9)	538(88.1)	2.0	[1.3, 3.2] **
No	407(40.0)	26(6.4)	381(93.6)		
Maternal age					
<20 years	77(7.5)	25(32.5)	52(67.5)	6.1	[3.6, 10.7] **
20-34 years	772(90.9)	56(7.3)	716(92.7)		
>34 years	172(18.2)	20(11.4)	152(88.4)	1.7	[1.0, 2.9]
20-34 years	772(81.8)	56(7.3)	716(92.7)		
Family income					
<5000 rupees	701(69.4)	80(11.4)	621(88.6)	1.8	[1.1, 2.9] *
≥5000 rupees	309(30.6)	21(6.8)	288(93.2)		
Mat. education					
Illiterate	708(69.5)	81(11.4)	627(88.6)	2.1	[1.2, 3.6] **
Non-illiterate	310(30.5)	18(5.8)	292(94.2)		
Pat. education					
Illiterate	382(37.6)	47(12.3)	335(87.7)	1.6	[1.1, 2.4] *
Non-illiterate	635(62.4)	52(8.2)	583(91.8)		

**p<0.01, *p<0.05

Table 4.2: Univariate analysis of maternal health and pregnancy history, risk factors for LBW in Peshawar, 2003.

Variable		Birthweight <2500 grs	≥2500grs	OR	95% CI
	(N=1039)	(n=101)	(n=938)		
Gestational age					
Preterm	229(22.8)	60(26.2)	169(73.8)	6.4	[4.1, 9.8] **
Full term	776(77.2)	41(5.3)	735(94.7)		
Maternal diabetes					
Yes	27(2.7)	3(11.1)	24(88.9)	1.2	[0.4, 3.9]
No	974(97.3)	96(9.9)	878(90.1)		
Maternal hypertension					
Yes	183(18.3)	25(13.7)	158(86.3)	1.6	[1.0, 2.6]*
No	816(81.7)	74(9.1)	742(90.9)		
Maternal anaemia					
Yes	383(38.5)	47(12.3)	336(87.7)	1.5	[1.0, 2.3] *
No	613(61.5)	52(8.5)	561(91.5)		
Other health conditions					
Yes	59(6.0)	8(13.6)	51(86.4)	1.5	[0.7, 3.3]
No	918(94.0)	87(9.5)	831(90.5)		
Maternal height					
<1.55mtr	310(30.8)	38(12.3)	272(87.7)	1.4	[0.9, 2.2]
≥1.55mtr	696(69.2)	62(8.9)	634(91.1)		
Maternal weight					
<57kg	246(24.4)	35(14.2)	211(85.8)	1.8	[1.2, 2.8] **
≥57kg	763(75.6)	65(8.5)	698(91.5)		
Maternal BMI					
≤19.0kg/m^2	40(4.0)	4(10)	36(90)	1.0	[0.4, 2.9]
>19.00kg/m^2	958(96.0)	96(10)	862(90)		
Any abortion/miscarriage [a]					
Yes	232(22.7)	33(14.2)	199(85.8)	1.8	[1.1, 2.7] *
No	788(77.3)	68(8.6)	720(91.4)		
Abortion/miscarriage [b]					
Yes	172(17.2)	25(14.5)	147(85.5)	1.7	[1.1, 2.8] *
No	826(82.8)	74(9.0)	752(91.0)		
Gap between pregnancies [c]					
<1.5 years	220(33.2)	25(11.4)	195(88.6)	1.1	[0.7, 1.9]
≥1.5 years	443(66.8)	46(10.4)	397(89.6)		
Pregnancy registration					
No	545(53.9)	67(12.3)	478(87.7)	1.8	[1.2, 2.8] **
Yes	467(46.1)	34(7.3)	433(92.7)		

**p<0.01, *p<0.05, [a] History of any abortion/miscarriage in reproductive life, [b] Abortion/miscarriage immediately preceding this pregnancy, [c] gap between this and the previous pregnancy (excluding primiparas mothers).

$p<0.05$, respectively). However, the incidence of LBW in preterm births was significantly higher 26.2% than the full term babies 5.3% (OR=6.4, $p<0.01$), respectively. In MHPH group, 5 factors showed no significant association with LBW. These factors include, the gap between pregnancies (start of this and the end of the previous pregnancy), maternal height, diabetes, BMI and mothers with any other health condition (Table 4.2).

These results showed that, of the total twelve factors in the maternal health group diagnosed health conditions and pregnancy history; only three factors were found to be significantly associated with LBW ($p<0.01$). In these three factors one was gestational age, the other two were low maternal weight and pregnancy registration.

Summary: The overall univariate results showed that out of 20 factors (i.e. geo-demographics 8, and MHPH 12), 15 factors were found to be significantly associated with LBW at univariate level. However, of the total 15 significant factors, 8 of them (i.e. geo-demographics 5, and MHPH 3) were found to be significant at 0.01 levels. These important factors at univariate level were teenage mother, Afghan refugee mothers, maternal illiteracy, consanguineous births, less developed areas, preterm gestation, low maternal weight and non-registered mothers in the hospital. The other seven factors were found to be significant at 0.05 levels. These factors include: Tribal areas; low family income; non-educated fathers; hypertension; anaemia; and previous abortion/miscarriage (all abortion/miscarriages in the reproductive age and just before the present pregnancy).

4.2 Birthweight and gestational age

Derived statistics from the prospective data showed the distribution of birthweight in Table 4.3. A comparison of the present data set was made with another data set from Karachi that showed strong agreement; the details are given later, in section 5.1.

The present data-set can be divided into three groups as shown in Table 4.3. This table shows that 41.6% (42/101) were preterm and appropriate for gestational age (≥10th percentile, AGA), 17.8% (18/101) were preterm and small for gestational age (<10th percentile, SGA) and 40.6% (41/101) were full term and SGA (IUGR). Among the total LBW, 58.4% (59/101) were SGA, and 40.6% (41/101) were appropriate for gestational age (Table 4.3).

Gestational age at two levels (<37 weeks and ≥37 weeks) was chosen as an explanatory variable for the logistic regression model, therefore, any additional variables selected by the model are interpreted as explanatory variables for 69% (=41/59) of SGA (i.e. <2.5kg, ≥37 weeks, typically known as IUGR, de Onis 1998).

4.3 Results from logistic regression

In addition to crude odds ratios estimated from the univariate study, adjusted odds of the SGA were also estimated and nine factors were found to be significant in different separate multivariable models. Seven of the total factors, namely area of residence, nationality, consanguinity, maternal age, gestational age, anaemia and abortion/miscarriage, were found to be significant risk factors for SGA, using two different methods (i.e. Forced entering of all factors in the model, and Stepwise Backward Logistic Regression Method) (Table 4.4 and 4.5).

Further analyses were carried out to identify potential interactions between the explanatory variables. This resulted in a definitive model with three geo-demographical indicators, nationality, consanguinity and maternal age at birth, and two indicators of maternal health and pregnancy history, gestational age and abortion/miscarriage, appearing independently in the model (Table 4.5, Figure 4.1). In addition, there are two pair-wise interactions respectively, i.e. (i) area of residence and history of anaemia, and (ii) gestational age and abortion/miscarriage (Table 4.5, Figure 4.1).

The adjusted odds ratios reinforce the earlier results from univariate analysis, showing that five factors significantly increase the incidence of LBW (Table 4.5), namely Afghan refugees compared to Pakistani mothers (OR=2.6, $p<0.01$), consanguineous compared to non-consanguineous births (OR=2.4, $p<0.01$), teenage compared to middle age mothers (OR=8.4, $p<0.01$), preterm compared to full term (OR=10.5, $p<0.01$), and a history of abortions/miscarriages compared to mothers with no history of abortions/miscarriages (OR=3.4, $p<0.01$), respectively. A further interactive term shows that a history of anaemia in Tribal areas are expected to increase the risk of SGA compared to anaemic and non-anaemic mothers in the Settled areas (OR=3.3, $p<0.01$, Figure 4.1and 4.1a). However, preterm gestation with and without abortion/miscarriage were found to be at highest risk of LBW in this study (OR=11.0, 10.5, $p<0.01$), respectively (Table 4.5, Figure 4.1b).

The predicted probabilities of SGA among significant factors were found to be 0.32 and 0.25 for teenage mothers and preterm gestation with or without abortion/miscarriages, respectively;

Table 4. 3: Distribution of birthweight versus gestational age.

Birthweight (Kg)	≤24	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	
Total	7	3	0	4	1	6		19	4	13	11	161	123	261	92	277	11	9	3	1005
5.5-5.9														1						1
5.0-5.4														1		2	1		1	5
4.5-4.9												2	2	5	3	9	1	2		24
4.0-4.4												8	4	11	3	1				49
																22				
3.5-3.9												5	5	6	16	69	3	4	1	182
												18	16	39						
3.0-3.4										1	3	61	66	120	47	124	5	2	1	432
										2										
2.5-2.9						3		1	1	5	5	47	24	59	18	39		1		211
								6	1								1			
2.0-2.4				1		2		9	2	3	2	5	5	16	4	10				71
												12								
01.5-1.9	1	3		3	1			2		1		2		2	1	1				19
										1	1									
1.0-1.4	3					1		1				1	1	1						8
0.5-0.9	3																			3

Gestational age (weeks)

PTB and not SGA (n=42)

SGA and not IUGR (n=18)

SGA (n=60)

IUGR (n=41)

Table 4.4: The odds of LBW using univariate and logistic regression method for maternal geo-demographics and maternal health and pregnancy history in Peshawar 2003 (n=1039).

S. No	Factors		Univariate odds ratios	A1	A2	A3	A4	AS	B1	B2	B3	B4	BS
1	Geo-demographic factors including consanguinity	Area of residence	1.7*	2.15*	2.2*	2.2*	2.2*	S	3.1**	3.1**	2.6**	2.6**	S
2		Water sources	1.8**	1.5	1.4	1.3	1.3						
3		Nationality	2.5**	1.9	1.9	2.2#	2.2#	S			2.3*	2.3*	S
4		Consanguinity	2.0**	2.2*	2.3*	2.4*	2.4*	S	2.3*	2.3*	2.4*	2.4*	S
5		Family income	1.8*	1.2	1.2	1.5	1.5						
6		Maternal age	5.5**	27.2**	30.7**	31.3**	34.4**	S	20.9**	20.9**	26.9**	26.9**	S
7		Maternal education	2.1**	1.3	1.3	1.3	1.3						
8		Paternal education	1.6*	1.1	1.2	1.0	1.1						
9	Gestational period		6.4**	6.8**	6.6**	6.3**	6.1**	S	6.7**	6.7**	6.5**	6.5**	S
10	Diagnosed health condition	Diabetes	1.1	0.1	0.13	0.12#	0.13#	S					
11		Hypertension	1.6#	1.6	1.6	1.8	1.8						
12		Anaemia	1.5#	1.6	1.6	1.9#	1.8#	S			2.0*	2.0*	S
13		Any other risk	1.5	1.4	1.5	1.2	1.3						
14	Physical health	Height	1.5	0.9	1.0	0.9	1.0						
15		Weight	1.8**	1.8	X	1.8	X			X		X	
16		Body mass index (BMI)	1.0	X	0.9	X	1.0		X		X		
17	Pregnancy history[a]	TabMisC	1.8*	2.1*	2.1*	X	X	S	2.2**	2.2**	X	X	S
18		AbMisC	1.7*	X	X	2.2*	2.1*	S	X	X			
19		Gap between pregnancy	1.1	0.8	0.8	0.7	0.7						
20	Pregnancy registration		1.8**	1.1	1.1	1.2	1.1						

**$p<0.01$, *<0.05, #$p<0.10$, all empty cell (not significant), X (not included in the model due to high correlation); and S (significant in any previous model, i.e. A1 to A4 or B1 to B4).
[a] not applicable in case of primiparas mothers (first pregnancy); in the case of gap, the majority of the teenage mothers are primiparas (1st pregnancy) and are not included in the models due to missing value for gap; that is why the odds for maternal age jumped 5 time because the mothers included are experiencing at least 2nd pregnancy and hence at highest risk of LBW.
BMI: Body mass index = weight in kg/ (height in meter)^2; Gap: Gap between the start of this and the end of previous pregnancy.
Model A1and B1: All factors excluding BMI [correlated with weight] and AbMisC [correlated with TabMisC]
Model A2 and B2: All factors excluding weight [correlated with BMI] and AbMisC [correlated with TabMisC], and similarly
Model A3 and B3: All factors excluding BMI [correlated with weight] and TabMisC [correlated with AbMisC]
Model A4 and B4: All factors excluding weight [correlated with BMI] and TabMisC [correlated with AbMisC].
Note: In model A1-A4 and B1-B4, Entering all factors and Backward Stepwise logistic methods were used, respectively.

Table 4.5: Adjusted odds ratios and 95% confidence intervals for the final logistic regression model using 961 complete records.

Factors	B	AdjOR (95% CI)		PPr. of LBW	S. E.
Area of residence					
Tribal	-0.134	0.88[0.40, 1.90]			
Settled (Ref.)					
Nationality					
Afghan refugee	0.970	2.64 (1.39, 5.01) **		0.17	0.032
Local (Ref.)				0.09	0.009
Consanguinity					
Consanguineous	0.871	2.39 (1.39, 4.12)**		0.12	0.012
Non-consanguineous (Ref.)				0.06	0.012
Maternal age					
<20 years	2.122	8.35 (4.36, 15.98) **		0.32	0.048
>34 years	0.099	1.11(0.58, 2.11)		0.08	0.019
20-34 yrs (Ref.)				0.08	0.009
Gestational age					
≤37 weeks	2.350	10.48 (5.70, 19.20) **			
>37 weeks (Ref.)					
Anaemic-status					
Yes	-0.106	0.90 (0.49, 1.65)			
No (Ref.)					
Abortion/miscarriage					
Yes	1.209	3.35 (1.66, 6.77) **			
No (Ref.)					
Interactions					
Area x anaemia					
[Tribal area] [Anaemia (yes)]	1.438	4.21(1.46, 12.18) **	(3.31)	0.20	0.035
[Tribal area] [Anaemia (no)]			(0.90)	0.08	0.021
[Settled area] [Anaemia (yes)]			(0.90)	0.08	0.015
[Settled area] [Anaemia (no)] (Ref.)			-	0.09	0.013
Gestation x Abortion/miscarriage					
[Preterm] [Abortion/miscarriage (yes)]	-1.161	0.31(0.11, 0.87) *	(11.0)	0.25	0.052
[Preterm] [Abortion/miscarriage (no)]			(10.5)	0.25	0.032
[Full term] [Abortion/miscarriage (yes)]			(3.40)	0.11	0.023
[Full term] [Abortion/miscarriage (no)] (Ref.)			-	0.04	0.008
Intercept	-4.530**				

**p<0.01, *p<0.05, Ref. (Reference Category), AdjOR (Adjusted Odds Ratios), C.I (Confidence Interval), PPr. (the predicted probability LBW from the model, or prediction for the probability of LBW in future), and S.E. (Standard Error of the predicted probability). Values the parenthesis are the estimated adjusted odds of the concerned category from the model.
For example, Tribal area*anaemia (yes) = Exp (-0.134 -0.106 +1.438) = exp (1.198) = 3.313
Tribal area*anaemia (no) = Exp (-0.134 +0.000 +0.000) = exp (-0.134) = 0.880

the next biggest value for SGA was for mothers from Tribal areas with the history of anaemia, respectively. However, the predicted probabilities for consanguinity and full term birth with the history of abortion/miscarriages were found to be 0.12, and 0.11, respectively (Table 4.5). The predictive analysis confirmed the significant effects already noted for teenage mothers for preterm births (with and without abortion/miscarriage), anaemic mothers in the Tribal areas, Afghan refugee mothers and consanguineous births (Table 4.5).

4.4 The effect of geo-demographics controlling for MHPH

The effects of significant geo-demographics at multivariable analysis were further analyzed splitting data for the significant MHPH. Looking to the strong impact of gestational age on the incidence of LBW, it was necessary to analyze the effects of individual indicators separately for pre-term and full term births. The opportunity was taken to check the effect of geo-demographics, separately for anaemia and abortion/miscarriage, as well as both anaemia and abortion/miscarriage (Table 4.6).

Table 4.6 shows that, in the case of anaemia, the mothers in Tribal areas and Afghan refugees were found to be significantly at higher risk of LBW in all births (OR=2.5 and 2.8, $p<0.001$), and especially for full term (IUGR) babies (OR=5.0, 4.0, $p<0.01$), respectively. For non-anaemic mothers, the effect of Tribal areas in all, and Tribal area and Afghan refugees in full term babies were no longer apparent. However, after controlling for both anaemia and abortion/miscarriage the effect of Tribal areas and Afghan refugee were not significant. Moreover, Afghan refugees were at higher risk of LBW (<37 weeks and <2.5kg) without anaemia (OR=5.2, $p<0.01$), abortion/miscarriage (OR=6.0, $p<0.01$), and both anaemia and abortion/miscarriage (OR=9.9, $p<0.01$) compared to local Pakistani mothers (Table 4.6).

Consanguinity was found to be a significant risk factor for LBW in all births (OR=4.5, $p<0.01$), preterm births (OR=5.1, $p<0.01$), and full term births (OR=4.8, $p<0.05$) without anaemia and previous abortion/miscarriages compared to non-consanguineous births. However, the effect of consanguinity on IUGR was found to be less significant without anaemia, abortion/miscarriages or both anaemia and abortion/miscarriages (OR=2.5, $p>0.05$; 3.2, $p<0.05$; and 4.8, $p<0.05$, respectively) compared to all and preterm births.

Similarly, teenage mothers with or without any problems (i.e. anaemia, abortion/miscarriage or both) were found to be highly associated with LBW/IUGR. However, older mothers were at higher risk of IUGR controlling for both anaemia and abortion/miscarriage (OR=3.8, $p<0.05$) compared to middle age mothers (Table 4.6).

4.5 The effect of MHPH controlling for geo-demographics

The effects of MHPH were also analyzed splitting data for significant maternal geo-demographics for preterm and full term births (Table 4.7). The odds of LBW for a history of abortion/miscarriages in all births and especially in full term gestation were significantly higher compared to no history of abortion/miscarriage. However, the impact of abortion/miscarriages on LBW (compared to mothers with no history of abortion/miscarriages) was significantly higher in the Tribal areas in all (OR=3.2, $p<0.01$, Figure 4.3) and especially in full term babies (OR=7.1, $p<0.01$); whereas it was non-significant in the Settled areas (Table 4.7, Figure 4.2). Moreover, in full term babies, the effect

Table 4.6: Crude odds ratios and 95% confidence interval of LBW (n=101) for the significant geo-demographics, controlling for significant maternal health and pregnancy history in all, preterm and full term babies (n=1039).

S. No	Factors		Anaemia		Abortion/miscarriage		Anaemia and abortion/miscarriage
			Yes	No	Yes	No	Neither
All							
1	**Area of residence**	Tribal / settled area	2.5**[1.4, 4.7]	1.1[0.6, 2.2]	3.0**[1.4, 6.5]	1.2[0.7, 2.2]	0.7[0.3, 1.7]
2	**Nationality**	Afghan refugees / local people	2.8**[1.3, 5.8]	2.3*[1.2, 4.8]	2.4*[1.0, 5.7]	2.4**[1.3, 4.6]	2.1[0.9, 5.1]
3	**Consanguinity status**	Consanguineous / Non-consanguineous couples	1.4[0.7, 2.7]	3.3**[1.6, 6.8]	1.5[0.7, 3.3]	2.3**[1.3, 4.0]	4.5**[1.9, 12.8]
4	**Maternal age**	<20 years / 20-34 years	5.8**[2.2, 15.0]	7.5**3.8, 15.0]	13.0**[3.3, 51.0]	5.7**[3.1, 10.6]	7.2**[3.3, 15.5]
		>34 years / 20-34 years	1.6[0.8, 3.3]	1.6[0.7, 3.7]	1.7[0.8, 3.9]	1.4[0.6, 2.9]	1.7[0.6, 4.8]
Preterm							
1	**Area of residence**	Tribal / settled area	1.8[0.7, 4.7]	0.7[0.3, 2.0]	1.4[0.4, 5.0]	1.2[0.5, 2.5]	0.6[0.2, 1.9]
2	**Nationality**	Afghan refugees / local people	2.8[0.8, 10.0]	5.2**[1.6, 17.0]	2.2[0.5, 9.0]	6.0**[1.9, 19.0]	9.9**[1.7, 55.0]
3	**Consanguinity status**	Consanguineous / Non-consanguineous couples	1.8[0.7, 4.6]	4.3*[1.4, 13.4]	2.2[0.6, 8.0]	2.2*[1.0, 4.5]	5.10**(1.4, 18.5)
4	**Maternal age**	<20 years / 20-34 years	4.6*[1.1, 20.4]	7.7**[2.4, 24.0]	3.7[0.5, 29.0]	6.6**[2.4, 18.0]	10.7** [2.9, 40.0]
		>34 years / 20-34 years	0.8[0.3, 2.6]	1.4[0.4, 5.6]	1.8[0.5, 7.0]	0.9[0.3, 2.9]	0.7[0.1, 6.0]
Full term							
1	**Area of residence**	Tribal / settled area	5.0**[1.8, 14.0]	1.3[0.3, 3.4]	5.3**[1.9, 15.0]	1.2[0.5, 3.1]	0.6[0.1, 2.5]
2	**Nationality**	Afghan refugees / local people	4.0**[1.4, 11.7]	1.5[0.5, 4.6]	2.4[0.8, 7.4]	2.2[0.8, 6.2]	1.2[0.3, 5.3]
3	**Consanguinity status**	Consanguineous / Non-consanguineous couples	1.5[0.5, 4.4]	2.5[0.9, 7.0]	1.2[0.4, 3.3]	3.2*[1.1, 9.5]	4.8*[1.1, 21.0]
4	**Maternal age**	<20 years / 20-34 years	5.7*[1.1, 31.0]	8.5**[3.2, 22.7]	29.0**[4.0, 186]	6.0**[2.1, 17.0]	6.9** [2.1, 23.3]
		>34 years / 20-34 years	3.4*[1.2, 9.8]	2.4[0.8, 7.0]	2.1[0.7, 6.4]	2.6[0.9, 7.6]	3.8*[1.1, 13.0]

**p<0.01, *p<0.05

Table 4.7: The significance of anaemia and abortion/miscarriage (using crude odds ratios with 95% confidence interval, in four levels table), on LBW babies for all, preterm and full term babies (n=1039) splitting for all significant geo-demographic factors.

S. No.	Factors	Area of residence		Nationality		Consanguinity		Maternal age			
		Tribal area	Settled area	Afghan refugees	Local people	Consanguineous couples	Non-consanguineous couple s	<=19 years	>19 years	20-34 years	>34 years
All											
1	Anaemia (yes/no)	2.4* [1.1, 5.1]	1.1 [0.6, 1.8]	1.7 [0.7, 4.3]	1.4 [0.9, 2.3]	1.2 [0.7, 2.0]	2.9* [1.2, 6.7]	1.4 [0.5, 3.8]	1.8* [1.1, 2.9]	1.8* [1.0, 3.0]	1.7 [0.7, 4.4]
2	TabMisC (yes/no)	3.2** [1.5, 6.7]	1.3 [0.7, 2.3]	1.7 [0.7, 4.3]	1.7* [1.0, 2.8]	1.6 [0.9, 2.7]	2.4* [1.1, 5.5]	3.8* [0.9, 15.0]	1.9* [1.2, 3.1]	1.7 [0.9, 3.0]	2.1 [0.8, 5.3]
Preterm											
1	Anaemia (yes/no)	3.2* [1.0, 10.3]	1.3 [0.6, 2.7]	1.0 [0.2, 5.0]	1.9 0.9, 3.7	1.5 [0.7, 3.0]	3.4 [0.9, 12.0]	1.3 0.3, 7.5	2.0* [1.0, 4.0]	2.2* [1.0, 4.7]	1.3 [0.3, 6.7]
2	TabMisC (yes/no)	1.1 [0.3, 3.3]	1.0 [0.4, 2.1]	0.4 [[0.1, 2.0]	1.0 [0.5, 2.0]	1.0 [0.4, 2.2]	1.0 [0.3, 3.4]	0.5 0.1, 4.7	1.2 [0.6, 2.4]	1.0 [0.4, 4.3]	2.0 [0.4, 10.0]
Full term											
1	Anaemia (yes/no)	2.3 [0.8, 6.5]	0.6 [0.2, 1.5]	2.4 [0.6, 9.3]	0.9 [0.4,1.9]	1.1 [0.5, 2.3]	1.8 [0.5, 6.4]	0.8 0.2, 4.6	1.5 [0.7, 3.2]	1.2 [0.5, 3.0]	1.8 [0.5, 6.0]
2	TabMisC (yes/no)	7.1** [2.4, 20.5]	1.6 [0.7, 4.0]	3.0 0.8, 11.7	2.9** [1.4, 6.0]	2.4* [1.0, 5.0]	6.5** [1.7, 23.6]	13.0** [2.0, 87.0]	3.0** [1.5, 6.0]	2.7* [1.0, 7.0]	2.2 [0.7, 7.3]

**p<0.01, *p<0.05 and CI for confidence interval of abortion/miscarriages was also observed in Pakistani mothers (OR=2.9, p<0.01), non-consanguineous births (OR=6.5, p<0.01) and teenage mothers (OR=13.0, p<0.01), respectively (Table 4.7).

Summary: This section highlighted the adverse effect of maternal geo-demographics and MHPH separately in preterm and full term babies (Table 4.6 and 4.7). These results showed the significance of teenage mothers and consanguinity in all; Afghan refugees, consanguinity and teenage mother in the preterm group; and consanguinity and older age mothers in the full term babies controlling for both anaemia and abortion/miscarriage. However, abortion/miscarriage was found to be one of the important influential factors that increases the risk of IUGR babies.

4.6 Pathways

In addition to univariate and multivariate analyses, two types of pathways were investigated to identify the baseline factors and missing links among factors. These pathways were created by establishing independent associations among factors using logistic regression, and associations among factors using univariate methods.

Pathway one: Table 4.8 and Figure 4.1 show the independent association of important influential factors associated with LBW/SGA shown in Table 4.5, with other important factors (shown in Table 4.1 and 4.2). These associations show that, (i) Afghan refugees were at higher risk of non-registering pregnancy in the hospital (OR=2.4, p<0.01), (ii) the odds of deprived areas (OR=8.6, p<0.01), maternal illiteracy (OR=1.6, p<0.05) and non-registering pregnancy (OR=2.0, p<0.01) were significantly higher in the Tribal areas compared to Settled areas.

Anaemia was significantly higher in (a) deprived areas compared to developed areas (OR=1.9, $p<0.01$), (b) mothers with a history of abortion/miscarriage compared with no history of abortion/miscarriage (OR=1.5, $p<0.05$), and (c) non-registering pregnancy in the hospital compared to mothers who registered pregnancy in the hospital (OR=1.5, $p<0.01$), (iii) consanguinity was significantly higher in the illiterate compared to mothers with some education (OR=1.6, $p<0.01$), (iv) hypertension was more common in the mothers with the history of previous abortion/miscarriages compared to no abortion/miscarriage (OR=1.9, $p<0.05$) and preterm compared to full term gestation (OR=1.5, $p<0.05$). However, preterm gestation was highly associated with low income compared to other than low income mothers (OR=1.6, $p<0.01$), and (v) low pregnancy weight was significantly associated with teenage compared to middle age mothers (OR=2.3, $p<0.01$).

The overall picture of these associations show that area status (deprived areas), maternal education and pregnancy registration are the three baseline factors that influence maternal and newborn health in Afghan refugees and Tribal areas, whereas family income affect newborn health through maternal age and gestational age. In maternal health and pregnancy history, (i) previous abortion/miscarriage affect birthweight through anaemia, (ii) hypertension through gestational age, and (iii) low maternal weight in case of teenage mothers, respectively (Table 4.8, Figure 4.1).

Pathway-two: A general cross-association of all factors considered in this study was established, linking all factors associated with one another at univariate level (Table 4.9, Figure 4.4 and 4.4a). Figure 4.4 and 4.4a show that, overall deprived and Tribal areas, and Afghan refugees were significantly associated with maternal and paternal social status (i.e.

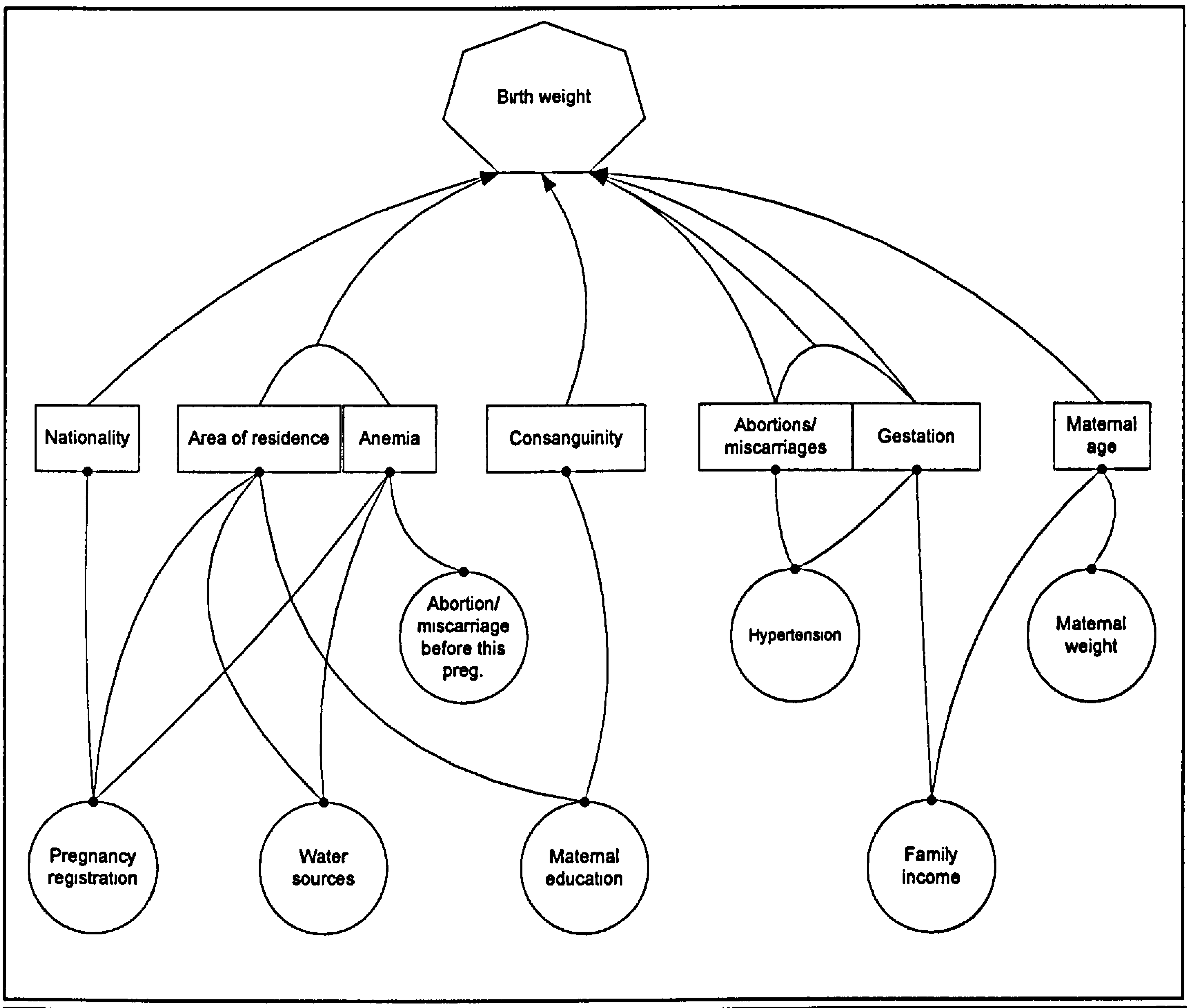

Figure 4.1: The independent association of LBW with significant factors, and further pathways using logistic regression. This figure shows the independent association of nationality, area-status, anaemia, consanguinity, abortion/miscarriage, gestational age and maternal age with other important factors studied.

Table 4.8: The association of the influential factors for LBW with other important factors using backward logistic regression (n=1039).

S. No	Factors	Water sources	Family Income	Maternal education	Hypertension	Abortion/miscarriage before this pregnancy	Total abortion/miscarriage	Maternal pregnancy weight	Pregnancy registration
1	**Maternal age** <20 years 20-34 years		1.8* [1.0, 3.3]					2.3** [1.4, 3.8]	
2	**Consanguinity** Consanguineous Non-consanguineous	0.7* [0.6, 1.0]		1.6** [1.2, 2.2]					
3	**Nationality** Afghan refugees Local people				0.5* [0.27, 0.91]				2.4** [1.5, 3.6]
4	**Abortion/miscarriages (all)** Yes No				1.9** [1.3, 2.7]				
5	**Area or residence** Tribal area Settled area	8.6** [6.1, 12.2]		1.6* [1.1, 2.4]					2.0** [1.4, 2.8]
6	**Anaemia** Yes No	1.9** [1.5, 2.5]				1.5* [1.1, 2.2]			1.5** [1.2, 2.0]
7	**Gestational age** <37 weeks ≥37 weeks		1.6** [1.2, 2.3]		1.5* [1.1, 2.3]				
7a	[1]**Gestational age** <37 weeks ≥37 weeks		2.1** [1.3, 3.4]		1.6 † [1.0, 2.6]		1.5* [1.0, 2.3]		

**<0.01, *<0.05, †<0.10, [1] using all covariate in the model

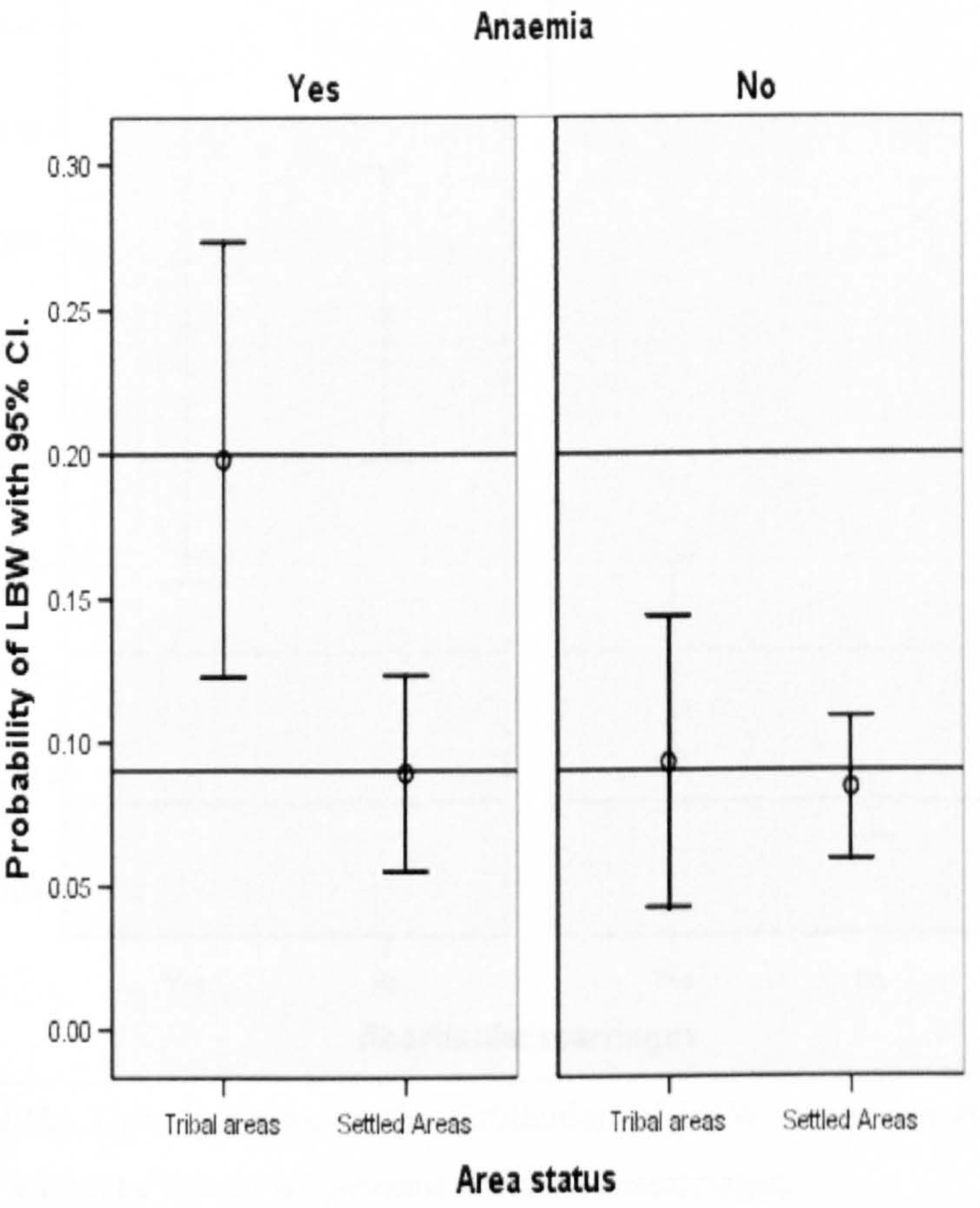

Figure 4.1a: This figure shows the distribution of LBW in Tribal and Settled areas with and without a history of anaemia during pregnancy.

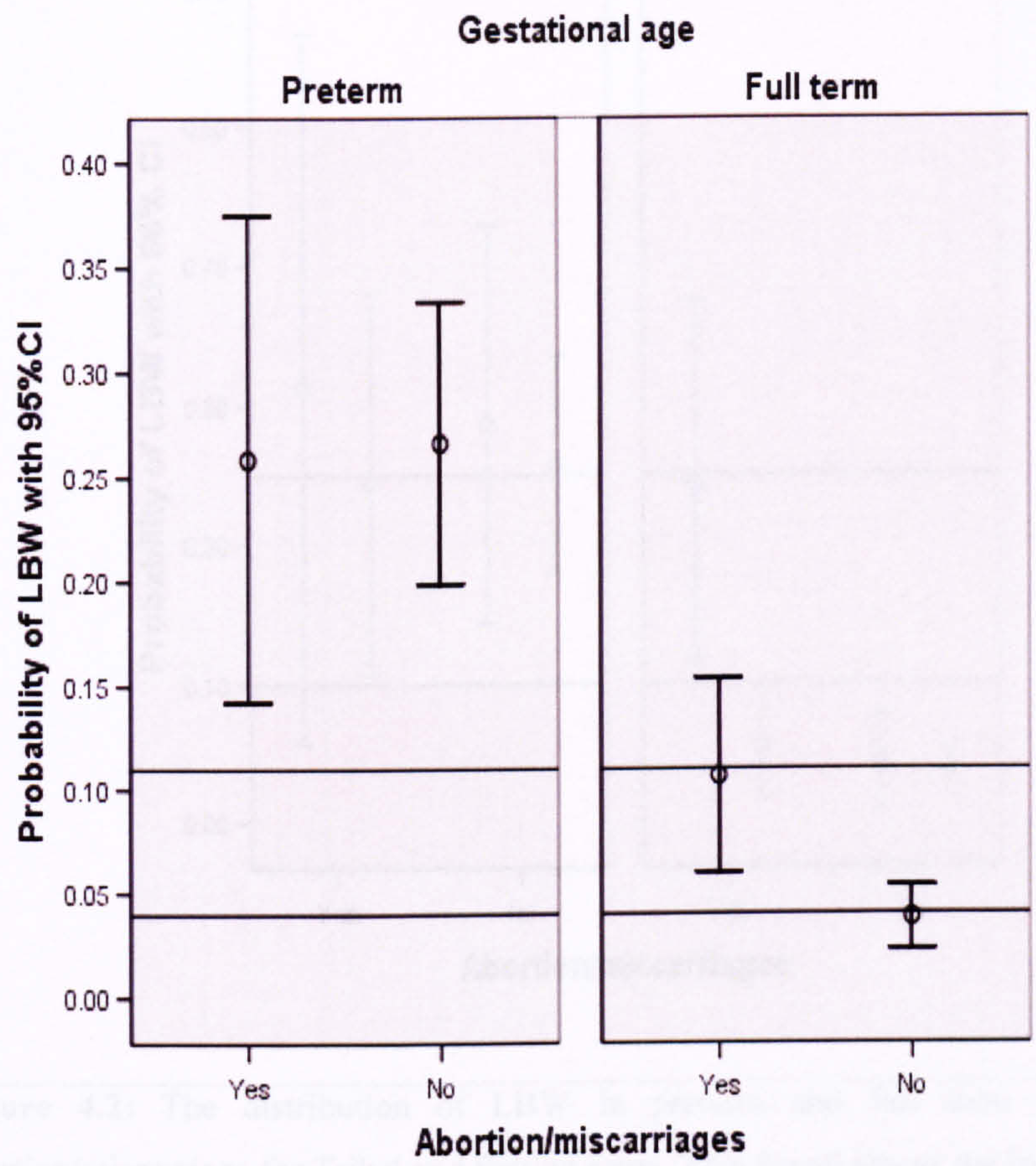

Figure 4.1b: This figure shows the distribution of LBW in preterm and full term with and without a history of previous abortion/miscarriages.

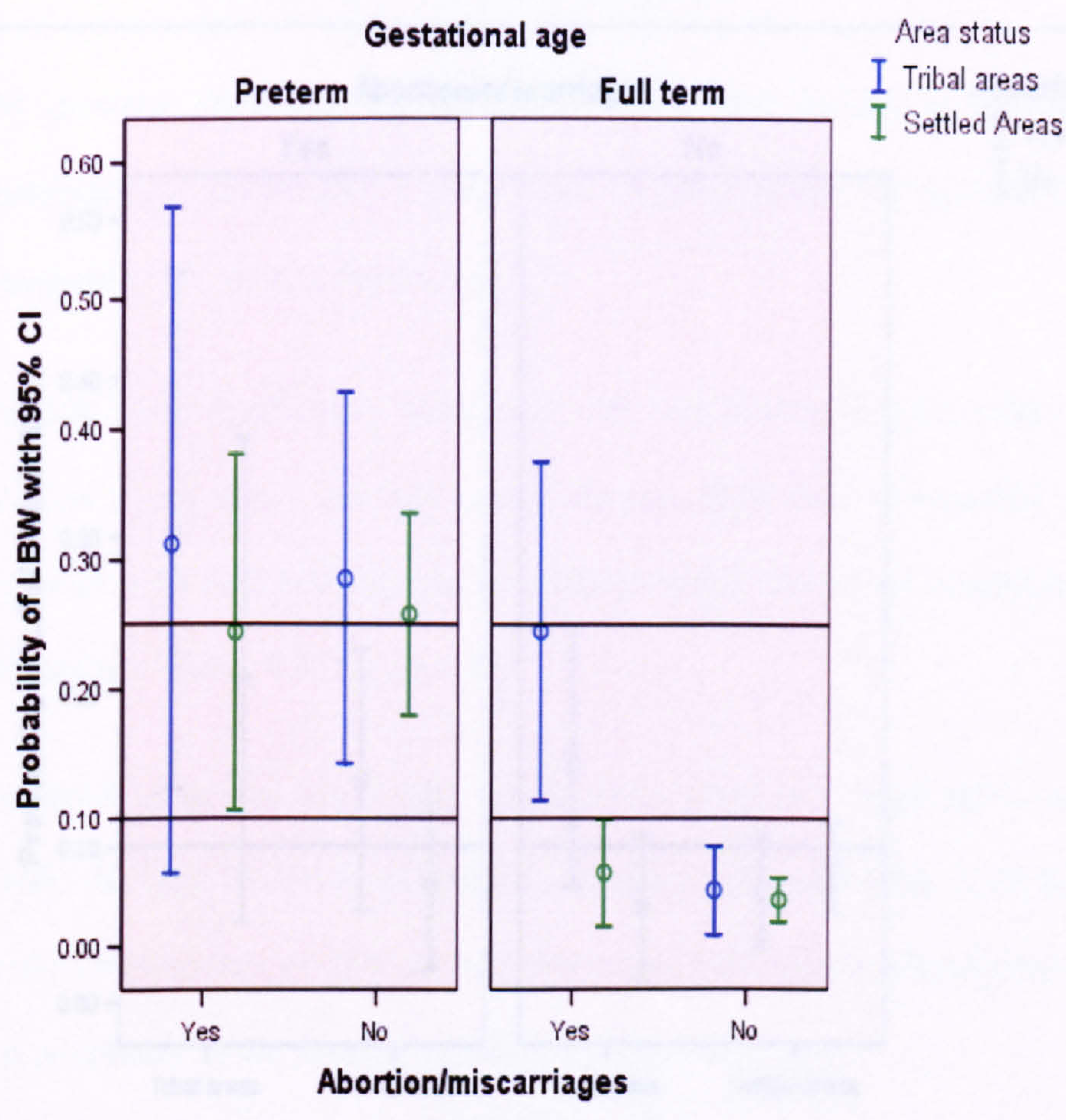

Figure 4.2: The distribution of LBW in preterm and full term with and without abortion/miscarriage for Tribal and Settled areas. This figure shows the incidence of LBW in Tribal and settled areas controlling for gestational period. In full term babies a history of previous abortion/miscarriage in Tribal areas, the proportion of LBW is significantly higher 25% compared to 5% in the same group without abortion/miscarriage.

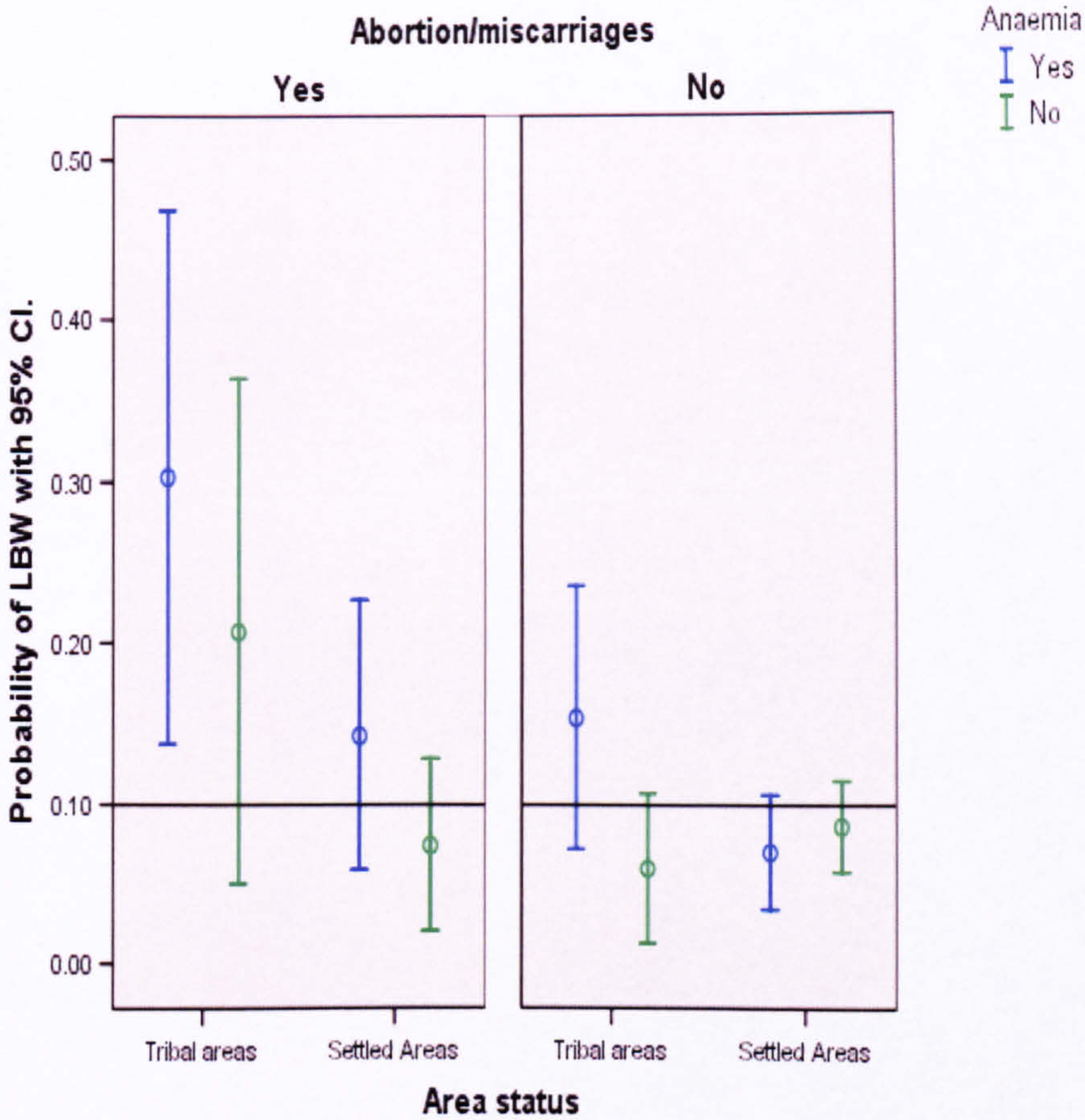

Figure 4.3: The distribution of LBW with and without a history of abortion/miscarriage in Tribal and Settled areas for anaemic and non-anaemic mothers. This figure shows the relative proportion of LBW in Tribal and settled areas for different combinations of anaemic-status and abortion/miscarriage. In anaemic-mothers the proportion of LBW is significantly higher in Tribal areas compared to settled areas. However, the proportion of LBW in Tribal areas is nearly 30% of the babies for anaemic-mothers with a history of abortion/miscarriage, compared to 7% without anaemia and abortion/miscarriage.

maternal and paternal education and family income). The family social status further influences maternal physical health (i.e. height and weight), gestational age and maternal age through consanguinity (Table 4.9, Figure 4.4).

The older mothers were significantly associated with less developed and Tribal areas, more likely to have low social status (i.e. low family income, high ratio of maternal and paternal illiteracy) and were presented with adverse pregnancy history and health conditions compared to middle age mothers (Table 4.9, Figure 4.4a).

The less developed areas and low social status affect pregnancy registration and anaemic status. However, the high incidence of maternal anaemia was associated with, (i) history of previous abortion/miscarriage or (ii) non registration or both abortion/miscarriages and non registration of pregnancy in the hospital (Table 4.9, Figure 4.4).

It was further found that previous abortion/miscarriages affected the gap between pregnancies, and was associated with hypertension, diabetes, anaemia and other risks like hepatitis, vaginal bleeding during pregnancy etc. This study did not find any link of pregnancy registration with any maternal health condition or adverse pregnancy history except diabetes (Table 4.9, Figure 4.4).

Summary of the pathways: The two pathways showed that 6 geo-demographic factors along with pregnancy registration and anaemia were found to be associated with one another making links like a *spider-web*. However, the previous abortion/miscarriages along with maternal health conditions made another separate group, where previous abortion/miscarriage was found to be the centre of adverse pregnancy history (i.e. short gap between pregnancies,

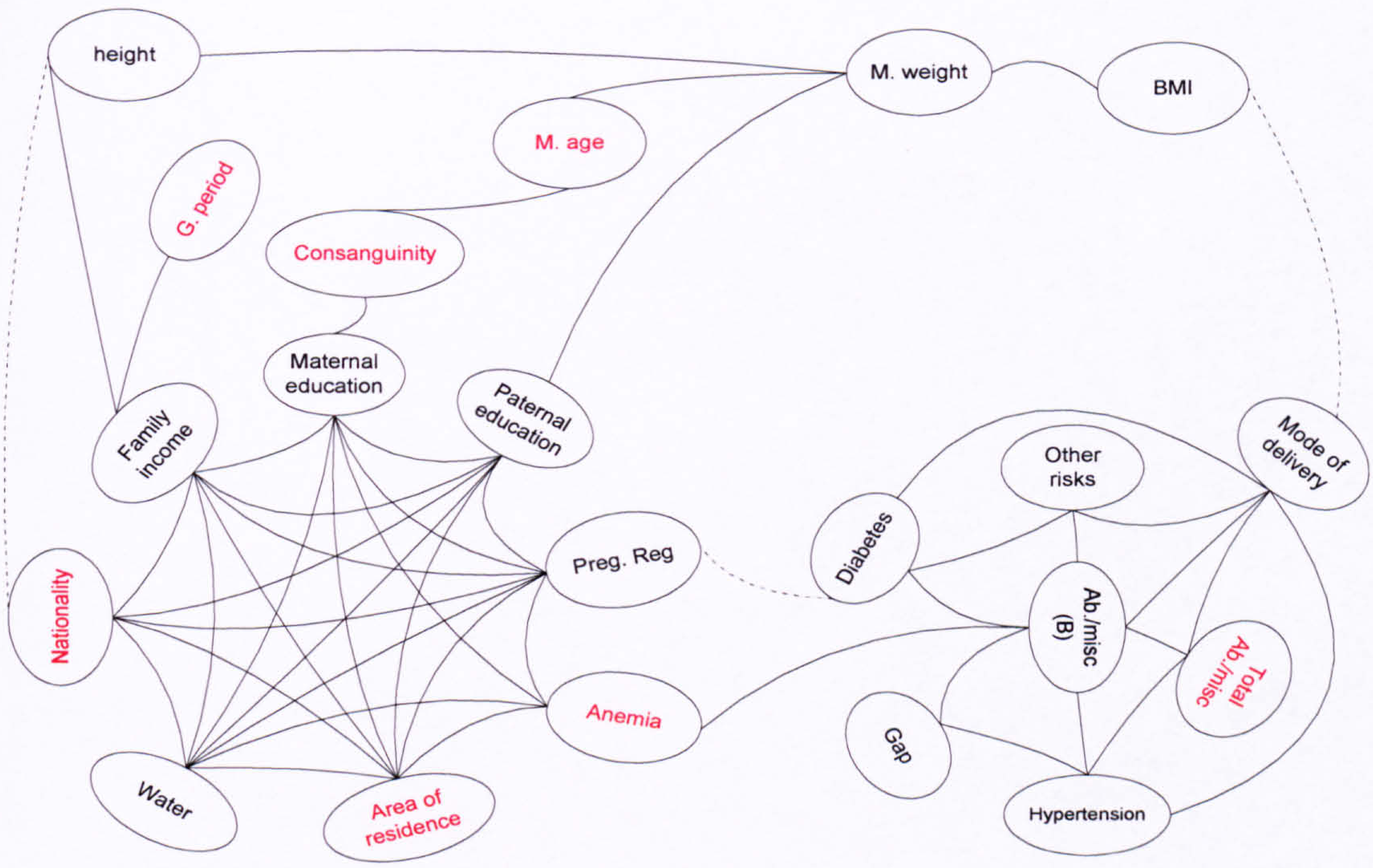

Figure 4.4: Univariate associations among different factors, making pathways among factors. This Figure shows the univariate graphical presentation of cross-association of factors given in Table 4.9. The geo-demographic factors including pregnancy registration and anaemia were found be associated with one another, making a shape like a "web-net". The diagnosed health condition, pregnancy history and mode of delivery were found to be associated with one another, making a second group, respectively.

It should be noted that, teenage mothers were significantly associated with consanguinity (OR=2, p<0.01). This mean that in every three teenage mothers two (67%) delivered in this study were consanguineously married. This highlights two important points, i.e. (i) consanguineously married teenage mothers are at higher risk that is why the proportion is 2:1, or (ii) they are advantageous and use hospital for delivery twice compared to non-consanguineously teenage mothers; because their mothers and others family members are nearby and getting less problems in attending hospitals for delivery compared to non-consanguineously married teenage mothers.

Note: Factors with coloured text are independently associated with low birthweight (<2.5kg), and doted lines show the negative association.

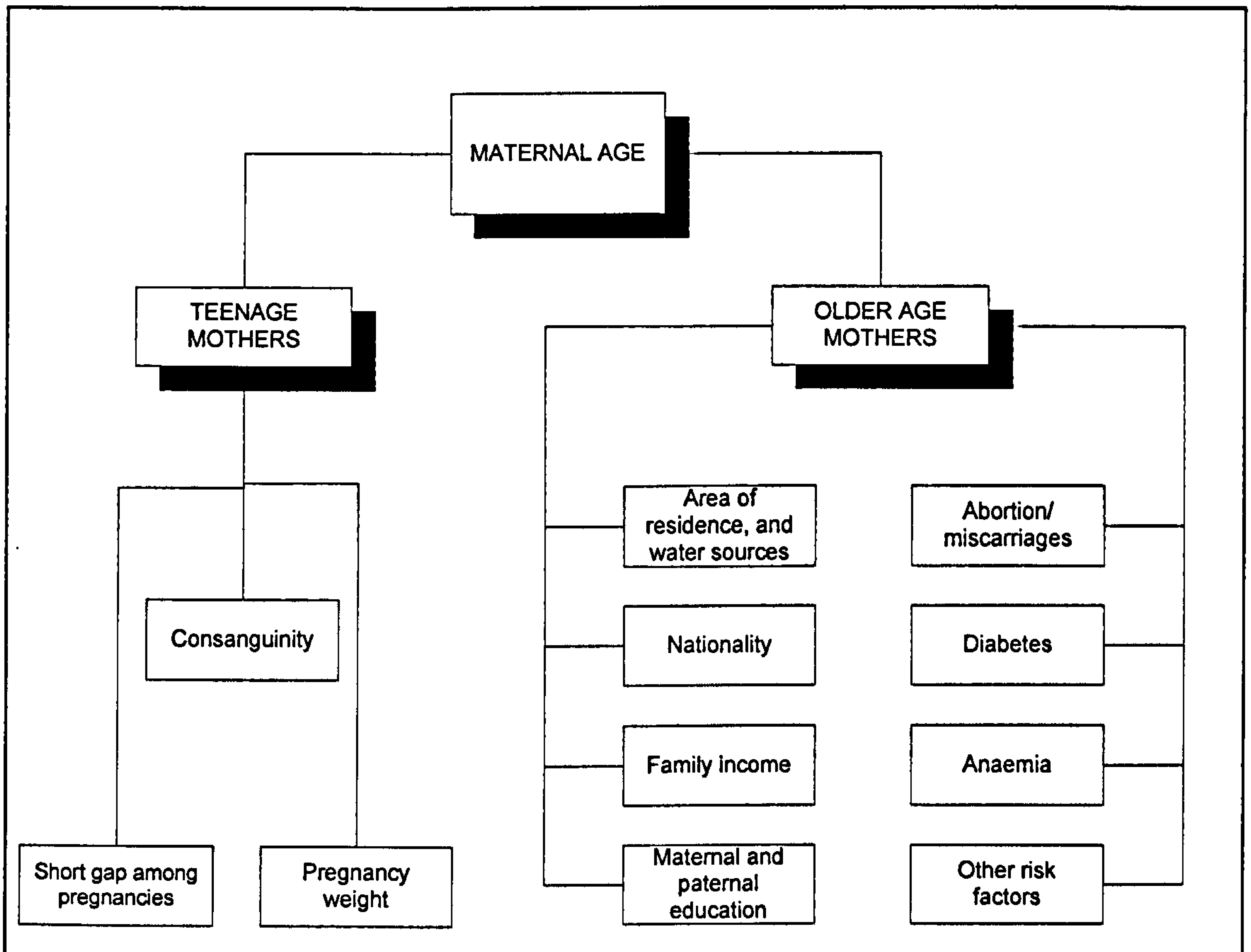

Figure 4.4a: The univariate associations of teenage and older age mothers (<20 and >34 years) with other important factors. This Figure shows the univariate association of teenage and older age mothers with other important geo-demographics, maternal health and pregnancy history including pregnancy registration and mode of delivery. The teenage mothers were found to be significantly associated with consanguinity and pregnancy weight. However, older age mothers were more likely from less developed and Tribal areas, belongs to Afghan refugees, low family income including maternal and paternal illiteracy. Moreover, older age mothers were found to be at higher risk of abortion/miscarriages, diabetes, anaemia and other risks like hepatitis, tuberculoses and vaginal bleeding during pregnancy.

Table 4.9: The cross tabulation of univariate associations (crude odds ratios) among all factors used in this study and their univariate effect on newborn weight.

Factors	Area of residence	Water sources	Nationality	Consanguinity	Family income	Age (<20 years)	Age (>34 years)	Maternal education	Paternal education	Gestational period	Diabetes	Hypertension	Anaemia	Other risk factors	Maternal height	Maternal weight	Maternal BMI	Total abortion/miscarriage	Abortion/miscarriage (Before this pregnancy)	Gap between pregnancies	Pregnancy registration	Mode of delivery	Low birth weight
Area of residence		8.5**	2.5**	0.9	1.8**	0.7	2.4**	2.5**	1.7**	1.3	1.3	1.4	1.6**	1.1	0.8	1.2	0.8	1.3	1.6*	0.7	2.5**	1.4*	1.7*
Water sources			1.7**	0.9	2.2**	0.9	1.9**	2.6**	2.3**	1.3	1.4	1.4	2.0**	1.5	1.2	1.0	0.9	1.1	1.1	0.8	1.6**	1.0	1.8**
Nationality				1.1	1.9**	0.9	3.7**	1.4	1.7**	0.8	0.3*	0.6*	1.2	1.8	0.5**	1.0	0.6	1.6*	1.3	1.7*	2.3**	1.0	2.5**
Consanguinity					1.3	2.0**	1.0	1.6**	1.0	1.0	0.7	1.2	1.0	0.9	1.0	1.0	1.4	1.1	1.0	1.2	1.2	0.9	2.0**
Family income						1.5	1.7**	3.0**	4.2**	1.6**	0.8	1.0	1.3	0.5	1.8**	1.3	1.8	1.2	0.9	1.2	2.2**	0.7*	1.8*
Maternal age (<20 years)								1.2	1.0	1.7*	3.0	1.2	0.7	0.4	1.5	2.7**	2.0	0.6	0.8	2.8**	1.2	0.9	6.1**
Maternal age (>34 years)								2.0**	2.0**	0.9	3.0*	1.3	1.5*	1.8*	0.8	0.7	0.8	2.6**	1.9**	0.7	1.5*	1.3	1.7
Maternal education									5.9**	1.0	1.0	1.5*	1.5**	1.3	1.0	1.4*	3.1*	1.3	1.3	0.9	1.8**	0.9	2.1**
Father education										1.0	2.4*	1.3	1.4	1.4	0.8	1.5**	1.4	1.3	1.4	1.2	1.9**	0.9	1.6*
Gestational period											2.1	1.4*	1.2	0.8	1.3	1.0	1.0	1.2	1.2	1.0	1.2	1.2	6.4**
Diabetes												2.0*	1.7	3.9**	0.6	0.7	0.9	1.7	3.0**	0.6	0.3**	3.0**	1.1
Hypertension													1.5*	1.6	1.1	0.7*	0.5	1.9**	1.7**	0.5**	1.0	1.8**	1.6
Anaemia														1.7*	1.2	0.9	0.5	1.5*	1.6**	1.0	1.7**	1.3	1.5#
Other risk factors															0.7	1.4	0.8	1.6	2.2**	0.8	1.0	2.5**	1.5
Maternal height																1.7**	0.11	1.3	1.4	1.1	1.3	1.4*	1.4
Maternal weight																	140**	0.8	0.6*	1.0	1.0	0.7*	1.8*
Maternal BMI																		0.6	0.1*	0.7	0.5*	0.3**	1.0
Total abortion/miscarriage																			41**	1.4*	0.9	1.7**	1.8*
Abortion/miscarriage (before this pregnancy)																				2.5**	1.0	1.9**	1.7*
Gap between consecutive pregnancies																					1.4	0.7*	1.1
Pregnancy registration																						0.9	1.8**
Mode of delivery																							0.9

**p<0.01, *p<0.05

Note: This table represents the univariate cross-associations among covariates estimated through odds ratios = ad/bc. For example, the odds ratio =2.5** for area of residence (Tribal / Settled area) and nationality (Afghan refugee / Pakistani mothers); which shows that "71.5% (=2.5/1+2.5) of Afghan refugees (2.5 times) investigated in this study were based in tribal areas compared to 28.5% in the Settled areas).

hypertension, and other risks like hepatitis, vaginal bleeding during pregnancy etc, and caesarean delivery). The combination of both univariate association and multivariate association among factors and birthweight show that, (i) previous abortion/miscarriages affect birthweight in the Tribal area compared to Settled area through maternal anaemia due to non-registering pregnancy in the hospital, and (ii) low social status (maternal and paternal illiteracy, and low family income) affect birthweight through gestational age, consanguinity and maternal age.

4.7 Summary

The overall analyses highlight the importance of geo-demographics, maternal health and pregnancy history on birthweight. In the geo-demographic group, maternal social-status (i) influences birthweight in the Tribal areas through anaemia due to previous abortion/miscarriages and non-registering pregnancy in the hospital, and (ii) affects birthweight through consanguinity, maternal age and gestational age, due to low family income and maternal illiteracy. The independent effect of consanguinity on birthweight could be due to genetic problems; however, the independent effect of Afghan refugee on birthweight needs further investigation in this region.

CHAPTER 5

DISCUSSION

In this chapter, the results of low birthweight (LBW) are discussed in relation to other findings, and in the light of the limitations and strength of the study. The conclusions and implications for clinical practice, legislation and future research are also discussed.

5.1 Limitations and strengths of the study

This study has been conducted in public hospitals that cover only 9% (urban=18%, rural=6%) of the total births, whereas the majority (91%) of the deliveries take place at home (78%), or in private hospital/clinics etc (13%) (PIHS 2002). There is no system in place to record birth at home and no complete database electronic or hard papers, this study had to recruits patients prospectively from the four main public hospitals in Peshawar. This necessarily excludes births in private hospitals, clinics, and at home.

The clinicians for this study collected data during the daytime one week, and at night time the next week, depending upon their duty timetable. Of the expected 50% of mothers recruited to the study, 45% of the deliveries for this study were recorded and 5% were missed during the study time. It is not known how many of the 5% refused to participate in the study. However, it is assumed that the missing 5% babies were not from a specific group of mothers that could influence the results of the study. This study is based on 1039 mothers and their newborn (single births) collected prospectively from four public hospitals. Therefore, the present study is likely to be a representative study of the mothers and their newborn that are delivered in the public hospitals.

In the present study abortion/miscarriage was used for both induced and spontaneous abortion, "due to the taboos and sensitivity associated with reporting an induced abortion" (Saleem and Fikree 2001). In the context of the present study, it was not possible to interview women at their homes in privacy to separate induced and spontaneous abortion as practiced by Saleem and Fikree (2001) in Karachi. In addition, it was also not possible to collect data on energy intake that might be one of the important factors in Peshawar as reported by others in developing countries (Kramer 2003).

This study employed births irrespective of gestational age (<37 weeks or =>37 weeks). However, birthweight <2.5kg (LBW) could be due to, (i) short gestation (<37 weeks), or (ii) small for gestational age, due to intra-uterine growth restrictions in any gestational week (IUGR). The gestational age in this study was calculated from the first day of the last menstrual period (LMP) as reported by another study in Karachi (Parveen 2001), and categorized such that any delivery from 24 and <37 weeks termed as preterm birth (Smith et al 2005). Some mothers may have had estimates of gestational age derived by ultrasound measurement made at antenatal visits, although this would not be the case for un-registered pregnancies which accounts for more than half of the observations.

Ultrasound in the first trimester provides reliable estimates of the gestational age (Khan et al 2004). However, confirmation through ultrasound was not possible in our case at the time of delivery. In one study in Karachi, Fikree et al (1994) used Parkin's criteria (i.e. examining skin colour, skin texture, breast development, and ear firmness) and Brenner et al's chart through specialist staff trained for the purpose, however, in the present study the clinicians used maternal information, maternal clinical examination and baby examination in the delivery room that is expected to be reliable without ultrasound confirmation as practiced by Parveen (2001) in a hospital based study in Karachi. It was not possible for the present study to train the clinician and then use the methods which were used by Fikree et al (1994), due to short time for data collection and resources.

The reliability of the estimates of gestational age was further investigated using a descriptive table showing the incidence of observations grouped by birthweight and gestational weeks, shown in Table 4.3. A comparison of the profile of birthweight against gestational age with that listed in (Williams et al 1982) shows a remarkably strong agreement, especially as one set of figures were derived from a city in a technologically advanced country, whilst our figures refers to a border province in a developing country. The birth weight against gestational age in the present data set collected at Peshawar was further compared with another hospital-based study using LMP in Karachi (Parveen 2001) and found to be comparable. This was taken to indicate that the estimates of gestational age in the prospectively acquired data set are sufficiently good to justify a description of the LBW cohort as shown in the Table 4.3, comprising low weight births expected for gestational age and small for gestational age (SGA) latter including a sub group of intra-uterine growth restricted (IUGR).

Factors and coding: From the covariates originally collected, 20 were used, to keep at least 5 events (LBW) per factor, as there are 101 occurrences of LBW in the data. This ratio of events per variable is on the threshold of acceptability for the size of the pool of covariates prior to initiating the variable selection process, as recommended in the literature (Peduzzi et al 1996).

Further, the majority of the covariates (19 out of 20) were coded dichotomously, whereas maternal age was categorized into three categories (<20 years, 20-34 years, and >34 years). One of the main reasons for combining multiple attributes together into dichotomous coding was to maintain a high ratio of number of events over the number of model parameters to be fitted. Therefore, dichotomous coding loses specificity to the attributes that are combined together. In the case of maternal age it was important to separate three groups, therefore this variable is coded with three attributes.

Sample representativeness: This data set was compared with published reports to check the representativeness of the sample. It was found that in the geo-demographic factors, the sample was consistent for some factors with the population or community based studies. These factors include, consanguinity 60% (60.2% in a community-based study, Grant et al 1997), family income <5000 rupees 69.4% (house hold index category of I and II 76%, Grant et al 1997), maternal illiteracy 69.5% (Pakistan 70%, NWFP 80%, PDF 2003), paternal illiteracy 37.6% (Pakistan 36%, WHO 2006), and non-fresh water 36.8% (NWFP 42%, PIHS 2001-2002) were consistent with the prevalence reported in the community or population-based (Table 4.1).

In maternal health and pregnancy history, the incidence of preterm births, diabetes, and abortion/miscarriage are also not significantly different compared to population or population-based studies. The ratio of preterm births in the present study 22.8% (15% to 30%, Najmi 2000), diabetes 2.7% (2.6% to 3.8% for the mothers age 15 years and above in NWFP, Tribal areas and Baluchistan, Jafar et al 2004), abortions/miscarriage 22.7% (estimated abortions 26% in NWFP and 20% in Pakistan) (Population Council 2003) are also comparable with other studies. The prevalence of hypertension in this study (18.3%) is less than another report

(28.4%) for all women age 15 and above, Jafar et al 2003) (Table 4.2). The low proportion of hypertension in our study might be due to the fact that our estimate is for the mothers of reproductive age only (15-49 years), whereas Jafar et al's reported all women age 15 years and above. So the prevalence of hypertension in the present study might be representative of the prevalence of reproductive age in this region.

However, in the geo-demographic factors, the proportion of mothers from Tribal areas in the present study was higher 24% (243/1013) compared to the total population of 15% (1524, 000/10179, 000, Census 1998, Federal Bureau of Statistics) in this region (NWFP and Tribal area). The high participation of mothers from the Tribal areas in the present study is likely to be due to non-availability of healthcare services of the same standard in the Tribal area compared to Settled areas of NWFP. Similarly, the low representation of teenage mothers in the present study 7.5% (<20 years), compared to 19.6% in a community based study (Grant et al 1997), is likely to be due to low health awareness in teenage mothers, cultural reasons like *strict pardah of teenage mothers* and the inability to afford hospital costs in the early years of marriage.

In the maternal health and pregnancy history, due to non-availability of community-based literature regarding maternal physical health (e.g. maternal height, weight and BMI etc), it is assumed that the proportion of maternal health parameters used in this study might not be significantly different from the population in general (Table 4.1).

The representativeness of geo-demographics and maternal health and pregnancy history factors show that, (i) the present study is a representative study of the 70% un-educated and low family income mothers, and also (ii) one of the representative studies of the population at large, that could be used as a base for community/population based studies in this region.

5.2 The incidence of low birthweight

The present study investigated the incidence of LBW, and its influential factors in two parts, (i) investigating LBW (<2.5 kg) adjusting for gestational age to catch the factors associated with birthweight (SGA), and (ii) the factors independently associated with short gestational age (preterm <37 weeks), a cause of LBW (<37 weeks, and <2.5kg).

The overall incidence of LBW (<2.5kg) in this study at Peshawar (10%) was half that of other recent studies (19-23%), in Lahore and Karachi (Najmi 2000, Aziz et al 2001) and the overall national average (UNICEF-Statistics of low birthweight, 2006). The differential in the incidence of LBW might be due to racial differences in Lahore and Karachi, compared to Peshawar. People living in Lahore and Karachi are known as Punjabi and Sindhi and have different health characteristics (hypertension and diabetes) than people living in NWFP known as Pathan (Jafar et al 2003, and 2004). However, the incidence of LBW in Budhni village near Peshawar was reported to be 5% (Northrop-Clewes et al 1998). The variation in the present and Northrop-Clewes et al's study could be due to the differences in village-based study and a hospital-based study. In the hospital based study the ratio of mothers at risk is suspected to be more prevalent than in a village based study, due to referral of high risk mothers from the Basic Health Units (BHUs) to the main hospitals. Another reason for the high incidence of LBW babies in our study compared to Northrop-Clewes study could be the inclusion of mothers from Tribal areas and Afghan refugees. These mothers from Tribal areas and Afghan refugees were found to be at higher risk compared to mothers from Settled areas and Pakistani mothers, respectively.

In the present study, of the total LBW babies 60% were preterm and 40% full term (Table 1). The high ratio of premature births (60%) in Peshawar is within the range of 46% to 70% reported by others studies in Islamabad and Lahore (Khan 2003, Najmi 2000). This highlights the importance of prematurity and newborn health at large. The ratio of prematurity in the present study (22.8%, Table 4.2) is within the range of 11% to 31% reported for India and Pakistan (Aris, 1992, Najmi 2000, Khaskeli et al 2006). So splitting the total LBW, it was found that in the total LBW babies, 41.6% were preterm and appropriate for gestational age, 17.8% were preterm and small for gestational age and 40.6% were full term and SGA (IUGR). Among the total LBW, 58.4% were SGA, and 40.6% were appropriate for gestation (Table 4.3).

Summary

The estimated incidence of LBW in Peshawar based on public-hospitals is nearly half that of the national average, yet is double that of a village-based study near Peshawar (Northrop-Clewes et al 1998). The high incidence of LBW in Lahore and Karachi compared to this study in Peshawar might be due to ethnicity; whilst the high incidence of LBW in this hospital-based study in Peshawar compared to Northrop-Clewes study in Budhni village is due to inclusion of Tribal areas and Afghan refugees. Because, mothers from Tribal areas and Afghan refugees were found to be at higher risk of LBW compared to mothers from Settled areas and Pakistani mothers, respectively. In this study 60% of the total LBW babies were preterm, and 40% full term, whilst 59% of the total LBW babies were small for gestational age due to intrauterine growth restrictions.

Recommendations for future studies

The overall incidence of LBW based on all births (public/private hospitals and home delivery) is still a question to be investigated. Therefore, it would be better if all births (i.e. public hospitals, private hospitals/clinics, and home deliveries) are combined in a database, and researched for different categories of mothers (e.g. area-wise, age-wise, health-wise etc) in relation to LBW (preterm, full term, and SGA). However, due to high ratio of preterm LBW babies found in the present study, short gestational age needs special attention and further investigation to identify the risk factors associated with short gestation in different groups of mothers in population based studies. Moreover, it is also important to know the main causes of IUGR in the population, in order to inform mothers, policy makers and health professional for any intervention.

5.3 Influential factors associated with LBW/SGA

To investigate the influential factors associated with LBW, gestational age was taken as a covariate so that to estimate variation in LBW due to short gestational age, and other factors that explain the variation in SGA/IUGR. The effect of short gestational age (<37 weeks) on LBW is discussed below, and the significant covariates for SGA are discussed in section 5.4.

Gestational age

Short gestation of <37 weeks is one of the main causes of LBW. In Peshawar, 70% of the preterm babies were appropriate for gestational age, and 30% preterm were intra-uterine restricted and below 2.5kg (Table 4.3). The main factors independently associated with short gestation of <37 weeks (preterm gestation) adjusted for other important factors were family income (OR=2.1, p<0.01), hypertension during pregnancy (OR=1.6, p<0.10), and abortion/miscarriage (OR=1.5, p<0.05) (Table 4.8). These influential factors associated with short gestational age are discussed below:

Family income: A univariate analysis of the present data set showed that family income was found to be one of the main causes of non-registered pregnancy in the hospital (OR=2.2, p<0.01), and was significantly associated with maternal and paternal illiteracy (OR= 3.0, 4.2, p<0.01), Tribal and deprived areas (OR=1.8, 2.2, p<0.01) (Table 4.9). The effect of maternal social status with preterm gestation was consistent with other hospital based studies in Karachi (Tabussum et al 1994), and Kanara India (Prasad et al 1994). In Karachi the prevalence of preterm births was 9.4% in upper-middle and high socio-economic class, where 90% of the pregnancies were booked/registered in the hospital. In Kanara India, the ratio of preterm births was very low (7.5%) due to high maternal social status (73%) and adequate access to health care (90%) in Prasad et al study in Kanara India. Therefore, in order to reduce the incidence of short gestational age, maternal social status needs to be improved as a long term policy and targeted mothers with low social status as a short term policy.

Hypertension: The present study found 18.3% of mothers were hypertensive in Peshawar. The independent effect of hypertension (OR=1.6, p<0.10, Table 4.8) was found to be an increased risk of preterm births in the present study. The association of hypertension with short gestation in our study is in agreement with other studies in developing (Kramer 2003, Mavalankar et al 1992, Yadev et al 1997, Khan et al 2003, Shaheen et al 2003) and developed countries (Kramer et al 1999, Steer 2005, Peacock et al 1995).

Abortion/miscarriages: The proportion of previous abortion/miscarriage was 22.7% during any time in the reproductive age, whilst it was 17.2% before the present pregnancy (Table 4.2), and it was independently associated with preterm gestation (Table 4.8). A univariate study of the present data also associated diabetes, hypertension, anaemia and other risk factors (i.e. hepatitis, tuberculosis and vaginal bleeding during pregnancy) with previous abortion/miscarriages (OR=3.0, 1.7, 1.6, and 2.2 $p<0.01$) (Table 4.9, Figure 4.4). Therefore, non-adequate antenatal care might be one of the main causes of adverse pregnancy history (abortion/miscarriage) and increased risk of adverse pregnancy outcomes in the case of maternal health conditions, and adverse pregnancy history is also reported by others (Mavalankar et al 1992, Tabussum et al 1992). The factor abortion/miscarriage in this study might underestimate the effect in the case of induced abortion and overestimate the effect for spontaneous abortion (also see section 5.4.1).

Summary

This study highlights the importance of preterm births that accounted for more than half of the total babies with <2.5kg in the present study. The two factors that directly increased the risk of preterm gestation were hypertension and previous abortion/miscarriages. However, one of the important geo-demographic factors associated independently with preterm births is maternal social status and especially family income. The present study associated low family income with Tribal and deprived areas, parents education and non-registering pregnancy in the hospital. Therefore, low family income could affect pregnancy outcomes through inadequate health care in the case of maternal health conditions and/or adverse pregnancy history.

Recommendations for clinical practice

1. Health professionals and women should be made aware of the high risk of hypertension during pregnancy and the adverse effects of previous abortion/miscarriage on next pregnancy.

2. The government should focus on the poor segment of the population through extra funding for free medication for those mothers who cannot afford medication in the case of maternal health conditions (hypertension) and adverse pregnancy history (abortion/miscarriage) to minimise poor pregnancy outcomes.

3. The government should provide health care facilities in the deprived areas, so that the poor mothers can access medical care directly instead going to urban and developed areas for health care.

Recommendations for future studies

The present study found family income, hypertension and abortion/miscarriage as risk factors of short gestational age based on public hospital-based data, which might be more representative of the mothers delivered at public hospitals. However, private hospitals/clinics and community based studies are recommended to investigate the influential factors associated with short gestational age.

5.4 Influential factors associated with SGA

The discussion shown in the next sub-section takes gestational age as an independent variable, and so seeks to explain the residual variations due to SGA. In addition to gestational age, this study found three geo-demographic factors (i.e. maternal age, consanguinity, nationality/ethnicity), and two maternal health and pregnancy history (MHPH) factors (i.e. anaemia, and abortion/miscarriage) significantly increased the risk of SGA. The details of these factors are discussed as follows.

5.4.1 Abortion/miscarriages

According to the literature, a large number of abortions are conducted in Pakistan, where 1 in 5 women suffer from post abortion complications (Population Council 2004). Due to restrictive legal status in Pakistan (Rehan 2003), the majority of the unwanted pregnancies are terminated by the hands of non-professionals, which affect maternal health through excessive loss of blood, sepsis, damage to the uterus, and infection of the uterus and hence affect the next pregnancy through poor maternal health (Population Council 2004, Hussain et al 2004).

Fikree and Pasha (2004) reported that "decisions about seeking care in such emergencies are made largely by the husband or the elder member of his family". However, a lack of family health awareness and family planning in case of previous abortion/miscarriage increase the risk of poor maternal health (e.g. high grade fever, heavy vaginal bleeding etc) and hence adverse pregnancy outcomes in the next pregnancies (Saleem and Fikree 2001, Karim et al 1998).

In the present study, previous abortion/miscarriages were associated independently with SGA babies (Table 4.5, Figure 4.1 and 4.2). It was further found that, a history of previous abortion/miscarriages was independently associated with maternal hypertension (OR=1.9, p<0.01) and abortion/miscarriage before this pregnancy was found to be one of the main causes of maternal anaemia during the present delivery (OR=1.5, p<0.01) (Table 4.8, Figure 4.1). The association of abortion/miscarriage with anaemia and hypertensive disorder was found to consistent with another study in Calcutta-India (Pahari et al 1997), whilst the effect of previous abortions in the present study at Peshawar, is consistent with study in Ahmedabad (Mavalankar et al 1992), and hypertension during pregnancy with Kramer et al's study (1999) in Canada and reports from other developing countries (Kramer 2003).

It was estimated in Pakistan that of the total mothers who experienced abortions and were hospitalized due to post abortion complications 78.7% were induced compared to 21.3% who had a spontaneous abortion (Population Council 2004). In the present study abortion/miscarriage was used for induced and spontaneous abortion, "due to the taboos and sensitivity associated with reporting an induced abortion" (Saleem and Fikree 2001). It was not possible to interview women, at their homes in privacy to separate induced and spontaneous abortion as reported by another study in Karachi (Saleem and Fikree 2001), because the present study recruited mothers in the hospital when they were admitted for delivery. Saleem and Fikree's study (2001) interviewed mothers at their home in privacy, in three sites using staff who were familiar to the mothers. This study "purposely selected these field sites due to familiarity of the residents with the staff from CHS/AKU so as to facilitate the conduct of the study" (Saleem and Fikree 2001). In the present study the combined effect of induced and spontaneous abortion underestimates the effect of previous induced abortion and overestimates spontaneous abortion.

Moreover, the poor quality of the existing post abortion care in the rural areas of Pakistan (i.e. short supply of female staff, and lack of appropriate equipment and staff training) need to be addressed, to minimize maternal morbidity and adverse pregnancy outcome (Population Council 2004).

Summary

The present study found previous abortion/miscarriage an increased risk of SGA independent of other important factors. The present study also found hypertension during pregnancy as one of the influential factors associated with previous abortion/miscarriages. Previous abortion/miscarriage was also one of the main causes of maternal anaemia during pregnancy. However, due to the illegal status of abortion, the main issue of induced abortion could be unsafe abortion by the hands of non-professionals which increases the risk of maternal health conditions, inadequate post abortion care including lack of facilities, equipments and trained staff.

Recommendations for clinical practice

1. To reduce the adverse pregnancy outcomes including maternal morbidity and mortality, a health awareness program regarding abortion for women could be of great value. Inclusion of husbands in the health awareness program could maximize the benefits, because the majority of the health decisions are made by the husbands in the male dominated society of NWFP.

2. Adequate access to family planning for all and especially in the deprived and Tribal areas could reduce the number of unwanted pregnancies, and hence the number of abortions.

3. Trained staff with all the required equipments necessary for post-abortion care should be provided to the local hospitals at district level in the Settled areas and Agency level in the Tribal areas; so that trained staff with all required equipment can deal with such mothers in their district/Agency instead of having to refer them to the main hospitals in Peshawar.

Legal issues

In addition to clinical practice, the legal status of induced abortion needs to be addressed, to reduce the number of back-door abortions performed by untrained health attendants.

Recommendations for future studies

The present results are based on findings from public-hospitals with limited information about, whether a mother had a history of induced or spontaneous abortion. Independent large studies on induced and spontaneous abortion in Tribal and Settled areas based on all births could further clarify the adverse effect of abortions on birth outcomes. However, investigating the association of abortion/miscarriage with maternal health and pregnancy history (e.g. anaemia and haemorrhage adjusting for family social status and health conditions, e.g. diabetes, hypertension etc.) could be helpful in understanding its overall impact on maternal and newborn health.

5.4.2 Anaemia in Tribal areas

Anaemia is a common problem with pregnant women in developing countries, ranging from 8% to 33% in Pakistan (Bhutta 2000) and is one of the influential factors associated with LBW and IUGR (Lone et al 2004). In the present study, the incidence of anaemic mothers was found to be 38.5%, this was significantly higher in Tribal and deprived areas compared to Settled and developed areas (OR=1.6, 2.0, $p<0.01$, Table 4.9, Figure 4.4). This study found that anaemia was one of the main causes of SGA in the Tribal area compared to non-anaemic mothers in Tribal areas and Settled area (Table 4.5, Figure 4.1, 4.1a, 4.3). The effect of anaemia in our study is consistent with other studies in Karachi and Ahmedabad (Rehman et al 2005, Lone et al 2004, Mavalankar et al 1992).

The detailed multivariate analysis of anaemia in this study showed that it was independently associated with un-registered pregnancies in the hospital, deprived areas (where fresh drinking water is still not available), and previous abortion/miscarriages (Table 4.8, Figure 4.1). It was also noted that, in addition to the high ratio of non-educated mothers in the Tribal areas, non-registration of pregnancy and a high ratio of deprived areas were found to be the main causes of high anaemia compared to Settled areas (Figure 4.1). This was also seen in another study in Karachi, where disadvantaged mothers living in deprived areas (Kucha house material and low social status) were at higher risk of IUGR babies (Fikree et al 1994). In the present study, maternal anaemia was independently associated with previous abortion/miscarriage, therefore, the high odds of SGA in Tribal areas might be due to previous abortion/miscarriage (Figure 4.1).

The present study also observed that in deprived areas (i.e. Tribal and less developed areas) the mothers were less likely to register their pregnancy even in the case of previous abortion/miscarriage compared to mothers living in the Settled areas (Figure 4.4). Therefore, the significant effect of anaemia in Tribal areas is more likely to be due to inadequate post abortion care that increases the risk of LBW through anaemia.

Durrant et al (2000) associated access to better health care services and financial resources with paternal education in a community based study in rural Punjab-Pakistan (Durrant et al 2000). In Peshawar and especially in the Tribal areas, due to high maternal illiteracy, paternal social status/education might be one of the important factors for pregnancy registration (Figure 4.4) as seen in the other developing countries (Macassa et al 2003). Therefore, in addition to maternal area of residence and social status, this study highlights the importance of paternal social status as one of the important factors for maternal health in the deprived areas.

Summary

This study associated maternal anaemia with a high ratio of SGA in the Tribal area compared to Settled areas. The significant effect of anaemia was associated with a high ratio of un-registered pregnancies, maternal illiteracy, and high ratio of deprived areas in the Tribal areas compared to Settled areas. In addition to deprived areas and low maternal social status the present study highlights the importance of paternal social status as one of the important factors that might play a very important role regarding newborn health through access to adequate health care.

Recommendations for clinical practice

Health professionals and mothers especially in the Tribal areas should be informed regarding the effect of maternal anaemia on adverse pregnancy outcomes. Pregnancy registration should be encouraged to reduce anaemia, and especially in the case of mothers with a history of abortion.

Recommendations for future studies

Large studies should be designed to investigate the root causes and effect of anaemia on SGA in different Tribal areas (Khyber, Kurram, Bajaur, Mohmand, Orakzai, and North and South Waziristan) compared to Settled areas, considering maternal and paternal social status, previous history of abortion/miscarriage, post abortion care and pregnancy registration in the hospital.

5.4.3 Afghan refugees

In addition to the independent effect of anaemia in the Tribal areas and abortion/miscarriage, the present study in Peshawar also found the adverse independent effect of nationality on SGA. The Afghan refugee mothers were independently at higher risk of GSA, compared to Pakistani mothers (Table 4.5, Figure 4.1). The higher incidence of SGA in Afghan refugee mothers is consistent with other studies like Vietnamese refugees in Hong Kong (King et al 1990) and refugees from Bosnia, Herzegovina and Serbia (Kuvacic et al 1996). However, in a large study of refugee camps, Hynes et al (2002) reported that "seven of 9 had lower percentages of LBWs than in the country of origin and 5 of 9 had lower percentages of LBWs than the host country". These findings show that the effect of camps compared to the host country is not consistent and may vary from country to country due to the ethnicity and facilities in the camps (e.g. adequate food and nutrition during pregnancy etc) (Hynes et al 2002). However, information regarding Afghan refugees in NWFP is limited regarding their accommodation status (camps or private accommodation), food and nutrition during pregnancy, and mental health problems that might be helpful to explain the diversity in SGA between Afghan refugees and Pakistani mothers (Rahman et al 2007).

The present study found that the adverse effect of refugee mothers on SGA might be due to high ratio of non-registered pregnancies in Afghan refugees compared to Pakistani mothers (Figure 4.1), whilst the non-registered pregnancies are at increased risk of anaemia in the Tribal areas (Table 4.1). In a univariate study, it was also found that the majority of Afghan refugee mothers were from Tribal and deprived areas, and belonged to low income families with un-educated husbands compared to Pakistani mothers (Figure 4.1, 4.4).

The present study found that 69% of the mothers delivered at the four public hospitals belonged to low income families (Table 1), whilst the ratio of poor mothers was higher in refugees 80% (96/120) compared to Pakistani mothers 67.6% (611/904). This study showed that majority of the poor Afghan refugees and Pakistani mothers use public hospitals. Therefore, on the basis of these findings it is also concluded that the present study is likely to be a representative study of the poor Afghan mothers.

Summary

The present study independently associated Afghan refugees at higher risk of SGA compared to Pakistani mothers adjusting for other important factors. The high ratio of SGA in Afghan refugees compared to Pakistani mothers could be due to, (i) a non-registered pregnancy, (ii) living in deprived and Tribal areas, and (iii) belonging to a low income group with high ratio of non-educated husbands compared to Pakistani mothers. This study confirmed that majority of the poor Afghan refugees used public hospitals in Peshawar compared to the Pakistani mothers.

Recommendations for clinical practice

Special healthcare centres should be established to look after the refugees mothers during pregnancy. However, all pregnant Afghan refugee mothers should be registered and regularly checked for possible risk, to minimize adverse pregnancy outcomes.

Recommendations for future studies

The high ratio of SGA in Afghan refugees compared to Pakistani mothers in this study was based on public-hospital data, where this study in Peshawar found that majority of the low income Pakistani and refugee mothers were delivered. Therefore, the present study is likely to be representative of the low income refugees; however, it is not known whether these refugees are living in camps or in private accommodation. Therefore, further studies regarding LBW/SGA comparing (i) camps and private accommodations of the refugees with Pakistani mothers in Tribal and Settled areas, and (ii) public and private hospitals are needed, to understand, why there is a high ratio of SGA in Afghan refugees compared to Pakistani mothers.

5.4.4 Consanguinity

Consanguinity is common in developing countries due to social, cultural and economic reasons. In this study the majority of the people (60%) were found to be consanguineous, which is consistent with other community based studies in Pakistan (Grant and Bittles 1997, Hussain and Bittles 1998). In Pakistan a number of studies have associated consanguinity with adverse pregnancy outcomes and high neonatal mortality (Hussain & Bittles 1998, Fikree et al 1994, Grant & Bittles 1997). The independent effect of consanguinity on neonatal mortality is well-established in Pakistan, but due to social, cultural and economic reasons consanguinity is still common in Pakistan (Grant et al 1997, Bittles 2005, and 1994).

The present study found that consanguineous mothers were independently at higher risk of SGA compared to non-consanguineous couples (Table 4.5, Figure 4.1). The impact of consanguinity in our study is consistent with other studies in Karachi (Fikree and Berendes 1994), Pakistani Muslims in Birmingham UK (Honeyman et al 1987), Riyadh Saudi Arabia (Al-Sekait 1989, Al-Eissa et al 1995) and in the other developing countries reported by Kramer (2003).

Consanguinity was found to be independently associated with maternal illiteracy (Table 4.8, Figure 4.1), whereas majority of them were teenage mothers (Table 4.9, Figure 4.4), consistent with a community-based study in Pakistan (Grant et al 1997). These findings lead to the conclusion that high ratio of SGA babies in consanguineous couples may be due to genetic problems, maternal social status (illiteracy) and maternal age (teenage mothers) (Figure 4.1 and 4.4).

The present study is limited by the information regarding double first cousins that might be helpful to understand the effect of double first cousins on pregnancy outcome. In a study of consanguinity in Punjab-Pakistan (1979-85), Bittles et al (1993) reported that infant mortality was significantly higher in the first and second cousin marriages (i.e. 7.8% and 6.9%) compared to no-consanguineous couples 5.1%. Whilst, neonatal mortality was 12.5% in the double first cousin marriage that was significantly higher from consanguineous and non-consanguineous births (Bittles et al 1993 cited in Bittles 1994). It is suspected that the incidence of SGA in the double-first-cousins might be higher, and should not be ignored whilst investigating pregnancy outcomes.

Summary

The literature survey has associated consanguinity with a high ratio of neonatal mortality in Pakistan, however, the present study significantly associated consanguinity with SGA independent of other important factors studied. Furthermore, there was a significant positive association between consanguinity and non-educated mothers and consanguinity and maternal age. Therefore, in addition to genetic problems, the majority of consanguineously married mothers have two disadvantages, i.e. young maternal age and they are less likely to be educated. The present study is based on consanguineous (combination of 1st and 2nd cousin) marriages against non-consanguineous, whilst information regarding double first cousins marriage in this area may add more to the present knowledge on cousin marriages.

Recommendations for clinical practice

In this scenario, where people have a value for consanguinity compared to non-consanguineous marriages, (1) awareness regarding the effects of consanguinity on neonatal health in general, and especially up-dating the heads of the families in the Tribal areas, and (2) universal female education, could reduce the number of consanguineous marriages, and hence the poor health of the newborn.

Legal issues

In addition to health awareness, moving towards legislation regarding consanguinity could be one of the milestones in improving the health of the new generation.

Recommendations for future studies

The present study associated consanguineous compared to non-consanguineous births with SGA, however, but did not collect data regarding double first cousins. Further community-based studies are recommended to investigate and compare double first cousin marriages with consanguineous (1^{st} and 2^{nd} cousin) and non-consanguineous births on LBW/SGA. Moreover, investigating the main reasons for high ratio of consanguinity in this region and addressing these specific factors could be helpful for any intervention to reduce the morbidity and mortality due to consanguinity/genetic problems.

5.4.5 Maternal age

Maternal age is a well-known factor that influences the newborn weight independent of other risk factors (Najmi 2000, Yaqoob et al 1998, Karim et al 1994, Makhija et al 1990, Malik et al 1997, Hirvi et al 1994, Mondal 1997). However, in this study teenage mothers were independently associated with SGA compared to middle and older age mothers. The predicted probability of SGA was estimated to be 0.32, 0.08 and 0.08 for teenage, middle age and older age mothers, respectively (Table 4.5). Furthermore, we found that teenage mothers were independently associated with low maternal weight and had low family income (OR=2.3, 1.8, $p<0.01$) compared to middle age mothers (Table 4.8, Figure 4.1).

In a community based study in Pakistan, Zahid found that neonatal and infant mortality rates were highest among teenage mothers and declined as the maternal age increased (Zahid 1996). This study in Peshawar, found that the probability of SGA is significantly higher in teenage mothers compared to middle and older mothers. These findings highlight a relationship of teenage mothers and neonatal mortality through newborn weight, which was also reported in another study in Bangladesh (George et al 2004).

The present study in Peshawar found a pathway regarding teenage mothers that starts from, (i) maternal education, where non-educated girls are more likely to be consanguineously married compared to educated girls (Figure 4.1 and 4.4), (ii) consanguinity was more common in teenage mothers compared to non-teenage mothers (Figure 4.4), and (iii) teenage mothers were independently associated with low family income, and had low pregnancy weight compared to middle and older age mothers (Figure 4.1 and 4.4). The effect of teenage mothers through low maternal weight and low social status in Peshawar, is consistent respectively with Malik et al (1997) and Deshmukh et al's study (1998) in India.

Instead of teenage mothers, studies in Karachi and Brazil associated maternal height and weight (Ferraz et al 1990, Fikree and Berendes 1994)], height and BMI in Canada (Kramer et al 1999), and maternal weight and social status in Brazil and India (Ferraz et al 1990, Mavalankar et al 1992, Sachdev 2001). Therefore, we conclude that a teenage mother in our study is confounding the effect of maternal physical health parameters, and low social status. However, further studies on teenage mothers could be helpful in explaining the role of teenage mothers and its association with adverse pregnancy outcomes.

Summary

Teenage mothers were independently at higher risk of SGA, however, low pregnancy weight and low social status were significantly associated with teenage mothers. The univariate and multivariate analyses established a pathway that majority of the non-educated girls are consanguineously married at early age (teenage) which affects birthweight through, (i) maternal physical health parameters and (ii) inadequate access to healthcare resources during pregnancy because of their low social status.

Recommendations for clinical practice

To minimize the high ratio of LBW/SGA in teenage mothers, the present study recommends health awareness programs regarding adverse pregnancies in teenage mothers through the media for all, village-based for the deprived areas, and health awareness program for the head of the families and tribes in Tribal areas. Also awareness regarding low maternal weight could further reduce adverse pregnancy outcomes in teenage mothers.

Legal issues

Legislation regarding legal restrictions on teenage marriages could be helpful as a long term policy in reducing the teenage marriages, and hence the high ratio of LBW/adverse pregnancy outcomes.

Recommendations for future studies

The adverse effect of young age at pregnancy is well known, and the present study based on public hospitals found two main factors associated with this, i.e. low maternal weight and low family income. However, the present study based on public-hospital data set is not a representative study of all teenage mothers in Peshawar, due to the fact that the majority of the wealthy/high social status mothers are expected to be delivered in private hospitals/clinics and un-educated/low social status mothers from deprived areas, at home. Therefore, investigating the adverse pregnancy outcomes in teenage mothers for low income, middle income and wealthy mothers in public and private hospitals/clinics, and home deliveries in different areas (Tribal and Settled areas) could be helpful in understanding the increased risk of adverse pregnancy outcomes in teenage mothers. Also, investigating the main factors associated with adverse pregnancy outcomes in different groups of mothers could be helpful in understanding the problem. To understand the causes of early marriage, studies should also investigate, why early marriage of young girls are preferred.

5.5 Summary

This chapter discussed the important factors for LBW/SGA, limitations and the strengths of the study carried out at Peshawar. This produced a list of recommends for clinical practice, and future research. This study was limited to four main public-hospitals in Peshawar, and the sample investigated was consistent with other population and community based studies. In this study, the gestational age (<37 weeks) showed the largest independent effect in explaining LBW compared to other important factors. Low family income, hypertension and a history of previous abortion/miscarriage were independently associated with short gestational age. This study also suggests that encouraging pregnancy registration and addressing problems related to maternal health and pregnancy history (maternal anaemia, abortion/miscarriage, pregnancy weight) as a short term policy; and taking into account the cultural factors (teenage marriage, consanguinity, maternal education), as long term policy might reduce SGA babies. Legislation regarding consanguinity, teenage marriage and abortion is also recommended to reduce such practices and hence adverse pregnancy outcomes. In addition, further studies need to investigate influential factors in more detail and recommend measures to reduce the poor neonatal health in this part of Pakistan.

CHAPTER 6

CONCLUSION

6.1 Introduction

The core of this research was to collect baseline statistics and investigate the main influential factors associated with low birthweight (LBW) in the four public-hospitals at Peshawar. Studies have shown that the incidence of LBW varies from place to place due to variation in maternal geo-demographics, maternal health and pregnancy history. The incidence of LBW is high in South-Asia, especially in Bangladesh, India and Pakistan, but it varies from place to place within each country due to the diversity of influential factors associated with newborn health. The literature survey found that the incidence of LBW and its associated factors are unknown in the region of Peshawar, the capital of NWFP-Pakistan. This thesis, therefore investigated LBW, identified the influential factors associated with LBW, and SGA babies and presented practical recommendations to minimise it in Peshawar and the surrounding areas. The main contributions of this thesis are outlined in section 6.2 below.

6.2 Main contributions

The main contributions of this thesis include a set of baseline statistics that had not been collected before from the public hospitals, an explanatory model for birthweight, and potential practical implications in the light of findings from the present data set. The details of these contributions are as follows:

6.2.1 Baseline statistics

The first outcome of the thesis was a set of baseline statistics for maternal geo-demographics, maternal health and pregnancy history from a substantial sample of mothers from this part of Pakistan. These statistics show a high prevalence of illiteracy, low income families, or consanguinity among the mothers who delivered in the four public-hospitals at Peshawar. There were also a significant proportion of mothers from Tribal areas, deprived areas where fresh water sources are not readily available, and Afghan refugees who also used these four main public-hospitals (for details see Table 4.1).

The majority of mothers also do not register their pregnancy at the hospital prior to giving birth. This may be reflected in the findings that 2 in 5 mothers were anaemic and 1 in 5 was hypertensive. In this area, one-third of the total mothers had short inter-pregnancy interval and nearly every 4^{th} mother had a history of previous abortion/miscarriage (for details see Table 4.2).

6.2.2 Explanatory model

The second outcome of the thesis was an explanatory model for LBW, using all the above factors considered in the univariate study. This model uses gestational age as a covariate, therefore any additional variables selected by the model are interpreted as explanatory variables for SGA.

This model showed that five factors significantly increase the incidence of SGA, namely:-

- Afghan refugee status compared to Pakistani mothers

- consanguineous compared to non-consanguineous births
- teenage births compared with the age group 20-35 years
- a history of abortion/miscarriages compared to mothers with no history of abortions/miscarriages.

In addition, a history of anaemia in Tribal areas increased the risk of SGA compared to non-anaemic mothers in the Settled areas.

This study also established pathways that link the influential factors selected by explanatory model with other important factors that were not selected by the model. It was found from multiple independent association tests that, registering the pregnancy in the hospital, water sources (deprived areas), maternal education, family income, abortion/miscarriages, hypertension and maternal weight are all linked with LBW/SGA through the influential factors stated above (for details see Figure 4.1).

6.2.3 Practical implications

This research provided valuable and practical suggestions with regards to health issues associated with birthweight in the previous chapter. These suggestions are aimed at improving the clinical practice and highlighting legal issues which impact adversely on health practices and therefore need to be addressed. The most notable emerging issues presented in chapter 5, within this area are:

1. There is a need for enhancing awareness in the public, about maternal health in general and particularly targeting gestational age, abortion/miscarriage, anaemia, consanguinity, teenage marriages, maternal weight, hypertension and access to health resources.

2. In addition to health awareness, traditional approaches to marriage regarding consanguineous and teenage marriage; and induced abortion need to be understood at a deeper level and should be addressed through legislation, in order to minimize adverse practices.

6.3 Limitations and strength of the study

The present study recruits mothers prospectively from the four main public hospitals at Peshawar, due to the fact that there is no established system and database that could record all births in public and private hospitals, and in home. The public hospitals cover nearly one-tenth of all deliveries, whilst the remaining mothers are delivered in private hospital/clinics or in the homes.

In the present study due to the taboos and sensitivity, the factor abortion/miscarriage was used for induced and spontaneous abortion; however, it was not possible to separate the two due to cultural and legal barriers (for details see section 5.4.1). The researcher was also unable to collect data on nutrition that might be one of the factors associated with maternal anaemia as reported by others in developing countries (Kramer 2003). Similarly, the present study also overlooked, whether the refugees recruited were in the camps or in the private accommodation to establish associations of their child's newborn health with camps or private accommodation.

The strength of the present study was that, the proportion of consanguinity, low family income, maternal and paternal education, non-fresh water areas, diabetes, hypertension, and anaemia found in the present study were not significantly different from population or population-based studies.

6.4 Future directions

Chapter 5, has already highlighted future directions stemming from thesis in each section. This subsection reiterates the need for further research that come out from the present study. Firstly, it is clear from the findings and recommendations that this research is by no mean complete. In fact this is a starting point and there is a need to investigate low birthweight (preterm, full term and SGA) based on all births (delivered at public, private and home) combined in a database and researched for influential factors considering maternal characteristics (i.e. geo-demographics, maternal health and pregnancy history) including cultural factors. Secondly, separate detailed investigation of (i) induced and spontaneous abortions, (ii) anaemia and its association with induced and spontaneous abortions in different geographic locations (e.g. Tribal areas, deprived areas etc), (iii) Afghan refugees in the camps or in private accommodations in different areas (Tribal and settled areas) and hospitals (public, private and home), (v) consanguinity at different levels, and (vi) different maternal age groups in low, middle and high income families in Tribal and settled areas considering their physical health, need to be investigated to identify the influential factors associated with birthweight.

REFERENCES

Acevedo-Garcia D, Soobader MJ, Berkman LF. (2005). The Differential Effect of Foreign-Born Status on Low Birth Weight by Race/Ethnicity and Education. *Pediatrics.* January;115(1):e20-e30.

Agha S. (2000). The determinants of infant mortality in Pakistan. *Social Science and Medicine.* 51:199-208.

Akbar N, Shami N, Asif S. (2002). Maternal mortality in a tertiary care teaching hospital. *J. Coll Physician Surg Pak.* Jul;12(7):429-31.

Akhtar J, Qureshi R, Rahim F, Moosvi S, Rehman A, Jabbar A, Islam N, Khan MA. (1996). Diabetes in pregnancy in Pakistani women: prevalence and complications in an indigenous South Asian community. *Diabetic Medicine.* 13:189-191.

Al-Eissa Ya, Ba'aqeel Hs, Haque Kn. (1991). Low birthweight in Riyadh, Saudi Arabia: incidence and risk factors. *Ann Trop Paediatr.* 11(1):75-82.

Al-Eissa Ya, Ba'aqeel Hs. (1994). Risk factors for spontaneous preterm birth in a Saudi population. *Eur J Obstet Gynecol Reprod Biol.* Oct;57(1):19-24.

Alexander GR, Korenbrot CC. (1995). The role of prenatal care in preventing low birth weight. *Future Child.* Spring;5(1):103-20.

Ali M, Bhatti MA, Ushijima H. (2004). Reproductive Health Needs of Adolescent Males in Rural Pakistan: An Exploratory Study. *The Tohoku Journal of Experimental Medicine.* 204(1):17-25.

Ali M, Lulseged S. (1997). Factors influencing adolescent birth outcome. *Ethiop Med J.* 35(1):35-42.

Al-Jasmi F, Al-Mansoor F, Alsheiba A, Carter AO, Carter TP, Hossain MM. (2002). Effect of interpregnancy interval on risk of spontaneous preterm birth in Emirati women, United Arab Emirates. *Bull World Health Organ.* 80(11):871-5

Allen LH. (2000). Anemia and iron deficiency: effects on pregnancy outcome. *Am J Clin Nutr.* May;71(5):1280S-4S.

Amin N, Abel R, Sampathkumar V. (1993). Maternal risk factors associated with low birth weight. Indian J Pediatr. Mar-Apr;60(2):269-74.

Allison PD. (1999). Multiple Regression: A Primer. Pine Forge Press, London.

Al-Sekait MA. (1989). Maternal influences on birth weight. *J R Soc Health.* Apr;109(2):69-70.

Abel R, Sampathkumar V. (1993) .Maternal risk factors associated with low birth weight. *Indian J Pediatr.* Mar-Apr;60(2):269-74.

Andersson L, Sundstrom-Poromaa I, Wulff M, Astrom M, Bixo M. (2004). Implications of antenatal depression and anxiety for obstetric outcome. *Obstet Gynecol.* Sep;104(3):467-76.

Anderson JE, Nelson DE, Wilson RW. (1998). Telephone coverage and measurement of health risk indicators: data from the National Health Interview Survey. *Am J Public Health.* Sep;88(9):1392-5.

Andrews NC. (1999). Medical progress: disorder of iron metabolism. *N Eng J Med.* 341: 1986-95

Anwar S. (1996). Risk factors of low birth weight infants (Dissertation). *Bangladesh College of Physicians and Surgeons,* Dhaka.

Antonisamy B, Rao PS, Sivaram M. (1994). Changing scenario of birthweight in south India. *Indian Pediatr.* Aug;31(8):931-7.

Arif MA, Qureshi AH, Jafarey SN, Alam SE, Arif K. (1998). Maternal sociocultural status: a novel assessment of risk for the birth of small for gestational age, low birth weight infants. *J Obstet Gynaecol Res.* Jun;24(3):215-22.

Ashraf M, Naheed HS, Ayesha HS. (2003). Feto maternal outcome in Eclampsia. *Biomedica.* 19:68-73.

Ashraf T. (2004). Eclampsia; maternal and perinatal mortality at BMC Complex Quetta. *Professional Med J.* 11(2):171-5.

Ashraf R, Gul A, Noor R, Chohan NT. (2004). A Septic induced abortion maternal mortality and morbidity. *Ann King Edward Med Coll.* Dec;10(4):346-7.

Ashworth A, Feachem RG. (1985). Interventions for the control of diarrhoeal diseases among young children: prevention of low birth weight. *Bull W.H.O.* 63: 165-84.

Ashworth A. (1998). Effect of intrauterine growth retardation on mortality and morbidity in infant and young children. *European Journal of Clinical Nutrition.* 52(1): S34-S42.

Asian Development Bank. (2004). ADB Preparing Project to Develop Federally Administered Tribal Areas in Pakistan', Asian Development Bank press release, 18 February. (http://www.publications.parliament.uk /pa/cm200304/cmselect/cmfaff/441/44109.htm).

Awan MM, Akbar MA, Khan MI. (2004). A study of anaemia in pregnant women of Railway Colony, Multan Pakistan. *J Med Res.* Mar; 43(1):11-4.

Aziz S, Billoo AG, Samad NJ. (2001). Impact of socioeconomic conditions on prenatal mortality in Karachi. *J Pak Med Assoc.* Oct;51(10):354-60.

Bacci A, Manhica GM, Machungo F, Bugalho A, Cuttini M. (1993). Outcome of teenage pregnancy in Maputo, Mozambique. *Int J Gynaecol Obstet.* Jan;40(1):19-23.

Bakketeig LS, Hoffman HJ, Harley EE. (1979). The tendency to repeat gestational age and birth weight in successive births. *Am J Obstet Gynecol.* 135(8):1086-103.

Balarajan R, Soni RV, Botting B. (1989). Sudden infant death syndrome and postneonatal mortality in immigrants in England and Wales. *BMJ.* Mar 18;298(6675):716-20.

Bang A, Reddy MH, Deshmukh MD. (2002). Child mortality in Maharashtra. *Economical Political Weekly.* 37: 4947-65.

Baqui AH, Arifeen SE, Amin S, Black RE. (1994). Levels and correlates of maternal nutritional status in urban Bangladesh. *Eur J Clin Nutr.* May;48(5):349-57.

Barros FC, Victora CG and Horta BL. (2001). Ethnicity and infant health in Southern Brazil. A birth cohort study. *Int J Epidemiol.* 30:1001-1008.

Bartlett LA, Jamieson DJ, Kahn T, Sultana M, Wilson HG, Duerr A. (2002). Maternal mortality among afghan refugees in Pakistan, 1999-2000. *The Lancet.* Vol. 359. www.thelancet.com (accessed July 15, 2004).

Begum F, Buckshe K, Pande JN. (2003). Risk factors associated with preterm labour. *Bangladesh Med Res Counc Bull.* Aug;29(2):59-66.

Begum N, Hussain T, Afridi B, Hamid A. (1991). Effect of supplementary feeding of pregnant women on birth weight of the new born. *Plant Foods Hum Nutr.* Oct;41(4):329-36.

Begum S, Aziz-un-Nisa, Begum I. (2003). Analysis of Maternal Mortality in A Tertiary Care Hospital to determine causes and Preventable factors. *J Ayub Med Coll Abbottabad.* 15(2):49-52.

Begum S, Huda SN, Musarrat N, Ahmed S, Banu LA, Ali SM. (2002). Nutritional status and birth outcomes of the diabetic and non-diabetic pregnant women. *Bangladesh Med Res Counc Bull.* Dec;28(3):97-103.

Berkowitz GS, Skovron ML, Lapinski RH, Berkowiz RL. (1990). Delayed childbearing and the outcome of pregnancy. *N Eng J Med.* 322: 659-64.

Bergsjo P. (1999). Qualitative and quantitative research. Is there a gap, or only verbal disagreement? *Acta Obstet Gynecol Scand.* Aug;78(7):559-62.

Bhalerao VR, Galvankar M, Kowli SS, Kumar R, Chautervedi RM. (1984). Contribution of the education of the prospective fathers to the success of maternal health care programme. *J Postgrad Med.* 30(1):10-2.

Bhargava SK, Ghosh S, Lall UB. (1979). A study of low birth weight infants in an urban community. *Health Popul Perspect Issues.* Jan-Mar;2(1):54-66.

Bhargava SK, Singh KK, Saxena BN. (1991). ICMR Task Force National Collaborative Study on Identification of High Risk Families, Mothers and Outcome of their Off-springs with particular reference to the problem of maternal nutrition, low birth weight, perinatal and infant morbidity and mortality in rural and urban slum communities. Summary, conclusions and recommendations. *Indian Pediatr.* Dec;28(12):1473-80.

Bhuiya A, Mostafa G. (1993). Levels and differentials in weight, height and body mass index among mothers in a rural area of Bangladesh. *J Biosoc Sci.* Jan;25(1):31-8.

Bhutta ZA. (2000). Why has so little changed in maternal and child health in South Asia? *BMJ.* September;321(30):809-812.

Bhutta ZA, Khan I, Salat S, Raza F, Ara H. (2004). Reducing length of stay in hospital for very low birthweight infants by involving mothers in a stepdown unit: an experience from Karachi (Pakistan). *BMJ.* Nov;13;329(7475):1151-5.

Bhutta ZA, Yusuf K. (1997). Neonatal respiratory distress syndrome in Karachi: some epidemiological considerations. *Paediatr Perinat Epidemiol.* Jan;11(1):37-43.

Bittles AH, Grant JC, Shami SA. (1993). Consanguinity as a determinant of reproductive behaviour and mortality in Pakistan. *Int J Epidemiol.* 22(3):463-7.

Bittles, AH. (1994). The role and significance of consanguinity as a demographic variable. *Population and Development Review.* 20:561-584.

Bittles AH. (2005). Endogamy, consanguinity and community disease profiles. *Community Genet.* 8(1):17-20.

Blondel B, Breart G. (1995). Home visits during pregnancy: consequences on pregnancy outcome, use of health services, and women's situations. *Semin Perinatol.* 19:263-71

Bloom SS, Lippeveld T, Wypij D. (1999). Does antenatal care make a difference to safe delivery? A study in urban Uttar Pradesh, India. *Health Policy Plan.* Mar;14(1):38-48.

Bloom SS, Tsui AO, Plotkin M, Bassett S. (2000). What husbands in northern India know about reproductive health: correlates of knowledge about pregnancy and maternal and sexual health. *J Biosoc Sci.* Apr;32(2):237-51.

Bloom SS, Wypij D, Das Gupta M. (2001). Dimensions of women's autonomy and the influence on maternal health care utilization in a north Indian city. *Demography.* Feb;38(1):67-78.

Boerma JT, Weinstein KI, Rutstein SO, Sommerfelt AE. (1996). Data on birth weight in developing countries: can surveys help? *Bull World Health Organ.* 74(2):209-16.

Borja JB, Adair LS. (2003). Assessing the net effect of young maternal age on birthweight. *Am J Hum Biol.* Nov-Dec;15(6):733-40.

Boss LP, Brink EW, Dondero TJ. (1987). Infant mortality and childhood nutritional status among Afghan refugees in Pakistan. *Int J Epidemiol.* Dec;16(4):556-60.

Bove F, Shim Y, and Zeitz P. (2002). Drinking water contaminants and adverse pregnancy outcomes: a review. *Environ Health Perspect.* February;110(1):61-74.

Breart G, Blondel B, Maillard F. (1987). Pregnancy after 34 years: risks and evolution of risks. *Contracept Fertil Sex (Paris).* Sep;15(9):829-32.

Bundey S, Alam H, Kaur A, Mir S, Lancashire R. (1991). Why do UK-born Pakistani babies have high perinatal and neonatal mortality rates? *Paediatric and Perinatal Epidemiology*. 5: 101-104

Bushra R, Tayyaba A. (2004). Maternal and Perinatal outcome in term singleton breech presentation. *J Post. Med Inst.* Sep;18(3):373-9.

Cardwell CR, Carson DJ, Patterson CC. (2005). Parental age at delivery, birth order, birth weight and gestational age are associated with the risk of childhood Type 1 diabetes: a UK regional retrospective cohort study. *Diabet Med.* Feb;22(2):200-206.

Carroli G, Villar J, Piaggio G, Khan-Neelofur D, Gulmezoglu M, Mugford M et al. (2001).WHO systematic review of randomised controlled trials of routine antenatal care. *Lancet.* 357:1565-70

Casebeer AL, Verhoef MJ. (1997). Combining qualitative and quantitative research methods: considering the possibilities for enhancing the study of chronic diseases. *Chronic Dis Can.* 1997;18(3):130-5.

CDC and UNICEF. (2002). Working to Improve Maternal Health. http://cpmcnet.columbia.edu/dept/sph/popfam/rp/index_temp2.html#AWIMH (accessed March 27, 2004).

Celghorn G. (1999). Iron deficiency anemia and cognitive development. *Medical Chennel.* 5: 1-2.

Chan BCP and Lao TT. (1999). Influence of parity on the obstetric performance of mothers aged 40 years and above. *Hum Reprod.* 14:833-837.

Cleary-Goldman J, Malone FD, Vidaver J, Ball RH, Nyberg DA, Comstock CH, Saade GR, Eddleman KA, Klugman S, Dugoff L, Timor-Tritsch IE, Craigo SD, Carr SR, Wolfe. (2005). Impact of maternal age on obstetric outcome. *Obstet Gynecol.* May; 105(5); 983-990.

Cleland JG, Sathar ZA. (1984). The Effect of Birth Spacing on Childhood Mortality in Pakistan. *Population Studies.* Nov; 38(3):401-418.

Cogswell Me, Yip R. (1995). The influence of fetal and maternal factors on the distribution of birthweight. *Semin perinatol.* Jun;19(3):222-40.

Connolly G, Kennelly S, Conroy R and Byrne P. (1998). Teenage pregnancy in the Rotunda Hospital. *Ir Med J.* 91:209-212.

Coste J, Job-Spira N, Fernandez H. (1991). Risk factors for spontaneous abortion: a case-control study in France. *Hum Reprod.* Oct;6(9):1332-7.

Daly F, Hand DJ, Jones MC, Lunn AD, Mcconway KJ. (1995). Elements of Statistics. Addison Wesley, London.

Darr A and Modell B. (1988). The frequency of consanguineous marriage among British Pakistanis. *Journal of Medical Genetics.* 25:186-190.

Das K, Ganguly SS, Saha R, Ghosh BN. (1981). Interrelationship of birth weight with certain biological and socio-economic factors. *Indian J Public Health.* 25:11-9.

Dawodu AH, Laditan AA. (1985). Low birthweight in an urban community in Nigeria. *Ann Trop Paediatr.* 1985 Jun;5(2):61-6.

De B, Lin S, Lohsoonthorn V, Williams MA. (2007). Risk of preterm delivery in relation to maternal low birth weight. *Acta Obstet Gynecol Scand.* 86(5):565-71.

de Costa CM. (2002). Consanguineous marriage and its relevance to obstetric practice. *Obstet Gynecol Surv.* Aug;57(8):530-6.

de Onis M, Blossner M, Villar J. (1998). Levels and patterns of intrauterine growth retardation in developing countries. *Eur J Clin Nutr.* Jan;52 (1):S5-15.

Deshmukh JS, Motghare DD, Zodpey SP, Wadhva SK. (1998). Low birth weight and associated maternal factors in an urban area. *Indian Pediatr.* Jan;35(1):33-6.

Dhar B, Mowlah G, Kabir DM. (2003). Newborn anthropometry and its relationship with maternal factors. *Bangladesh Med Res Counc Bull.* Aug;29(2):48-58.

DHS. (1991-4). Demographic and health survey of Bangladesh. http://www.childinfo.org (accessed March 21, 2006).

Dickute J, Padaiga Z, Grabauskas V, Gaizauskiene A, Basys V, Obelenis V. [Do maternal social factors, health behavior and work conditions during pregnancy increase the risk of low birth weight in Lithuania?]*Medicina (Kaunas).* 2002;38(3):321-32. Lithuanian.

Dobson R. (2001). Caesarean section rate in England and Wales. *BMJ.* 323: 951.1

Dougherty CR, Jones AD. (1982). The determinants of birth weight. *Am J Obstet Gynecol.* Sep 15;144(2):190-200.

Drooger JC, Troe JW, Borsboom GJ, Hofman A, Mackenbach JP, Moll HA, Snijders RJ, Verhulst FC, Witteman JC, Steegers EA, Joung IM. (2005). Ethnic differences in prenatal growth and the association with). maternal and fetal characteristics. *Ultrasound Obstet Gynecol.* Aug;26(2):115-22.

Duignan NM, Studd JW, Hughes AO. (1975). Characteristics of normal labour in different racial groups. *Br J Obstet Gynaecol.* Aug;82(8):593-601.

Dunn G, Everitt B. Clinical Biostatistics.(1995). An Introduction to Evidence Based Medicine. Edward Arnold: London.

Dunne F, Brydon P, Smith K and Gee H. (2003). Pregnancy in women with Type 2 diabetes: 12 years outcome data 1990–2002. *Diabetic Medicine.* 20(9):734.

Dunn KA, Huss HF. (2004). Mail survey reliability through follow-up mailings: the case of auditor changes. *Managerial Auditing Journal.* Vol. 19(8); 1048-1054.

Dunne FP, Brydon PA, Proffitt M, Smith T, Gee H, Holder RL. (2000). Fetal and maternal outcomes in Indo-Asian compared to caucasian women with diabetes in pregnancy. *QJM.* Dec;93(12):813-8.

Durrant VL, Sathar ZA. (2000). Greater Investment in Child Through Women's Empowerment: A Key to Demographic Changes in Pakistan. No. 137.

Dyjack D, Soret S, Chen L, Hwang R, Nazari N, Gaede D. (2005). Residential environmental risks for reproductive age women in developing countries. *J Midwifery Womens Health.* Jul-Aug;50(4):309-14.

Ehrenberg HM, Mercer BM, Catalano PM. (2004). The influence of obesity and diabetes on the prevalence of macrosomia. *Am J Obstet Gynecol.* 191(3):964-968.

Emanuel I, Leisenring W, Williams MA, Kimpo C, Estee S, O'Brien W, et al. (1999). The Washington State Intergenerational Study of Birth Outcomes: methodology and some comparisons of maternal birthweight and infant birthweight and gestation in four ethnic groups. *Paediatr Perinat Epidemiol.* 13(3): 352_69.

Eysenbach G, Wyatt J. (2002). Using the Internet for surveys and health research. *J Med Internet Res.* Apr-Nov;4(2):E13.

Eysenbach G, Till JE. (2001). Ethical issues in qualitative research on internet communities. *BMJ.* Nov;323(7321):1103–5.

Eysenbach G, Powell J, Kuss O, Sa ER. (2002). Empirical studies assessing the quality of health information for consumers on the world wide web: a systematic review. *JAMA.* May;287(20):2691–700.

Federal Bureau of statistics, Pakistan : http://www.statpak.gov.pk/depts/pco/statistics/pop_sex_ratio_growth_rate/pop_sex_ratio_growth_rate.html (accessed November 21, 2006).

FAO. (2006). Food and Agriculture Organization of the United Nations. http://www.fao.org (accessed Jan 26, 2006).

Fatmi Z, Gulzar AZ, Kazi A. (2005). Maternal and newborn care: practices and beliefs of traditional birth attendants in Sindh, Pakistan. *East Mediterr Health J.* Jan-Mar;11(1-2):226-34.

Feleke Y, Enquoselassie F. (1999). Maternal age, parity and gestational age on the size of the newborn in Addis Ababa. *East Afr Med J.* Aug;76(8):468-71.

Ferraz EM, Gray RH, Cunha TM. (1990). Determinants of preterm delivery and intrauterine growth retardation in North-East Brazil. *Int J Epidemiol.* 19(1):101-108.

Field A. Discovering Statistics Using SPSS for Windows. Sage Publications, London, 2003.

Fikree FF, and Pasha O. (2004). Role of gender in health disparity: the South Asian context. *BMJ.* April 3;(328):823-826.

Fikree FF, Azam SI, & Berendes HW. (2002). Time to focus child survival programmes on the newborn: assessment of levels and causes of infant mortality in rural Pakistan. *Bull World Health Organ.* 80(4):271-6.

Fikree FF, Berendes HW, Midhet F, D'Souza RM, & Hussain R. (1994). Risk factors for intrauterine growth retardation: results of a community-based study from Karachi. *J Pak Med Assoc.* Feb;44(2):30-4.

Fikree FF, Berendes HW. (1994). Risk factors for term intrauterine growth retardation: a community-based study in Karachi. *Bulletin of the World Health Organization.* 72(4):581-587.

Finch BK. (2003). Early origins of the gradient: The relationship between socioeconomic status and infant mortality in the United States. *Demography.* Nov;40(4):675-699.

Fischbacher C, Bhopal R, Patel S, White M, Unwin N, Alberti KG. (2001). Anaemia in Chinese, South Asia, and European populations in New Castle upon Tyne: cross sectional study. *BMJ.* 322:958-959.

Fraser AM, Brockert JE, Ward RH. (1995). Association of young maternal age with adverse reproductive outcomes. *N Engl J Med.* 332:1113-1117

Fraser D, Weitzman S, Leiberman JR, Eschwege E. (1990). Factors Influencing Birth-Weight in Newborns of Diabetic and Non-diabetic Women: A Population Based Study. *European Journal of Epidemiology.* Dec;6 (4):427-431.

Freedman L, Wirth M, Waldman R, Chowdhry M, Rosenfield A. (2003). Millennium Project: Background Paper of the task force on child and maternal health. http://www.unmillenniumproject.org/documents/tf04apr18.pdf (accessed December 23, 2005).

Fuentes-Afflick E, Hessol NA, Perez-Stable EJ. (1998). Maternal birthplace, ethnicity, and low birth weight in California. *Archives of Pediatrics & Adolescent Medicine.* Nov;152(11):1105-1112.

Gao E, Gu J, Dang H, Yan Y. (1995). A comparative case study on the factors affecting infant mortality in Shanghai. *Chin J Popul Sci.* 7(1):67-78.

Guendelman S, Buekens P, Blondel B, Kaminski M, Notzon FC, Masuy-Stroobant G. (1999). Birth outcomes of immigrant women in the United States, France, and Belgium. *Matern Child Health J.* Dec;3(4):177-87.

George JF. (2004). ICDDR, B: Centre for Health and Population Research Dhaka, Bangladesh Global Form for Health Research. http://www.globalforumhealth.org/Non_compliant_pages/forum3/Forum3doc326.htm (accessed April 03, 2005).

Ghafoor F, Mansoor M, Malik T, Malik MS, Khan AU, Edwards R, Akhtar W. (2006). Role of thyroid peroxidase antibodies in the outcome of pregnancy. *J Coll Physicians Surg Pak.* Jul;16(7):468-71.

Global Health Council (2001). https://www.globalhealth.org/news/article/1219 (accessed January 22, 2004).

Gogate S. (2001). Intra-Uterine Growth Restriction-Obstetrician's Perspective. *Int J Diab Dev Ctries.* 21:51-56.

Gopalani S, Bennett K, Critchlow C. (2004). Factors predictive of failed operative vaginal delivery. *Am J Obstet Gynecol.* 191(3):896-902

Graham W, Fitzmaurice A, Bell J, Cairns J. (2004). The familial technique for linking maternal death with poverty. *The Lancet.* 363(9402):23-27.

Grant JC, Bittles AH. (1997). The comparative role of consanguinity in infant and child mortality in Pakistan. *Ann Hum Genet.* 61:143-149.

Hackman E, Emanuel I, van Belle G, Daling J. (1983). Maternal birth weight and subsequent pregnancy outcome. *JAMA.* 250(15):2016-9.

Hafeez A., Riaz R, Shah SU, Pervaiz J, & Southall D. (2004). Integrating health care for mothers and children in refugee camps and at district level. *BMJ.* Apr;328(7443):834-6.

Hakala TH, Ylikorkala O. (1989). Effective prenatal care decreases the incidence of low birthweight. *Am J Perinatol.* Apr;6(2):222-5.

Hakeem R. (2001). Socio-economic differences in height and body mass index of children and adults living in urban areas of Karachi, Pakistan. *Eur J Clin Nutr.* May;55(5):400-6.

Halbreich, U. (2005). The association between pregnancy processes, preterm delivery, low birth weight, and postpartum depressions--the need for interdisciplinary integration. *Am J Obstet Gynecol.* Oct;193(4):1312-22.

Hallberg L. (2001). Perspectives on Nutritional Iron Deficiency. *Annu. Rev.* Nutr. 21:1-21

Hanson U, Persson B. (1998). Epidemiology of pregnancy-induced hypertension and preeclampsia in type 1 (insulin-dependent) diabetic pregnancies in Sweden. *Acta Obstet Gynecol Scand.* 77:620–624.

Harrison KA, John CT. (1996). Maternal health in developing countries [letter]. *LANCET.* 10;347(8998):400

Hassan I, Haleem AA, Bhutta ZA. (1997). Profile and risk factors for congenital heart disease. *J Pak Med Assoc.* Mar;47(3):78-81.

Health and Welfare: Pakistan http://countrystudies.us/pakistan/43.htm (accessed July 07, 2007).

Health. (2004). healthfinder®—your guide to reliable health information http://www.healthfinder.gov/news/newsstory.asp?docID=517425 (accessed March 28, 2005).

Hegyi T, Carbone T, Anwar M, Ostfeld B, Hiatt M, Koons A, Pinto-Martin J, Paneth N. (1998). The apgar score and its components in the preterm infant. *Pediatrics.* Jan;101(1 Pt 1):77-81.

Hezekiah J (1993). The pioneers of rural Pakistan: the Lady Health Visitors. *Health Care Women Int.* Nov-Dec;14(6):493-502.

Hirve SS, Ganatra BR. (1994). Determinants of low birth weight: a community based prospective cohort study. *Indian Pediatr.* Oct;31(10):1221-5.

Hobcraft J. (1993). Women's education, child welfare and child survival: a review of the evidence. *Health Transit Rev.* 3:159-175.

Holmes J. (2006). Do community factors have a differential impact on the health outcomes of boys and girls? Evidence from rural Pakistan. *Health Policy Plan.* May;21(3):231-40.

Honeyman MM, Bahl L, Marshall T, & Wharton BA. (1987). Consanguinity and fetal growth in Pakistani Moslems. *Arch Dis Child.* Mar;62(3):231-5.

Hosain GM, Chatterjee N, Begum A and Saha SC. (2006). Factors associated with low birthweight in rural Bangladesh. *J Tropical Pediatrics.* 52(2):87-91.

Hultman CM, Sparen P and Cnattingius S. (2002). Perinatal risk factors for infantile autism. *Epidemiology.* 13:417-23.

Hussain M, Ashraf M, Noorani K. (2004). Alleged reasons and complications of induced Abortion. *J Surg Pakistan.* Sep;9(3):18-21.

Hussain R, Bittles AH. (1998). The prevalence and demographic characteristics of consanguineous marriages in Pakistan. *J Biosoc Sci.* Apr;30(2):261-75.

Hussain R, Bittles AH. (1999). Consanguineous marriages and differentials in age at marriage, contraceptive use and fertility in Pakistan. *Journal of Biosocial Science.* 31:121-138.

Hussain R, Bittles AH. (2004). Assessment of association between consanguinity and fertility in Asian populations. *J Health Popul Nutr.* Mar;22(1):1-12.

Hussain R. (1998). The impact of consanguinity and inbreeding on perinatal mortality in Karachi, Pakistan. *Paediatr Perinat Epidemiol.* 12(4);370-82.

Hussain R. (1999). Community perceptions of reasons for preference for consanguineous marriages in Pakistan. *J Biosoc Sci.* Oct;31(4):449-61.

Hussain R. (1998). The role of consanguinity and inbreeding as a determinant of spontaneous abortion in Karachi, Pakistan. *Ann Hum Genet.* Mar;62(Pt 2):147-57.

Hussain T, Tontisirin K. (1988). Effect of a formulation of supplementary food for pregnant women on birth weight of newborns. *J Nutr Sci Vitaminol (Tokyo).* Feb;34(1):151-7.

Hynes M, Sheik M, Wilson HG, & Spiegel P. (2002). Reproductive health indicators and outcomes among refugee and internally displaced persons in postemergency phase camps. *JAMA.* Aug;288(5):595-603.

IPPF News. (1978). The demographic cost of early marriages. *IPPF News.* Jan;3(1):2.

Islam A. (1992). A majority remain untreated. Bangladesh. *Integration.* Aug;(33):46-9.

Islam A. (2002). Health sector reforms in Pakistan: Why is it needed? *J Pak Med Assoc.* Mar;52(3):95-100.

Jacobsen G, Schei B, Hoffman HJ. (1997). Psychosocial factors and small-for-gestational-age infants among parous Scandinavian women. *Acta Obstet Gynecol Scand Suppl.* 165:14-8.

Jacobsson B, Hagberg G, Hagberg B, Ladfors L, Niklasson A and Hagberg H. (2002). Cerebral palsy in preterm infants: a population-based case-control study of antenatal and intrapartal risk factors. *Acta Paediatr.* 91:946-951.

Jafar TH, Levey AS, White FM, Gul A, Jessani S, Khan AQ, Jafary FH, Schmid CH, Chaturvedi N. (2004). Ethnic differences and determinants of diabetes and central obesity among South Asians of Pakistan. *Diabetic Medicine.* 21(7):716-723.

Jafar T, Levey A, Jafary F, Franklin W, Gul A, Rahbar M, Khan AQ, Andrew, Christopher H, Chaturvedi N. (2003). Ethnic subgroup differences in hypertension in Pakistan. *Journal of Hypertension.* May;21(5):905-912.

Javed MT, Abbas N, Hussain R, Zahoor T. (2001). A study on iron deficiency anemia and hematological differences around delivery in women of different socio-economic and age groups. *Medical Journal of Islamic Academy of Sciences.* 14(4):151-160.

Jones AD. (1882). The determinants of birth weight. *Am J Obstet Gynecol.* Sep 15;144(2):190-200.

Kabakian-Khasholine T and Campbell OMR. (2005). A simple way to increase service use: triggers of women's uptake of postpartum services. *BJOG.* 112(9): 1315-1321.

Kamal I. (1992). Traditional birth attendant training: sharing experiences. *Int J Gynaecol Obstet.* Jun;38 (l):S55-8.

Karim E, Mascie-Taylor CGN. (1997). The association between birthweight, socio-demographic variables and maternal anthropometry in an urban sample from Dhaka, Bangladesh. *Annals of Human Biology.* 24(5):387-40.

Karim SA, Bakhtawar I, Butta AT, Jalil M. (1998). Effects of first and second trimester vaginal bleeding on pregnancy outcome. *J Pak Med Assoc.* Feb;48(2):40-2.

Karim SA, Mastoor M, Ahmed AJ, Pasha O, Qureshi F, Akhtar S, Robinson SC. (1994). Macrosomia: maternal and fetal outcome. *Asia Oceania J Obstet Gynaecol.* 20(1):73-6.

Kaushik SL, Parmar VR, Grover N, Kaushik R. (1998). Neonatal mortality rate: relationship to birth weight and gestational age. *Indian J Pediatr.* May-Jun;65(3):429-33.

Khalida H, Shah GN, Farooq F. (1997). Some obstetric and foetal correlates in association with anemia in pregnancy. *Indian J Matern Child Health.* Apr-Jun;8(2):48-50.

Khan A. (2003). Adolescent and Youth Reproductive Health in Pakistan. A literature review. Population Council, United Nations. http://www.popcouncil.org/pdfs/rr/rr_11.pdf (accessed February 19, 2005).

Khan KS, Hashmi FA, Rizvi JH. (1995). Are non-diabetic women with abnormal glucose screening test at increased risk of pre-eclampsia, macrosomia and caesarian birth? *J Pak Med Assoc.* Jul;45(7):176-9.

Khan MM. (2001). Effect of maternal anaemia on Fetal parameters. *J Ayub Med College Abbottabad.* 13(2): 38-41.

Khan N, Jamal M. (2003). Maternal risk factors associated with low birth weight. *J Coll Physicians Surg Pak.* Jan;13(1):25-8.

Khan Z, Soomro GY, Soomro S. (1994). Mother's education and utilisation of health care services in Pakistan. *Pak Dev Rev.* Winter;33(4 Pt 2):1155-63.

Khan, S. (2005). Abortions: a Major Contributor to Maternal ill Health. *J Pak Med Assoc.* Jul;55(7):269.

Khan DB, Bari V, Chishty IA. (2004). Ultrasound in the diagnosis and management of intrauterine growth retardation. *J Coll Physicians Surg Pak.* Oct;14(10):601-4.

Khaskeli M, Baluch S, Kazi R, Qureshi GA. (2006). Preterm Birth - A Global Health Problem for Fetuses. *World Journal of Medical Sciences.* 1(2):126-129.

Khaskheli M. (2002). Evaluation of early pregnancy loss. Pakistan J. *Med. Research.* 41(2): 70-72.

Khatun A, Latifa S, Shahla K, Anowara B, Suhrab A, Rashid HU, Ullah S. (2003). Assessment of renal insufficiency in gestational proteinuric hypertension in third trimester pregnancy. *Bangladesh Med Res Counc Bull.* Dec;29(3):103-12.

Khawaja NP, Yousaf T, Tayyeb R. (2004). Analysis of caesarean delivery at a tertiary care hospital in Pakistan. *J Obstet Gynaecol.* Feb;24(2):139-41.

Khor GL. (2003). Update on the prevalence of malnutrition among children in Asia. *Nepal Med Coll J.* Dec;5(2):113-22.

King JC. (2003). The risk of maternal nutritional depletion and poor outcomes increases in early or closely spaced pregnancies. *J Nutr.* May;133(2):1732S-1736S.

King PA, Duthie SJ, Li DF, Ma HK. (1990). Obstetric outcome among Vietnamese refugees in Hong Kong: an age-matched case-controlled study. *International Journal of Gynecology and Obstetrics.* 33(3):203-210.

Kirchengast S and Hartmann B. (2003). Advanced maternal age is not only associated with newborn somatometrics but also with the mode of delivery. *Annals of Human Biology.* 30(1):1-12.

Kleinbaum DG. (1994). Logistic Regression: A Self-Learning Text. Springer-Verlag, Newyork, London.

Korejo R, Jafarey SN. (1991). Perinatal mortality in Jinnah Postgraduate Medical Centre, Karachi. *J Pak Med Assoc.* Jul;41(7):151-4.

Korejo R, Noorani KJ, Bhutta S. (2003). Sociocultural determinants of induced abortion. *J Coll Physicians Surg Pak.* May;13(5):260-2.

Kramer MS, Platt R, Yang H, McNamara, Ushe RH. (1990). Are all growth-restricted newborns created equal(ly)? *Pediatrics.* 103(3);599-602.

Kramer MS. (2003). The epidemiology of adverse pregnancy outcomes: an overview. *J Nutr.* May;133(2):1592S-1596S.

Kramer MS. (1998). Socioeconomic determinants of intrauterine growth retardation. *European Journal of Clinical Nutrition.* 52(S1):S29-S33.

Kramer MS. (1987). Determinants of low birth weight: methodological assessment and meta-analysis. *Bull World Health Organ.* 65(5):663-737.

Kurosaki T. (2002). Consumption Vulnerability and Dynamic Poverty in the North-West Frontier Province, Pakistan. http://www.williams.edu/Economics/neudc/papers/nwfrske2.pdf (accessed December 2006).

Kuvacic I, Skrablin S, Milkovic G. (1996). Possible influence of expatriation on perinatal outcome. *Acta Obstetricia et Gynecologica Scandinavica.* 75(4):367-371.

Lauszus FF, Paludan J, Klebe JG. (1999). Birthweight in women with potential gestational diabetes mellitus - an effect of obesity rather than glucose intolerance? *Acta Obstetricia Et Gynecologica Scandinavica.* 78 (6):520-525.

Lawn JE, Cousens S, Zupan J. (2005). Lancet Neonatal Survival Steering Team. 4 million neonatal deaths: when? Where? Why? *Lancet.* Mar;365(9462):891-900.

Lawoyin TO, and Oyediran ABOO. (1992). A prospective study on some factors, which influence the delivery of low birth weight babies in a developing country. *Afr J Med Sci.* 21:33-39.

Lawoyin TO. (1997). A prospective study on some factors which influence the delivery of large babies. *Srp Arh Celok Lek.* Sep-Oct;125(9-10):267-71.

Lee KS, Richard M, Ferguson, Corpuz M, Lawrence M, Gartner MD. (1988). Maternal age and incidence of low birth weight at term: A population study. *Am J Obstet Gynecol.* 158(1):84-89.

Lee SY, Chow CB, Ma PY, Ho YB, Shek CC. (2004). Gross motor skills of premature, very low-birthweight Chinese children. *Ann Trop Paediatr.* Jun;24(2):179-83.

Leke L, Kremp D. (1989). Impact of nutritional deficiencies on anemia in pregnant women. *Dev Sante.* Dec;(84):4-6.

Lima M, Figueira F, Ebrahim GJ. (1990). Malnutrition among children of adolescent mothers in a squatter community of Recife, Brazil. *J Trop Pediatr.* Feb;36(1):14-9.

Lin HC, Shen TC, Tang CH and Kao S. (2004). Association between maternal age and the likelihood of a caesarean section: a population-based multivariate logistic regression analysis. *Acta Obstetricia Et Gynecologica Scandinavica.* 83(12):1178-1183

Little RE. (1987). Mother's and father's birthweight as predictors of infant birthweight. *Paediatr Perinat Epidemiol.* Apr;1(1):19-31.

Lone FW, Qureshi RN, Emanuel F. (2004). Maternal anaemia and its impact on perinatal outcome. *Trop Med Int Health.* Apr;9(4):486-90.

Lumley J. (1993). The epidemiology of preterm birth. *Baillieres Clin Obstet Gynaecol.* 7: 477-498

Macassa G, Ghilagaber G, Bernhardt E, Diderichsen F, Burstrom B. (2003). Inequalities in child mortality in Mozambique: differentials by parental socio-economic position. *Soc Sci Med.* Dec;57(12):2255-64.

Machado CJ, Hill K. (2003). Early Infant Morbidity in the City of Sao Paulo, Brazil. Popul Health Metr. Oct;28;1(1):7.

Maddah M, Karandish M, Mohammadpour-Ahranjani B, Neyestani TR, Vafa R, Rashidi A. (2005). Social factors and pregnancy weight gain in relation to infant birth weight: a study in public health centers in Rasht, Iran. *Eur J Clin Nutr.* Oct;59(10):1208-12.

Magann EF, Winchester MI, Carter DP, James N, Martin J, Bass JD, Morrison JC. (1995). Factors adversely affecting pregnancy outcome in the military. *Am J Perinatal.* 12:462-466.

Majumder AK, May M, Pant PD. (1997). Infant and child mortality determinants in Bangladesh: are they changing? *J Biosoc Sci.* Oct;29(4):385-99.

Makhija K, Murthy GV. (1990). Sociobiologic factors influencing low birth weight at a rural project hospital. *J Indian Med Assoc.* Aug;88(8):215-7.

Makki AM. (2002). Risk factors for low birth weight in Sana'a city, Yemen. *Annals of Saudi Medicine.* Sep-Nov;22(5-6):333-335.

Malamitsi-Puchner A, Tzala L, Minaretzis D, Michalas S, Aravantinos D. (1994). Preterm delivery and low birth weight among refugees in Greece. *Paediatric and Perinatal Epidemiology.* 8(4):384-390.

Malik S, Ghidiyal RG, Udani R, Waingankar P. (1997). Maternal biosocial factors affecting low birth weight. *Indian J Pediatr.* 64:373-377.

Maqbool S, Saeed M, Khan SR. (1988). Birth asphyxia. *J Pak Med Assoc.* Aug;38(8):217-219.

Marai W, Lakew Z. (2002). Pregnancy outcome in the elderly gravida in Addis Ababa. *East Afr Med J.* Jan;79(1):34-7.

Margetts BM, Mohd Yusof S, Al Dallal Z, Jackson AA. (2002). Persistence of lower birth weight in second generation South Asian babies born in the United Kingdom. *J Epidemiol Community Health.* Sep;56(9):684-7.

Mathews F, Yudkin P, Neil A. (1999). Influence of maternal nutrition on outcome of pregnancy: prospective cohort study. *BMJ.* 319:339-343

Mavalankar DV, Gray RH, Trivedi CR. (1992). Risk factors for preterm and term low birthweight in Ahmedabad, India. *Int J Epidemiol.* Apr;21(2):263-72.

Mavalankar DV, Trivedi CC, Gray RH. (1994). Maternal weight, height and risk of poor pregnancy outcome in Ahmedabad, India. *Indian Pediatr.* Oct;31(10):1205-12.

McDowell I, and MacLean L. (1998). Blending qualitative and quantitative study methods in health services research. *Helth Informatics Journal.* 4:15-22.

McGinn T. (2000). Reproductive health of war-affected populations: What do we know? *International family planning perspectives.* December;26(4).

Mehra S, Agrawal D. (2004). Adolescent health determinants for pregnancy and child health outcomes among the urban poor. *Indian Pediatr.* Feb;41(2):137-45.

Merchant SS, Momin IA, Sewani AA, Zuberi NF. (1999). Effect of prepregnancy body mass index and gestational weight gain on birth weight. *J Pak Med Assoc.* Jan;49(1):23-5.

MI/UNICEF. (2004). Vitamin and mineral deficiency, A global progress report. http://www.micronutrient.org/reports/ (accessed August 21, 2005).

Midhet F, Becker S, Berendes HW. (1998). Contextual determinants of maternal mortality in rural Pakistan. *Soc Sci Med.* Jun;46(12):1587-98

Miller LC, Jami-Imam F, Timouri M, Wijnker J. (1995). Trained traditional birth attendants as educators of refugee mothers. *World Health Forum.* 16(2):151-6.

Mohanty C, Prasad R, Srikanth Reddy A, Ghosh JK, Singh TB, Das BK. (2005). Maternal Anthropometry as Predictors of Low Birth Weight. *J Trop Pediatr.* Feb;52(1):24-9.

Mondal B. (1997). Low birth weight in relation to sex of baby, maternal age and parity: A hospital based study on Tangsa Tribe from Arunachal Pradesh. *J Indian Med Assoc.* December;96(12).

Moore SE, Jalil F, Ashraf R, Szu SC, Prentice AM, Hanson LA. (2004). Birth weight predicts response to vaccination in adults born in an urban slum in Lahore, Pakistan. *Am J Clin Nutr.* Aug;80(2):453-9.

Moore VM, Davies MJ, Willson KJ, Worsley A, Robinson JS. (2004). Dietary Composition of Pregnant Women Is Related to Size of the Baby at Birth. *J. Nutr.* July;134:1820-1826.

Matveev AV. (2002). The advantages of employing quantitative and qualitative methods in intercultural research: practical implications from the study of the perceptions of intercultural communication competence by American and Russian managers. http://www.russcomm.ru/eng/rca_biblio/m/matveev01_eng.shtml (accessed April 25, 2007).

Mufti P, Setna F, Nazir K. (2006). Early neonatal mortality: effects of interventions on survival of low birth babies weighing 1000-2000g. *J Pak Med Assoc.* Apr;56(4):174-6.

Mumtaz Z, Shahab S, Butt N, Rab MA, DeMuynck A. (2000). Daily iron supplementation is more effective than twice weekly iron supplementation in pregnant women in Pakistan in a randomized double-blind clinical trial. *J Nutr.* Nov;130(11):2697-702.

Munger R, Isacson P, Hu S, Burns T, Hanson J, Lynch CF, Cherryholmes K, Dorpe PV, and Hausler WJ. (1997). Intrauterine growth retardation in Iowa communities with herbicide-contaminated drinking water supplies. *Environ Health Perspect.* March;105(3):308–314.

Murray CJ, Lopez AD. (1997). Global mortality, disability, and the contribution of risk factors: Global Burden of Disease Study. *Lancet.* 17;349(9063):1436-42.

Murthy HVV. (1991). Birth weight and the associated factors-a review . *Indian J Soc Work.* LII; 151-6.

Nabeela A. (2001). Saving the lives of mothers and newborn in Pakistan. Washington DC September 10. http://www.savethechildren.org/newsroom/speeches-and-testimony/saving-the-lives-of-mothers-and-newborns-in-pakistan.html (accessed May 14, 2005).

Naghmana A, Shami N, Asif S. (2002). Maternal Mortality in a Tertiary Care Teaching Hospital. *J Coll Physicians Surg Pak.* Jul;12(7):429-31

Naghmana A, Shaila A, Nabeela S, Shaeeha A. (2001). Recurrent Induced Abortion - Still A Prevalent Problem. *Ann King Edward Med Coll.* 7(4):296-7

Naheed I, Yasin A. (2000). Determinants of low birth weight babies (A prospective study of associated factors and outcome). *Ann King Edward Med Coll.* Dec;6(4):361-3.

Naib JM, Siddiqui MI, Afridi B. (2004). A review of septic induced abortion cases in one year at Khyber Teaching Hospital, Peshawar. *J Ayub Med Coll Abbottabad.* Jul-Sep;16(3):59-62.

Nahar N, Afroza S, Hossain M. (1998). Incidence of low birth weight in three selected communities of Bangladesh. *Bangladesh Med Res Counc Bull.* 1998 Aug;24(2):49-54.

Najmi RS. (2000). Distribution of birthweights of hospital born Pakistani infants. *J Pak Med Assoc.* 50(4):121-4.

Narayan H, Buckett W, McDougall W, Cullimore J. (1992). Pregnancy after fifty: profile and pregnancy outcome in a series of elderly multigravidae. *Eur J Obstet Gynecol Reprod Biol.* Oct 23;47(1):47-51.

Naseer UD, Khan AU, Illahi N. (2000). Perinatal and Maternal Outcome of Eclamptic Patients admitted in Nishtar Hospital, Multan. *J Coll Physicians Surg Pak.* 10(7):261-4.

National Health Survey of Pakistan. (1995). Pakistan medical Research Council, Islamabad, Pakistan. *The Pakistan Development Review.* 26:1.

Newton ER, Haering WA, Kennedy JL Jr, Herschel M, Cetrulo CL, Feingold M. (1986). Effect of mode of delivery on morbidity and mortality of infants at early gestational age. *Obstet Gynecol.* Apr;67(4):507-11.

NCCIC. (2007). National Child Care Information Centre. http://www.nccic.org (accessed dated 20.06.2007).

NGO. (1998). Pakistan: moving ahead. NGOs pilot adolescent reproductive health projects. *Adolesc Educ Newsl.* Dec;1(2):11.

Niaz U. (2001). Overview of Women's Mental health In Pakistan. *Pak J Med Sci.* 17(4):203-209.

Nicolaidis C, Ko CW, Saha S, Koepsell TD. (2004). Racial discrepancies in the association between paternal vs. maternal educational level and risk of low birthweight in Washington State. *BMC Pregnancy Childbirth.* Jun;4(1):10.

Northrop-Clewes CA, Ahmad N, Paracha P, David IT. (1998). Impact of health services provision on mothers and infants in a rural village in North West Frontier province, Pakistan. *Public Health Nutr.* Mar;1(1):51-9.

Norton M. (2005). New evidence on birth spacing: promising findings for improving newborn, infant, child, and maternal health. *Int J Gynaecol Obstet.* Apr;89(1):S1-6.

Office of Population Census and Survey. (1982-5). Mortality statistics, perinatal and infant: Social and biological factors. London: HMSO. (Series DHS No. 15-18.)

Ondao-Onama C, Tumwine JK. (2003). Immediate outcome of babies with low Apgar scores in Mulago hospital, Uganda. *East Afr Med J.* 80(1):22-9.

Orvos H, Hoffmann I, Frank I, Katona M, Pal A, Kovacs L. (1995). The perinatal outcome of outcome, use of health services, and women's situations. *Semin Perinatol.* 19:263-71

Pahari K, Ghosh A. (1997). Study of pregnancy outcome over a period of five years in a postgraduate institute of west Bengal. *J Indian Med Assoc.* Jun;95(6):172-4.

Paracha PI, Hameed A, Simon J, Jamil A, Nawab G. (1997). Prevalence of anaemia in semi-urban areas of Peshawar, Pakistan: a challenge for health professionals and policy makers. *J Pak Med Assoc.* Feb;47(2):49-53.

Parkash J, Das N. (2005). Pattern of admissions to neonatal unit. *J Coll Physicians Surg Pak.* Jun;15(6):341-4.

Parker JD, Schoendorf KC, Kiely JL. (1994). Associations between measures of socioeconomic status and low birth weight, small for gestational age, and premature delivery in the United States. *Ann Epidemiol.* Jul;4(4):271-8.

Parker JD, Schoendorf KC. (1992). Influence of paternal characteristics on the risk of low birth weight. *Am J Epidemiol.* Aug 15;136(4):399-407.

Patel V, Rahman A, Jacob KS, Hughes M. (2004). Effect of maternal mental health on infant growth in low income countries: new evidence from South Asia. *BMJ.* Apr 3;328(7443):820-3.

PDF. (2003). Comparative Socio-economic Indicators, Pakistan development Form. http://lnweb18.worldbank.org/sar/sa.nsf/Attachments/PDF2003-NWFP/$File/NWFP.pdf (accessed March 07, 2004).

Parveen Z. (2001). Birth weight percentiles by gestational age: a hospital based study. *J Ayub Med Coll Abbottabad.* Apr-Jun;13(2):22-7.

Peacock JL, Bland JM, Anderson HR. (1995). Preterm delivery: effects of socioeconomic factors, psychological stress, smoking, alcohol, and caffeine. *BMJ.* Aug 26;311(7004):531-5.

Peduzzi P, Concato J, Kemper E, Holford TR, Feinstein AR. (1996). A simulation study of the number of events per variable in logistic regression analysis. *J Clin Epidemiol.* Dec;49(12):1373-9.

Philip C, Rob C. (1998). American Medical Students Association, National Initiative on Teenage Pregnancy. http://www.amsa.org/pdf/teen_pregnancy.pdf

Philip JS. (2004). Maternal blood pressure in pregnancy, birth weight, and perinatal mortality in first births: prospective study. *BMJ.* 329:1312

PHNI. (2003). USAID Country Health Statistical Report (Pakistan). *http://www.dec.org/pdf_docs/PNACU748.pdf* (accessed May 18, 2004).

PHNIP. (2002). Country health statistical report, Pakistan http://www.dec.org/pdf_docs/PNACP270.pdf (accessed April 27, 2003).

Pickering RM, Deeks JJ. (1991). Risks of delivery during the 20th to 36th week of gestation. *Int J Epidemiol.* 20:456-66.

Pickett KE, Abrams B, Selvin S. (2000). Maternal height, pregnancy weight gain, and birthweight. *Am J Hum Biol.* Sep;12(5):682-687.

Pickett KE, Collins JW Jr, Masi CM, Wilkinson RG. (2005). The effects of racial density and income incongruity on pregnancy outcomes. *Soc Sci Med.* May;60(10):2229-38.

PIHS. (2001-02). Pakistan Integrated House Hold Survey. Federal Bureau of Statistics, Pakistan. http://www.statpak.gov.pk/depts/fbs/statistics/ pihs2000-2001/pihs2001-02_3.pdf (Accesses September 21, 2004).

PMRC. (1995). Pakistan Medical Research Council. National health survey of Pakistan.

Population Council. (2004). Research on Unwanted Pregnancies and Postabortion Complications in Pakistan, 2004. http://www.popcouncil.org/projects/RH_PakResearchUnwantedPreg.html (accessed June 19, 2006).

PPNH. (2002). Save the Children: Healthy Mothers and Healthy Newborns: The Vital Link http://www.prb.org/pdf/HealthyMothers_Eng.pdf (accessed March 13, 2003).

Prakash J, Pandey LK, Singh AK, Kar B. (2006). Hypertension in pregnancy: hospital based study. *J Assoc Physicians India.* Apr;54:273-8.

Prasad KN, Rao RS, Sujatha A. (1994). Birth weight pattern in Karnataka. *Indian Pediatr.* Jul;31(7):836-9.

Preventing Low Birthweight. (2004). http://www.adb.org/Documents/Books/Nutrition/What_Works/chapter2.pdf (accessed April 17, 2007).

Proceedings. (2004). National workshop on methodologies for assessment of vitamin A deficiency, iron deficiency anaemia and iodine deficiency disorders. All India Institute of Medical Sciences, India.

Qureshi A, Ijaz S, Syed A, Qureshi A, Khan AA. (2005). Periodontal infection: a potential risk factor for pre-term delivery of low birth weight (PLBW) babies. *J Pak Med Assoc.* Oct;55(10):448-52.

Radhakrishnan T, Thankappan KR, Vasan RS, Sarma PS. (2000). Socioeconomic and demographic factors associated with birth weight: a community based study in Kerala. *Indian Pediatr.* 37(8):872-6.

Rahi M, Kumavat AP, Garg S, Singh MM. (2005). Socio-Demographic Co-relates of Psychiatric Disorders. *Indian J Pediatr.* 72:395-398

Rahimtoola RJ, Qureshi AF, Ramzam M. (1977). A study of newborn infants at Jinnah Postgraduate Medical Centre, Karachi. *J Pak Med Assoc.* Jan;27(1):258-61.

Rahman A, Bunn J, Lovel H, Creed F. (2007). Association between antenatal depression and low birthweight in a developing country. *Acta Psychiatr Scand.* Jun;115(6):481-6.

Rahman A, Hafeez A. (2003). Suicidal feelings run high among mothers in refugee camps: a cross-sectional survey. *Acta Psychiatr Scand.* Nov;108(5):392-3.

Rahman A, Lovel H, Bunn J, Iqbal Z, Harrington R. (2004). Mothers' mental health and infant growth: a case-control study from Rawalpindi, Pakistan. *Child Care Health Dev.* Jan;30(1):21-7.

Ram K. (1994). Medical management and giving birth: responces of coastal women inTamil Nadu. *Reproductive Health Matters.* 4:20-26.

Randhawa MS, Moin S, Shoaib F. (2003). Diabetes mellitus during pregnancy, A study of fifty cases. *Pak J Med Sci.* 19(4):277-282.

Rani R. (1993). Safe motherhood programme. *Nurs J India.* Oct;84 (10): 231-3.

Rantakallio P, Laara E, Koiranen M, Sarpola A. (1995). Maternal build and pregnancy outcome. *J Clin Epidemiol.* Feb;48(2):199-207.

Rawlings JS, Rawlings VB, Read JA. (1995). Prevalence of Low Birth Weight and Preterm Delivery in Relation to the Interval between Pregnancies among White and Black Women. *N Engl J Med.* 332(2):69-74.

Ray A. (1996). Difficulties in obstetric practice in a hill subdivision. *J Indian Med Assoc.* Apr;94(4):131-2.

Rehan N. (2003). Attitudes of health care providers to induced Abortion in Pakistan. *J Pak Med Assoc.* Jul;53(7):293-6.

Rehan N, Inayatullah A, Chaudhary I. Rehan N, Inayatullah A, Chaudhry I. (2001). Characteristics of Pakistani women seeking abortion and a profile of abortion clinics. *J Womens Health Gend Based Med.* Oct;10(8):805-10.

Rehman A, Ghazanfar B, & Soomro N. (2005). Effects of maternal anemia on fetal outcome i.e. Apgar score and birth weight. *Pakistan J Surg.* Dec;21(2):102-5.

Reports Improving Birth Outcomes. (2003). Meeting the Challenge in the Developing World. http://www.iom.edu/report.asp?id=16191 (accessed May 02, 2004).

Reports, Reducing Birth Defects. (2003). Meeting the Challenge in the Developing World http://www.iom.edu/report.asp?id=16193

Rogers JF and Graves WL. (1993). Risk factors associated with low Apgar scores in a low-income population. *Paediatr Perinat Epidemiol.* 7:205-216.

Rona RJ, Mahabir D, Rocke B, Chinn S, Gulliford MC. (2003). Social inequalities and children's height in Trinidad and Tobago. *Eur J Clin Nutr Jan.* 57(1):143-50.

ICHG (2005). International Child Health Group, Royal College of Paediatrics. Newsletter, June, vol. 1, Issue 1. http://www.ichg.org.uk /publications/ newsletter_01.pdf (accessed April 13, 2007).

Sachdev HP (2001). Low Birth Weight in South Asia. *Int J Diab Dev Ctries.* 21:13-33

Saeed GA, Khattak N, Hamid R. (2002). Anaemia in pregnancy and spontaneous preterm birth. *J Pak Inst Med Sci.* 13(2);698-701.

Sai FT, Measham DM. (1992). Safe motherhood initiative: getting our priorities straight. *The Lancet.* 339(8791):478-80

Sajan F, Fikree FF. (2002). Does early age at marriage influence gynaecological morbidities among Pakistani women? *J Biosoc Sci.* Jul;34(3):407-17.

Saleem S, Fikree FF. (2001). Induced abortions in low socio-economic settlements of Karachi, Pakistan: rates and women's perspectives. *J Pak Med Assoc.* Aug;51(8):275-9.

Saleem S, Fikree FF. (2005). The quest for small family size among Pakistani women--is voluntary termination of pregnancy a matter of choice or necessity? *J Pak Med Assoc.* Jul;55(7):288-91.

Salik A, Javed L, Iqbal J, Sheikh S. (2004). Anemia in grandmultipara. *Ann King Edward Med Coll.* Dec;10(4):417-9.

Sami S, Baloch SN. (2004). Perinatal mortality rate in relation to gender. *J Coll Physicians Surg Pak.* 14(9):545-8.

Sanderson M, Emanuel I, Holt VL. (1995). The intergenerational relationship between mother's birthweight, infant birthweight and infant mortality in black and white mothers. *Paediatr Perinat Epidemiol.* 9(4):391-405.

Sathar ZA. (1983). Birth spacing and childhood mortality. *IPPF Med Bull.* Aug;17(4):2-3.

Sathar ZA, Akhtar A. (1986). Delayed marriages in Pakistan. *The Pakistan Development review.* 25(4):535-550.

Sathar ZA, Akhtar A. (1988). Evidence of fertility decline in Karachi. *The Pakistan Development Review.* 27(4 part II):659-668.

Sathar ZA, Mason KO. (1993). How female education affects reproductive behaviour in urban Pakistan. *East-West Centre, program on population.* 6(4).

Sathar ZA. (1979). Rural-urban fertility differentials. *The Pakistan Development Review.* 18(3).

Sathar ZA. (1985). Infant and child mortality in Pakistan-Some trends and differentials. *Journal of Biosocial Science*. 17:351-359.

Sathar ZA. (1987 a). Seeking Explanation for High Levels of Infant Mortality in Pakistan. *The Pakistan Development review*. Spring;25(1):55-70.

Sathar ZA. (1987 b). Sex differentials in mortality: A corollary of son preferences? *The Pakistan Development review*. Winter;26(4):554-565.

Sathar ZA. (1991). Changes in mortality in Pakistan 1960-88. *The Pakistan Development Review*. 30(4 part II):669-69.

Sathar ZA. (1992). Child survival and changing fertility patterns in Pakistan. *Pak Dev Rev*. Winter;31(4 Pt 2):699-711

SBP. (2001). State Bank of Pakistan, http://www.statpak.gov.pk/depts/fbs/statistics/pds2001/pdswritup.pdf (accessed September 11, 2003).

Sehgal A, Telang S, Passah SM, Jyothi MC. (2004). Maternal and neonatal profile and immediate outcome in extremely low birth weight babies in Delhi. *Trop Doct*. Jul;34(3):165-8.

Seidman DS, Samueloff A, Mor-Yosef S, Schenker JG. (1990). The effect of maternal age and socioeconomical background on neonatal outcome. *Int J Gynaecol Obstet*. 33(1):7-12.

Shafi T, Shafi T, Khan MR, Atiq M. (2003). Congenital heart disease and associated malformations in children with cleft lip and palate in Pakistan. *Br J Plast Surg*. Mar;56(2):106-9.

Shah and Ohlsson. (2002). Literature Review of Low Birth Weight, Including Small for Gestational Age and Preterm Birth. Evidence Based Neonatal Care and Outcomes Research, Canada. http://www.toronto.ca/health/low_birth_weight/pdf/lbw_lit_rewiew.pdf (accessed October 22, 2006).

Shaheen B, Hassan L, Obaid M. (2003). Eclampsia, a major cause of Maternal and Perinatal Mortality: A prospective analysis at a tertiary care hospital of Peshawar. *J Pak Med Assoc*. 53(8):346-50.

Shami SA, Qadeer T, Schmitt LH, Bittles AH. (1991). Consanguinity, gestational period and anthropometric measurements at birth in Pakistan. *Annals of Human Biology*. 18:523-527.

Shamim A, Khan HO, Rana JS, Ahmed KA. (1999). Intrauterine Growth Restriction: A perspective for Pakistan. *J Pak Med Assoc*. 9(2):50-52.

Sharma DC, Pendse V, Sahay K, Soni BL. (1991). The changing pattern of maternal and neonatal anemia at Udaipur during 2 decades in relation to poverty, parity, prematurity and vegetarianism. *Asia Oceania J Obstet Gynaecol.* Mar;17(1):13-7.

Sharma JB, Soni D, Murthy NS, Malhotra M. (2003). Effect of dietary habits on prevalence of anemia in pregnant women of Delhi.*The Journal of Obstetrics and Gynaecology Research.* April;29:Page 73.

Shawky S, Milaat W. (2000). Early teenage marriage and subsequent pregnancy outcome. *Eastern Mediterranean Health Journal.* 6(1):46-54.

Shera AS, Rafique G, Khwaja IA, Ara J, Baqai S, King H. (1995). Pakistan national diabetes survey: prevalence of glucose intolerance and associated factors in Shikarpur, Sindh Province. *Diabet Med.* Dec;12(12):1116-21.

Shirima CP, Kinabo JL. (2005). Nutritional status and birth outcomes of adolescent pregnant girls in Morogoro, Coast, and Dar es Salaam regions, Tanzania. *Nutrition.* Jan;21(1):32-38.

Sibai BM, Caritis S, Hauth J, Lindheimer M, VanDorsten JP, MacPherson C, Klebanoff M, Landon M, Miodovnik M, Paul R, Meis P, Dombrowski M, Thurnau G, Roberts J, McNellis D. (2000). Risks of preeclampsia and adverse neonatal outcomes among women with pregestational diabetes mellitus. National Institute of Child Health and Human Development Network of Maternal-Fetal Medicine Units. *Am J Obstet Gynecol.* Feb;182(2):364-9.

Sibert JR, Jadhav M, Inbaraj SG. (1978). Maternal and fetal nutrition in south India. *BMJ.* Jun;1(6126):1517-8.

Siddiqi S, Haq IU, Ghaffar A, Akhtar T, Mahaini R. (2004). Pakistan maternal and child health policy: analysis, lessons and the way forward. *Health policy.* 69:117-130.

Siddiqi S, Kielmann A, Khan M, Ali N, Ghaffar A, Sheikh U, Mumtaz Z. (2001). The effectiveness of patients referral in Pakistan. *Health Policy and Planning.* 16(2):193-198.

Simon DM, Vyas S, Prachand NG, David RJ, Collins JW Jr. (2006). Relation of maternal low birth weight to infant growth retardation and prematurity. *Matern Child Health J.* 10(4):321-7.

Singh M. (1990). Strategies to reduce neonatal mortality. *ICCW News Bull.* Apr-Jun;38(2):15-20.

Singh S. (2006). Hospital admissions resulting from unsafe abortion: estimates from 13 developing countries. Lancet. Nov 25;368(9550):1887-92.

Skjaerven R, Wilcox AJ, Oyen N, Magnus P. (1997). Mothers' birth weight and survival of their offspring: population based study. *BMJ.* 314:1376

Slattery MM, Morrison JJ. (2002). Preterm delivery. *Lancet.* Nov;360 (9344):1489-97.

Smeeton NC, Rona RJ, Dobson P, Cochrane R, Wolfe C. (2004). Assessing the determinants of stillbirths and early neonatal deaths using routinely collected data in an inner city area. *BMC Med.* Jul;6(2):27.

Smith GC, Pell JP, Dobbie R. (2003). Caesarean section and risk of unexplained stillbirth in subsequent pregnancy. *LANCET.* Nov;362(9398):1779-1784.

Smith GC, Pell JP, Dobbie R. (2003). Interpregnancy interval and risk of preterm birth and neonatal deaths: retrospective cohort study. *BMJ.* 327-313.

Smith ML, Spencer SA, Hull D. (1980). Mode of delivery and survival in babies weighing less than 2000 g at birth. *BMJ.* Oct;281(6248):1118-9.

Sohail R, Zainab S, Zaman F. (2004). Prevalence of anemia in obstetrical population. *Ann King Edward Med Coll.* Jun;10(2):146-8.

Stanton CK. Perinatal mortality in the Philippines: An investigation into the use of demographic survey data for the study of perinatal mortality and its determinants. PhD thesis, The John Hopkins University, Department of population Dynamics, 1996.

Stoltenberg C, Magnus P, Lie RT, Daltveit AK, Irgens LM. (1998). Influence of consanguinity and maternal education on risk of stillbirth and infant death in Norway, 1967-1993. *Am J Epidemiol.* Sep;148(5):452-9.

Stark J. (2004). Breaking the cycle: a community approach to prevention of low birth-weight babies. *International Journal of Healthcare Quality Assurance incorporating Leadership in Health Services.* 17(4):i-viii.

Steer P. (2005). The epidemiology of preterm labour. *BJOG: an International Journal of Obstetrics and Gynaecology.* 112(1):1-3.

Steer PJ, Little MP, Kold-Jensen T, Chapple J, Elliott P. (2004). Maternal blood pressure in pregnancy, birth weight, and perinatal mortality in first births: prospective study. *BMJ.* Dec 4;329(7478):1312.

Strobino DM, Ensminger ME, Kim YJ, Nanda J. (1995). Mechanisms for maternal age differences in birth weight. *Am J Epidemiol.* 142:504-514.

Sultana A, Ahmad S. (2002). Attitude of women of NWFP toward antenatal care. *J Ayub Med Coll Abbottabad.* 14(2):14-18.

Tabussum G, Karim SA, Khan S, Naru TY. (1994). Preterm birth--its etiology and outcome. *J Pak Med Assoc.* Mar;44(3):68-70.

Talsania NJ, Lala MK. (1994). Evaluation of antenatal risk scoring in a preterm birth prevention and perinatal loss. *Indian J Matern Child Health.* Jan-Mar;5(1):5-9.

Tariq P, Kundi Z. (1999). Determinants of neonatal mortality. *J Pak Med Assoc.* Mar;49(3):56-60.

Tasnim N, Mahmud G, Arif MS. (2005). Impact of reduced prenatal visit frequency on obstetric outcome in low-risk mothers. *J Coll Physicians Surg Pak.* Jan;15(1):26-9.

Terry PB, Condie RG. (1983). Ethnic differences in the distribution of normally formed singleton stillbirths. *Postgrad Med J.* Oct;59(696):659-60.

Terry PB, Condie RG, Settatree RS. (1980). Analysis of ethnic differences in perinatal statistics. *BMJ.* 281:1307-8.

Thorngren-Jerneck K, Herbst A. (2001). Low 5-minute Apgar score: a population-based register study of 1 million term births. *Obstet Gynecol.* Jul;98(1):65-70.

Tibrewala NS, Tibrewala SN, Tibrewala VN. (1980). Epidemiology and revention of low birth weight babies in a developing country. *Bull Int Pediatr Assoc.* Jan;3(5):27-36.

Tin TT, Thida M, Maung MM, Wai KT. (1994). Maternal influences on low birth weight. *Malays J Reprod Health.* Jun;12(1):32-7.

Tinker A, Ranson E. (2002). Healthy mothers and healthy newborns: Population Reference Bureau. Washington, DC 20009 USA. *WWW.prb.org*

Tomashek KM, Ananth CV, Cogswell ME. (2006). Risk of stillbirth in relation to maternal haemoglobin concentration during pregnancy. *Matern Child Nutr.* Jan; 2(1):19-28.

Torres-Arreola LP, Constantino-Casas P, Flores-Hernandez S, Villa-Barragan JP, Rendon-Macias E. (2005). Socioeconomic factors and low birth weight in Mexico. *BMC Public Health.* Mar;5(1):20.

Tough SC, Svenson LW, Johnston DW, Schopflocher D. (2001). Characteristics of preterm delivery and low birth weight among 113,994 infants in Alberta: 1994-1996. *Canadian Journal of Public health.* Jully-August;92(4).

Tripathy R, Parida SN, Tripathy SN, Devi PS, Das RN, Swain A. (2002). Physical status of newborns and neonatal outcome. *Indian J Ped.* 69(12):1041-5.

UNFPA. (2000). Reproductive Health: Meeting People's needs http://www.unfpa.org/about/report/2000/pdf/printch2.pdf (accessed December 06, 2003).

UNICEF. (2004). Low Birth Weight, Country Regional and Global estimates. http://www.childinfo.org/areas/birthweight/LBW_WHO_UNI CEF%202000.pdf (accessed July 13, 2005).

UNICEF. (2005). Statistics of Low birth weight http://www.childinfo.org/eddb/lbw/index.htm (accessed June 17, 2005).

UNICEF World Health Organization: Low Birth Weight, Country Regional and Global estimates. http://www.childinfo.org/areas/birthweight/LBW_WHO_UNICEF% 202000.pdf (accessed July 13, 2005).

UNICEF. (1992). Situation Analysis of Children and Women in Pakistan.

UNICEF. (2004). State of the world children 2005, New York: UNICEF.

United Nations. (2005). Millennium Indicators, Statistics Division, UN. http://unstats.un.org/unsd/mi/mi_series_results.asp?rowID=562&fID=r15&cgID=34 (accessed August 15, 2005).

United Nations: Standing Committee on Nutrition, 25th session. http://www.unsystem.org/scn/Publications /AnnualMeeting/SCN25/irondeficiency.html

United Nations: Sub-Committee on Nutrition, Number 21, December 2000. http://www.unsystem.org/scn/Publications/SCNNews /scnnews21.pdf (accessed May 30, 2004).

Usta IM, Sibai BM. (1995). Emergent management of puerperal eclampsia. *Obstet Gyn Clin North Am.* 22:315-35.

Valero De Bernabe J, Soriano T, Albaladejo R, Juarranz M, Calle ME, Martinez D, Dominguez-Rojas V. (2004). Risk factors for low birth weight: a review. *Eur J Obstet Gynecol Reprod Biol.* Sep;116(1):3-15.

Vangen S, Bergsjo P. (2003). Do women die from pregnancy these days? *Tidsskr Nor Laegeforen.* Dec;123(24):3544-5.

Villar J, Belizán JM. (1982). The relative contribution of prematurity and fetal growth retardation to low birth weight in developing and developed societies. *American Journal of Obstetrics and Gynecology.* 143:793-798.

Vangen S, Stoltenberg C, Holan S, Moe N, Magnus P, Harris JR, Stray-Pedersen B. (2003). Outcome of pregnancy among immigrant women with diabetes. *Diabetes Care.* Feb;26(2):327-32.

Vangen S, Stoltenberg C, Skjaerven R, Magnus P, Harris JR, Stray-Pedersen B. (2002). The heavier the better? Birthweight and perinatal mortality in different ethnic groups. *Int J Epidemiol.* Jun;31(3):654-60.

Veena SR, Kumaran K, Swarnagowri MN, Jayakumar MN, Leary SD, Stein CE, Cox VA, Fall CH. (2004). Intergenerational effects on size at birth in South India. *Paediatr Perinat Epidemiol.* Sep;18(5):361-70.

Vohr BR, Widen JE, Cone-Wesson B, Sininger YS, Gorga MP, Folsom RC and Norton SJ. (2000). Identification of neonatal hearing impairment: characteristics of infants in the neonatal intensive care unit and well-baby nursery. *Ear Hear.* 21:373-82.

Wahab A, Ahmad M. (1996). Biosocial perspective of consanguineous marriages in rural and urban Swat, Pakistan. *J Biosoc Sci.* 28(3):305-13.

Wahab A, Ahmad M. (2005). Consanguineous marriages in the Sikh community of Swat, NWFP, Pakistan. *Journal of Social Sciences.* 10(3):153-157.

Wahab A; Ahmad M; Shah SA. (2006). Migration as a determinant of marriage pattern: preliminary report on consanguinity among Afghans. Journal of Biosocial Science. May;38(3):315-325.

Wasunna A, Mohammed K. (2002). Low birthweight babies: socio-demographic and obstetric characteristics of adolescent mothers at Kenyatta National Hospital, Nairobi. *East Afr Med J.* Oct;79(10):543-6.

WDR. (1993). Word Development Report. International Bank for Reconstuction and development/ the World Bank, Washington, DC.

WHO. (2006). Health Statistics: http://www.who.int/whosis/whostat2006 /en/index.html (accessed February 05, 2007).

WHO. (1992). World Health Organization: The prevalence of anaemia in Women: a tabulation of available information, 2nd edition Geneva.

WHO. (1994). World Health Organization, Mother-Baby Package: Implementing safe motherhood in countries. Geneva.

WHO. (1994). World Health Organization: World-Bank (2001, 2003), The World Bank Group: Pakistan at a glance. http://devdata.worldbank.org/hnpstats/cg.asp (accessed July 27, 2006).

WHO. (1997). World Health Organization,"Coverage of Maternity Care: A Listing of Available Information, Fourth Edition". World Health Organization, Geneva.

WHO. (2004). World Health Organization, Estimates: Skilled attendant at delivery. http://www.who.int/reproductive-health/global_monitoring/skilled_attendance.html (accessed October 07, 2005).

WHO. (2006). Making Pregnancy Safer: Reduction of Maternal Mortality [http://www.wpro.who.int/internet/files/pub/360/115.pdf] [accessed November 5, 2006].

WHO. (2006). Water-related diseases http://www.unsystem.org/scn/Publications/Annual Meeting/SCN25/irondeficiency.html (accessed December 20, 2006).

WHR. (1997). Word Development Report, Fifty facts from the World Health Report, http://www.medstudents.com.br/servico/whofact.htm (accessed August 11, 2004).

Williams RL, Creasy RK, Cunningham GC, Hawes WE, Norris FD, Tashiro M. (1982). Fetal growth and perinatal viability in California. *Obstetrics and Gynecology.* 59(5):624-632.

Winkvist A, Akhtar HZ. (2000). God should give daughters to rich families only: attitudes towards childbearing among low-income women in Punjab, Pakistan. *Soc Sci Med.* Jul;51(1):73-81.

Wong S, Chan LY, YU V, Ho L. (1999). Hepatitis B carrier and perinatal outcome in singleton pregnancy. *Am J Perinatol.* 16(9):485-8.

World Bank. (2000). Atlas Database: http://ucatlas.ucsc.edu/output.php (accessed December 03, 2004).

Yadav S, Saxena U, Yadav R, Gupta S. (1997). Hypertensive disorders of pregnancy and maternal and foetal outcome: a case controlled study. *J Indian Med Assoc.* Oct;95(10):548-51.

Yakoob MY, Zakaria A, Waqar SN, Zafar S, Wahla AS, Zaidi SK, et al. (2005). Does malaria during pregnancy affect the newborn? *J Pak Med Assoc.* Dec;55(12):543-6.

Yasmin S, Osrin D, Paul E, Costello A. (2001). Neonatal mortality of low-birth-weight infants in Bangladesh. *Bull World Health Organ.* 79(7):608-14.

Yaqoob M, Cnattingius S, Jalil F, Zaman S, Iselius L, Gustavson K-H. (1998). Risk factors for mortality in young children living under various socio-economic conditions in Lahore, Pakistan: with particular reference to inbreeding. *Clin Genet.* Nov; 54(5):426-34.

Yaqoob N, Abbasi SM. (2002). Nutritional Iron Deficiency in our population. *J Coll Physicians Surg Pak.* Jul;12(7):395-7.

Yasin NA. (2000). Determinants of Low Birth Weight Babies (A prospective study of associated factors and outcome. *Ann King Edward Med Coll.* Dec;6-4:361-3.

Zahid GM. (1996). Mother's health-seeking behaviour and childhood mortality in Pakistan. *Pak Dev Rev.* Winter;35(4 Pt. 2):719-31.

Zhou W, Sorensen HT, Olsen J. (2000). Induced abortion and low birthweight in the following pregnancy. *Int J Epidemiol.* Feb;29(1):100-6.

Zhu BP. (2005). Effect of interpregnancy interval on birth outcomes: findings from three recent US studies. *Int J Gynaecol Obstet.* Apr;89(1):S25-33.

Zumrawi FY. (1991). Effects of the relative importance of different factors and their degree of interactions on child growth. *J Trop Pediatr.* 37(3):131-5.

Zupan J, Aahman E. (2005). Perinatal mortality for the year 2000: estimates developed by WHO. Geneva: World Health Organization.

Zhu BP, Rolfs RT, Nangle BE, Horan JM. (1999). Effect of the interval between pregnancies on perinatal outcomes. *N Engl J Med.* Feb;340(8):589-94.

Appendix I: Bar Charts

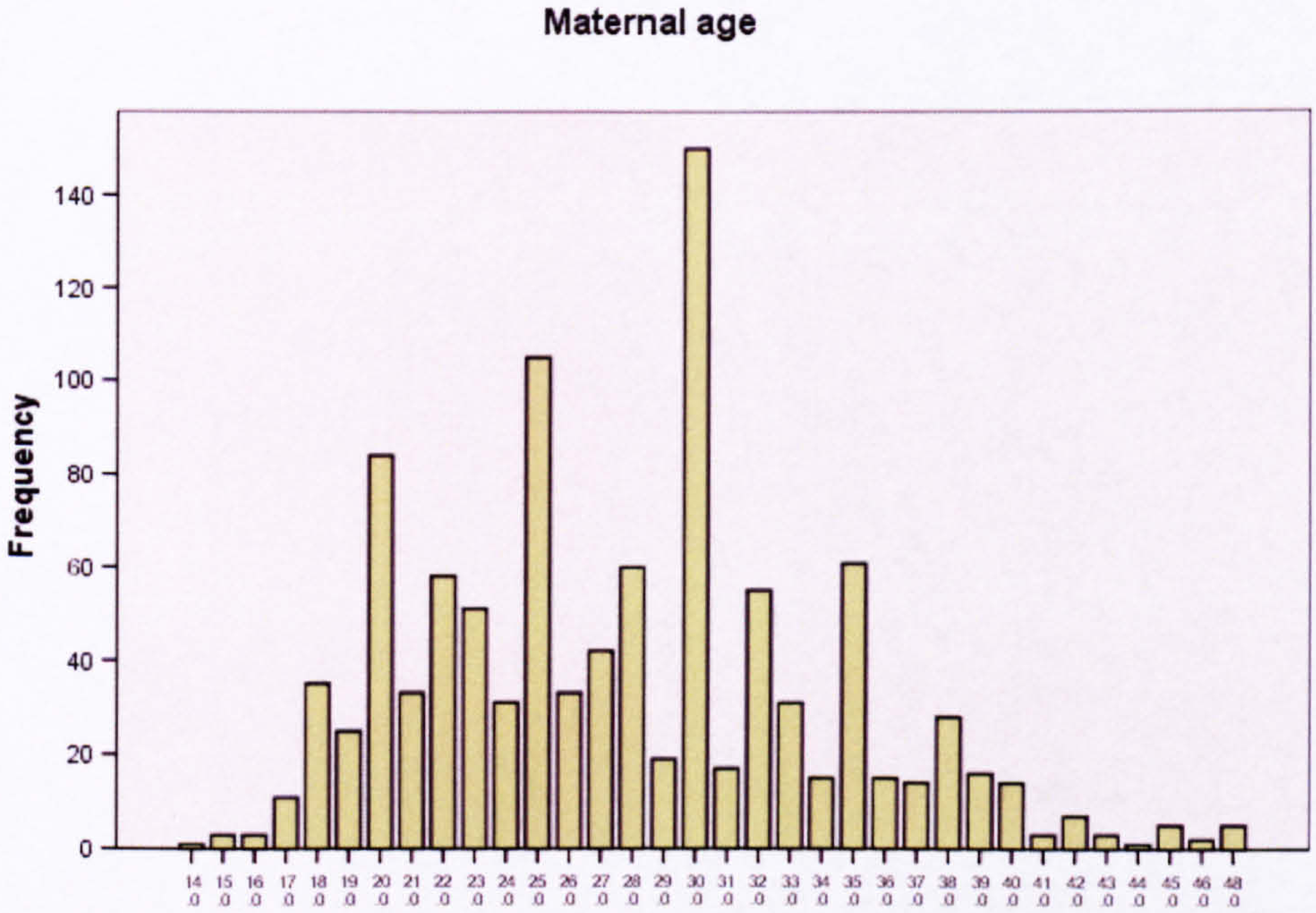

Figure 1: Bar chart of maternal age

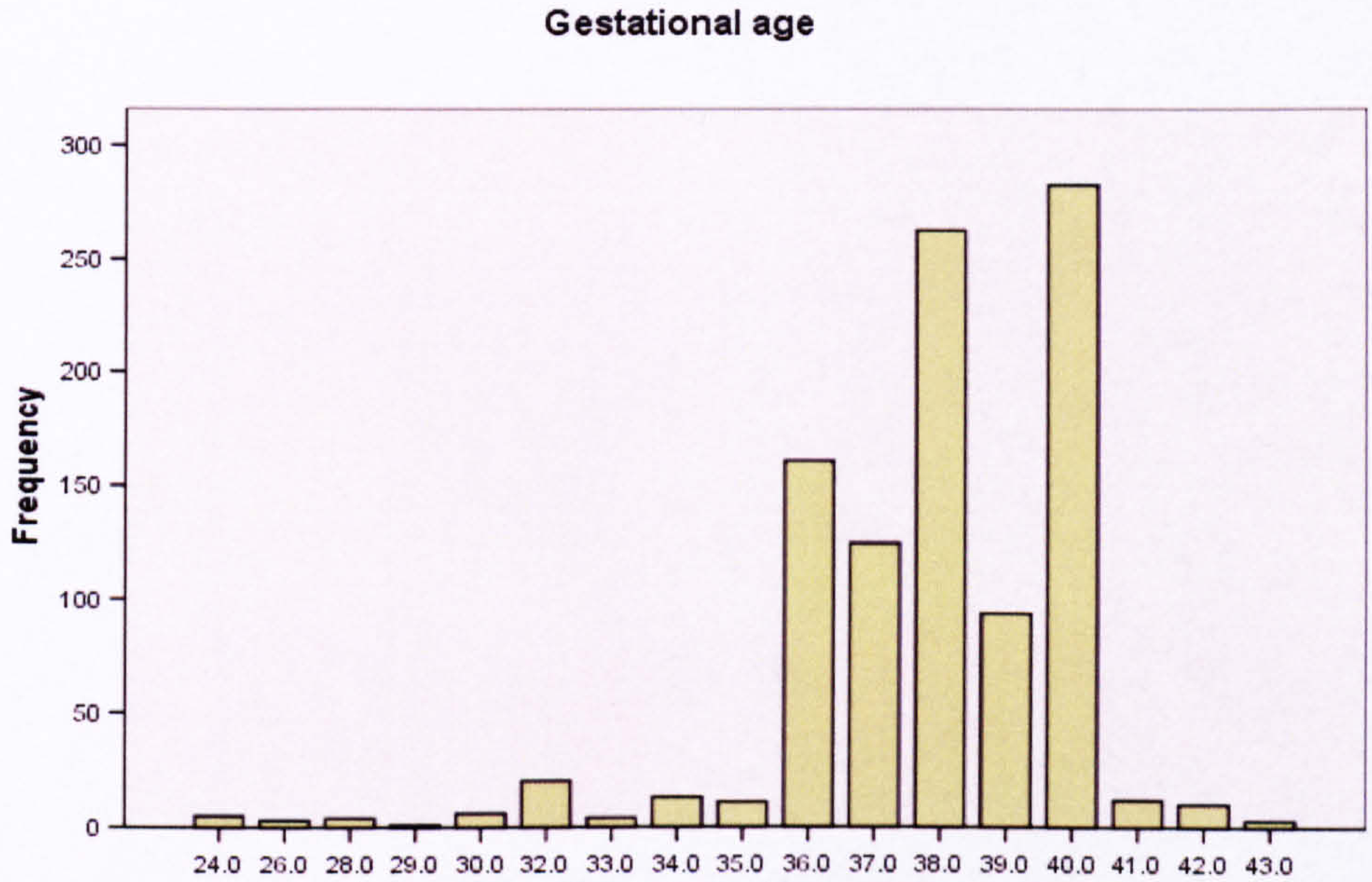

Figure 2: Bar chart of gestational age

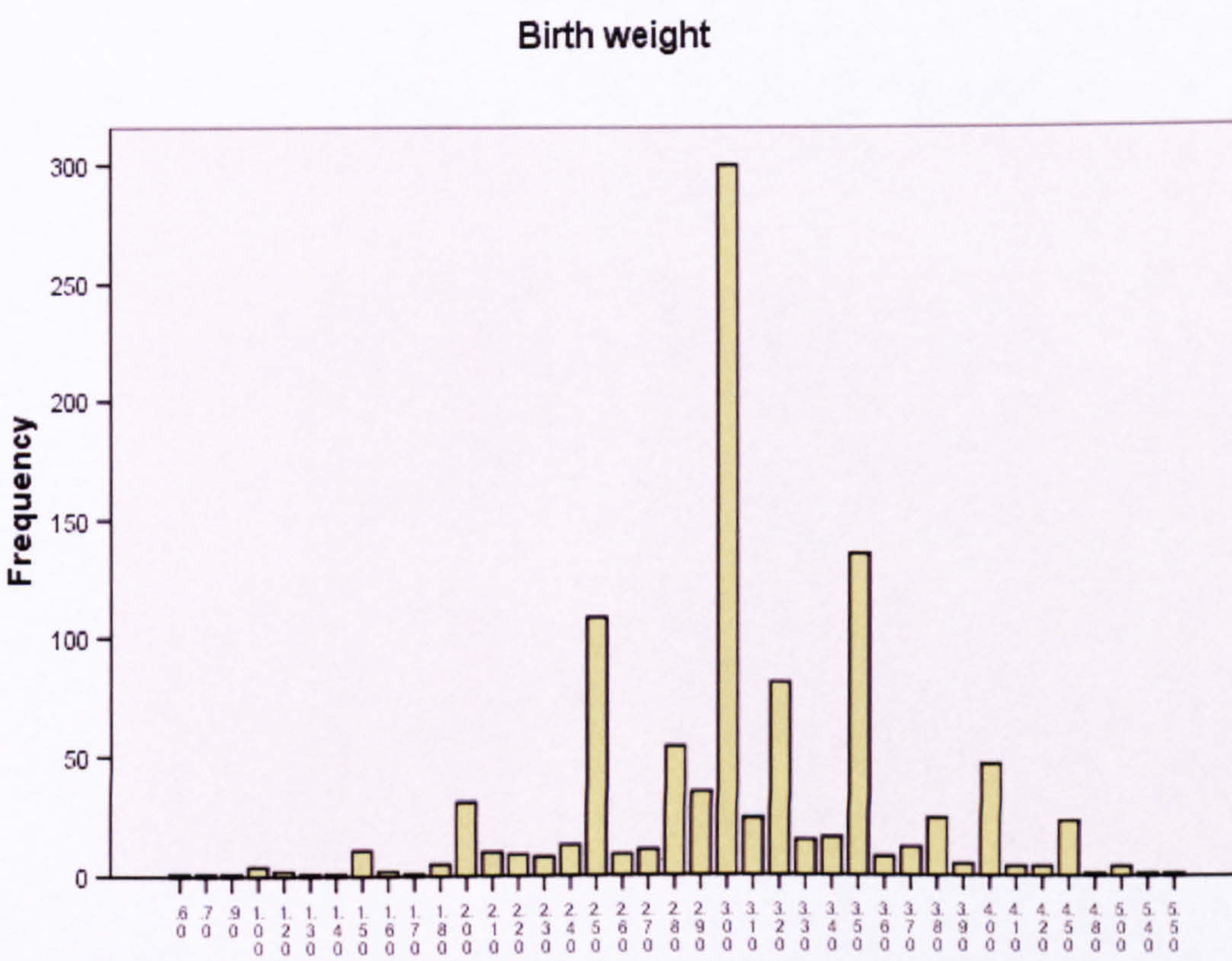

Figure 2: Bar chart of Birthweight

McWatt, Jo Appendix – II

From: McWatt, Jo
Sent: 06 August 2003 12:15
To: Badshah, Sareer; 'sareerbadshah@yahoo.com'
Cc: Lisboa, Paulo
Subject: Application for Ethical Approval

EC5.DOC

Dear Sareer Badshah,

Please below text which advises the outcome of the above.

Regards.

****

Ref. 02141

By email to private & JMU addresses

Dear Badshah Sareer,

I am pleased to inform you that the Ethics Committee has now considered your application for approval of the project entitled:

Impact of maternal age and other biosocial factors on newborn health at hospitals in Peshawar, N-W.F.P Pakistan.

Please note that ethical approval is given for a period of five years from the date granted and therefore the expiry date for this project will be October 2007. An application for extension of approval must be submitted if the project continues after this date.

I am enclosing form EC5 and would be grateful if you could spare the time to complete the questionnaire and return it to me.

Yours sincerely

Jo McWatt
Graduate Research Administrator
Tel: 0151 231 3119
E-mail: j.m.mcwatt@livjm.ac.uk

Encs.

Appendix III

Cross-correlation

	Area status	Water sources	Nationality/ ethnicity	Consangu inity	Maternal present age	Family income	Maternal education	Paternal education	Gestational age
Area status	1.000	.438	.143	-.024	-.051	.106	.160	.136	.022
Water sources	.438	1.000	.085	-.029	-.030	.163	.195	.203	.048
Nationality/ ethnicity	.143	.085	1.000	.017	-.036	.086	.044	.134	-.026
Consanguinity	-.024	-.029	.017	1.000	.083	.047	.101	.023	-.006
Maternal present age	-.051	-.030	-.036	.083	1.000	.039	.004	-.024	.071
Family income	.106	.163	.086	.047	.039	1.000	.247	.395	.085
Maternal education	.160	.195	.044	.101	.004	.247	1.000	.352	.011
Paternal education	.136	.203	.134	.023	-.024	.395	.352	1.000	.039
Gestational age	.022	.048	-.026	-.006	.071	.085	.011	.039	1.000
Diabetes	.020	.027	-.042	-.030	.045	-.021	.001	.068	.061
Hypertension	.061	.061	-.065	.035	.018	.002	.066	.065	.062
Anaemia	.100	.168	.027	.004	-.059	.058	.083	.096	.034
Other risk(s) factors	.011	.048	.051	-.017	-.043	-.077	.031	.023	-.020
Maternal height	.006	.013	-.054	-.003	.051	.116	-.028	.001	.030
Maternal pregnant weight	.045	-.033	.029	.002	.171	.064	.011	.031	.015
Body mass index (BMI)	.026	-.054	.085	.009	.112	.002	.012	.028	.002
Total abortion/miscarriage (TAB)	.047	.020	.065	.023	-.068	.028	.048	.067	.035
* Abortion/miscarriage before (AB/M)	.077	.034	.035	.008	-.033	-.027	.043	.072	.029
Gap between pregnancies	-.063	-.060	.095	.044	.117	.041	-.029	.048	.001
Pregnancy registration	.187	.116	.127	.035	.010	.179	.131	.191	.031
Mode of delivery	.063	.007	-.006	-.039	-.017	-.080	-.013	-.048	.036
Birth weight	.078	.084	.114	.092	.216	.071	.088	.096	.292

*abortion/miscarriage before the present pregnancy

Spearman correlations

	Gestational age	Diabetes	Hypertension	Anaemia	Other risk(s) factors	Maternal height (meter)	Maternal pregnant weight	Body mass index (BMI)
Area status	.022	.020	.061	.100	.011	.006	.045	.026
Water sources	.048	.027	.061	.168	.048	.013	-.033	-.054
Nationality/ ethnicity	-.026	-.042	-.065	.027	.051	-.054	.029	.085
Consanguinity	-.006	-.030	.035	.004	-.017	-.003	.002	.009
Maternal present age	.071	.045	.018	-.059	-.043	.051	.171	.112
Family income	.085	-.021	.002	.058	-.077	.116	.064	.002
Maternal education	.011	.001	.066	.083	.031	-.028	.011	.012
Paternal education	.039	.068	.065	.096	.023	.001	.031	.028
Gestational age	1.000	.061	.062	.034	-.020	.030	.015	.002
Diabetes	.061	1.000	.065	.044	.091	-.028	-.060	-.048
Hypertension	.062	.065	1.000	.077	.050	-.007	-.089	-.082
Anaemia	.034	.044	.077	1.000	.064	.040	.001	-.015
Other risk(s) factors	-.020	.091	.050	.064	1.000	-.049	.025	.062
Maternal height	.030	-.028	-.007	.040	-.049	1.000	.214	-.362
Maternal pregnant weight	.015	-.060	-.089	.001	.025	.214	1.000	.778
Body mass index (BMI)	.002	-.048	-.082	-.015	.062	-.362	.778	1.000
Total abortion/miscarriage (TAB)	.035	.041	.109	.082	.050	.026	-.084	-.091
* Abortion/miscarriage before (AB/M)	.029	.091	.090	.082	.087	.033	-.062	-.070
Gap between pregnancies	.001	-.045	-.106	-.009	-.035	.062	.114	.081
Pregnancy registration	.031	-.108	.018	.127	-.005	.109	.008	-.030
Mode of delivery	.036	.090	.117	.053	.115	.088	-.101	-.168
Birth weight	.292	.007	.059	.062	.033	.026	.101	.090

*abortion/miscarriage before the present pregnancy

Spearman correlations

	TAB	AB/M	Gap between pregnancies	Maternal registration in hospital	Birth weight
Area status	.047	.077	-.063	.187	.078
Water sources	.020	.034	-.060	.116	.084
Nationality/ ethnicity	.065	.035	.095	.127	.114
Consanguinity	.023	.008	.044	.035	.092
Maternal present age	-.068	-.033	.117	.010	.216
Family income	.028	-.027	.041	.179	.071
Maternal education	.048	.043	-.029	.131	.088
Paternal education	.067	.072	.048	.191	.096
Gestational age	.035	.029	.001	.031	.292
Diabetes	.041	.091	-.045	-.108	.007
Hypertension	.109	.090	-.106	.018	.059
Anaemia	.082	.082	-.009	.127	.062
Other risk(s) factors	.050	.087	-.035	-.005	.033
Maternal height	.026	.033	.062	.109	.026
Maternal pregnant weight	-.084	-.062	.114	.008	.101
Body mass index (BMI)	-.091	-.070	.081	-.030	.090
Total abortion/miscarriage (TAB)	1.000	**.656**	.075	-.022	.079
* Abortion/miscarriage before (AB/M)	**.656**	1.000	.191	.017	.070
Gap between pregnancies	.075	.191	1.000	.076	.015
Pregnancy registration	-.022	.017	.076	1.000	.083
Mode of delivery	.106	.119	-.078	-.031	-.012
Birth weight	.079	.070	.015	.083	1.000

*abortion/miscarriage before the present pregnancy; TAB (Total abortion/miscarriage); AB/M (abortion/miscarriage before the present pregnancy

ODDS RATIOS

Odds ratio is known as "test of homogeneous proportions", or "test of independence" for one way tables.

Understanding the odds ratios (OR)

1. OR = 1, shows no difference between exposed and controlled group; or, (OR-1)*100 = 0% increase in the exposed group.

2. OR>1, mean [(OR-1)*100%] increase in the exposed group compared to controlled group, and

3. OR<1, mean [(1-OR)*100%] decrease in the exposed group compared to controlled group.

Note: if the confidence interval includes the value of "1", the results (OR) does not show a clear or conclusive effect.

Calculation of odds ratios:

Table1: Cross tabulation of LBW babies in different income groups

Income	LBW n(%)	NBW n(%)	Total n(%)
<5000 Rupees	80(11.4) a	621(88.6) b	701(100) a+b
=>5000 Rupees	21(6.8) c	288(93.2) d	309(100) c+d
Total	101(10) a+c	909(90) b+d	1010(100) a+b+c+d = N

Birthweight is the outcome, where income exploratory variable

Odds ratios = a d / c b

= (80*288) / (21*621) = 1.78

Chi squares = $\frac{(ad-cd)^2 * N}{(a+b)(c+d)(a+c)(b+d)}$ = 5.1(1 d. f.), where d. f. = (r-1) (c-1)

Chi squares = $\frac{(80*288)^2 * 1010}{701*309*101*909}$ = 5.1(1 d. f.)

Since chi-square is significant (i.e. >3.84 for 1 degree of freedom).

This finding shows that the poor income (<5000 rupees) group of mothers has nearly double the odds of LBW compared to a family with =>5000 rupees income group.

95% C. I.

= exp (ln (odds ratio) ±1.96 (SE))

SE = sqrt (1/a + 1/b +1/c +1/d)

= sqrt (1/80 + 1/261+ 1/21+ 1/288)

= 0.255346

95% C.I.

= exp (ln (1.78) ± 1.96 (0.2554))

= exp (0.569 ± 0.5)

= exp (0.069, 1.07)

= (1.1, 2.9)

Odds of LBW in <5000 group = prob. of LBW / prob. of NBW......... (1)

= (80/701) / (621/701) =0.128824

Odds of LBW in =>5000 group = prob. of LBW / prob. of NBW .... (2)

= (21/309) / (288/309) = 0.074733

Odds Ratios is the ratio of odds in the <5000 group and => 5000 group, i.e.

Odds Ratio (OR) = 0.128824 / 0.074733 = **1.78**

Now taking equation (1), i.e. Odd of LBW in <5000 group

= prob. of LBW / prob. of NBW, or

= prob. of LBW / 1- prob. of LBW

=p(c|x) = p [outcome of interest | explanatory variable]

= p (LBW | x)

= p/(1-p)

Ln [p /1-p] $= b_0+b_1*x$

Taking the exponential of both sides gives

p (LBW | x) / 1-p (LBW | x) $= e^{[b0+b1*x]}$

p (LBW | x) $= e^{[b0+b1*x]}/[1+ e^{[b0+b1*x]}]$

p (LBW | x) $= e^{z}/[1+e^{z}]$ .... (A)

Where $Z=b_0+b_1*x$

Now

q(x) =1 – p (LBW | x)

$=1/[1+ e^{z}]$ .... (B)

Note that equation (B) estimate the probability of normal birthweight (NBW) in the exposed group (<5000 group, for x=1), and control group (=>5000 group, for x=0).

Using Logistic Regression

$$P(LBW|x) = \beta_0 + \beta_1 * x_1$$
$$= -2.618 + 0.569 * x_1 \quad \text{................ (C)}$$

Table 2: Logistic results using one dichotomous factor family income (<5000 Rupees, and =>5000 Rupees).

Birth weight(a)	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
							Lower Bound	Upper Bound
Intercept	-2.618	.226	134.1 95	1	.000	-	-	-
Family income <5000 Rupees	.569	.255	4.968	1	.026	1.767	1.071	2.914
Family income =>5000 Rupees	0(b)	.	.	0	.	.	.	.

a The reference category is: >=2.5 kg.
b This parameter is set to zero because it is redundant, where b_0=-2.618, b_1=0.569,
Wald statistic = $[b\text{'s} / \text{s.error}]^2$, and odds ratio = exp(0.569)=1.77 [Note that this is same as obtained through (ad / cb) formula manually from Table 1].

95% C.I. = exp [$\beta \pm 1.96$ (S.E. β)]
=exp [0.569±1.96(.255)]=[1.07, 2.91]

$$Z = -2.618 + 0.569\,(1) \qquad \text{for } x=1$$
$$= -2.049, \text{ and}$$

$$= -2.618 + 0.569\,(0) \qquad \text{for } x=0$$
$$= -2.618$$

Table 3: The probability of LBW and NBW in the exposed and controlled group.

Group	P(c/x)	
	Probability of (LBW) $p = 1/[1+e^{-z}]$	Probability of (NBW) $q = 1/[1+e^{z}]$
Exposed group (<5000 Rupees) x=1	$P(LBW/x)=1/[1+e^{2.049}]=0.114$ **Pr=11.4% (=0.114*100)**	$P(NBW/c)=1/[1+e^{-2.049}]=0.886$ **Pr=88.6%(=0.886*100)**
Controlled group (=>5000 Rupees) x=0	$P(LBW/x)=1/[1+e^{2.618}]$ p=0.068 **Pr=6.8%** (=0.068*100)	$P(NBW/c)=1/[1+e^{-2.618}]$ p=0.932 **Pr=93.2%** (=0.932*100)

p (probability of LBW); pr (proportion of LBW) in the relevant group.

Note: The proportion estimated in Table 3 through logistic regression method, are exactly identical as in the Table 1.

Multiple Logistic Regression

The probability of LBW in case of one covariate was estimated by

P(LBW, x=1) = $e^z / [1+e^z]$, Where $z = \beta_0 + \beta_1 * x_1$

In multivariate regression, the score "z" becomes a linear combination of the covariate values, as follows

P(LBW, x=i, i=1, 2, 3, ...n) = $e^z / [1+e^z]$

Where

$$Z = \beta_0 + \beta_1 * x_1 + \beta_2 * x_2 + \beta_3 * x_3 + \dots + \beta_n * x_n$$

The β's for the covariates, estimated through multiple logistic regression method are as follows:

Table 4: The coefficient of covariates, estimated through logistic regression method		
Number	Factor	β's
1	Tribal area	-0.134
2	Afghan Refugee	0.97
3	Consanguineous	0.871
4	Teenage mothers	2.122
5	Older age mothers	0.099
6	Preterm births	2.35
7	Anaemia	-0.106
8	Abortion/miscarriage	1.209
9	Tribal area*Anaemia	1.438
10	Preterm*Ab./miscarriage	-1.161
11	Constt (Without any prob.)	-4.53

However, the adjusted individual effect of covariates and adjusted effect of maternal age (teenage mothers) along with one other covariate is given below.

Table 5:

Number	Factor	β's	Status*	value
1	Tribal area	-0.134	0	0
2	Afghan Refugee	0.97	0	0
3	Consanguineous	0.871	0	0
4	Teenage mothers	2.122	1	2.122
5	Older age mothers	0.099	0	0
6	Preterm births	2.35	0	0
7	Anaemia	-0.106	0	0
8	Abortion/miscarriage	1.209	0	0
9	Tribal area*Anaemia	1.438	0	0
10	Preterm*Ab./miscarriage	-1.161	0	0
11	Constt (Without any prob.)	-4.53	1	-4.53
	Total (Z)			**-2.408**

* 1 for present, and 0 for absent

Table 5a: Estimation of probability of LBW and NBW

		exp(z)	1+exp(z)	1/1+exp(z)
LBW	(-z)	11.1117	12.1117	0.0825647
NBW	(+z)	0.09	1.09	0.9174353

Admission No: 8240

Date of Admn: 6/10/03

Please enter a figure or circle one answer in every question.

Maternal Registration:
- Booked
- Un-booked ✓

Status of entry:
- Regular/Normal
- Emergency ✓

Maternal health information:

Present age: 35 years

Marriage duration:

14 Yrs ____ months.

Height: 5.2 cm

Present weight: 60 kg.

Maternal Education:
- Illiterate ✓
- Primary school
- Middle/High school
- College/University

Maternal Professional status:
- Not employed ✓
- Employed

Nationality:
- Pakistani ✓
- Afghan-refugees

Area status: Jamrood
- Settled area
- Agency

Area:
- Rural
- Urban
- Urban Slum

If rural:
- Plain area
- Hilly area

Water Sources:
- Tap fresh water
- House well/other similar
- Any other ✓

Fathers' age: ________ years.

Fathers' Education
- Illiterate
- Primary school ✓
- Middle/High school
- College/ University

Family income per month from all sources:
- < 5,000 ✓
- 5,000-15,000
- > 15,000

Family status:
- Independent family ✓
- Combined family

Consanguinity:
- 1st cousin marriage
- 2nd cousin marriage ✓
- None

Distance from hospital/ B.H.U etc.
- <= 1 km
- 2-5 km
- > 5 km

Birth(s) History:
- Gravida: 7
- Para: 5.
- Total abortions/ miscarriages: 1.
- Total preterm deliveries: 0
- Gap between the start of this and the end of previous pregnancy: 3 yrs 6 months.
- Abortion/ miscarriages before this pregnancy:
  0) No ✓ 1) Yes
- No. of maternal visits to hospital/BHU during this pregnancy for antenatal check-ups: 2.

Diabetes:
- No ✓
- IDD
- NIDD

Anaemia:
- No ✓
- Mild
- Moderate
- Severe

Hypertension:
- No ✓
- Pre-gestational
- Gestational
- Pre-clampsia
- Eclampsia

Any other risk factor (s)
- No
- Yes ✓

Mode of delivery:
- Normal
- Caesarean ✓
- Any other

Information about the baby:
- Gestational age: 3
- Birth Weight: 2.
- Birth Length: ______
- Birth Head Circumference: ______
- Birth APGAR Scores: 8/

Fetal outcome/birth status:
- Live birth ✓
- Still birth
- Any other

Gender of birth:
- Female
- Male ✓

Congenital abnormality:
- No ✓
- Yes

Name of Doctor:

Signature: ________

Date: __/__/__

Appendix – V