An assessment of the dietary intake of pregnant women in the West Coast/ Winelands region, Western Cape Province: relation to low birth weight.

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A mini thesis submitted in partial fulfilment of the requirements for the degree of Magister Scientiae, in the Faculty of Community Health Sciences, University of the Western Cape.

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KEYWORDS

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Low birth weight

Preterm birth

Intrauterine growth retardation

Under-nutrition

Dietary intake

Nutrient deficiency

Dietary adequacy

Food frequency questionnaire

Food variety score

Dietary diversity score

ABSTRACT

AN ASSESSMENT OF THE DIETARY INTAKE OF PREGNANT WOMEN IN THE WEST COAST/ WINELANDS REGION, WESTERN CAPE PROVINCE: RELATION TO LOW BIRTH WEIGHT.

Masters (Nutrition Management) mini thesis, Faculty of Community Health Sciences, University of the Western Cape.

Introduction: Low birth weight (LBW) remains a public health problem in South Africa and particularly in the rural farming region in the Western Cape Province. Maternal smoking, alcohol consumption and household food insecurity are major concerns in this geographical area. **Aim:** This secondary analysis aimed to develop dietary scores to assess the dietary intake of pregnant women in the West Coast/ Winelands region and determine the association with LBW. Further to determine the association between the dietary scores and maternal socioeconomic and socio-demographic characteristics and maternal smoking and/or alcohol consumption during pregnancy. **Methods:** A case-control study including 198 cases (birth weight ≤2500g) and 202 controls (birth weight > 2500g) selected from postpartum women at the Paarl Hospital. The total case and control groups was further separated into a full term (≥ 37 completed weeks of gestation) case (n= 104) and control (n= 199) group and preterm (< 37 completed weeks of gestation) case (n= 94) and control (n=3) group. A non quantified food frequency questionnaire (FFQ) was used to record the women's food consumption during the previous month and formed the basis for the construction of the food variety score (FVS- count of food items consumed weekly) and the dietary diversity score (DDS- count of food groups consumed among six groups daily and weekly). **Results:** The bread/ cereal group was the most frequently consumed food groups and legumes least consumed food group across all case and control groups. Vegetable and fruit intake was low. More than 50% of the case and control mothers in total and full term group did not consume any milk or milk products. A positive correlation exists between both the FVS (r^2= 0.10579, p=0.0664)) and the daily-DDS (r^2= 0.15022, p=0.0088) and full term LBW. Maternal education is positively correlated with FVS

(r^2=0.12983, p=0.0099) and daily-DDS (r^2=0.13625, p=0.0067).No significant differences in the dietary scores between mothers who smoked and/ or consumed alcohol and those who practiced neither. However, in adjusted comparison the relationship between the dietary scores and birth weight seems to be affected by smoking and/ or alcohol consumption. **Conclusion:** This study suggests that mothers of infants with higher birth weights consume a diet with greater variety and diversity. Smoking and/ or alcohol consumption may mediate the relationship between dietary intake and infant birth weight.

DECLARATION

I declare that **"AN ASSESSMENT OF THE DIETARY INTAKE OF PREGNANT WOMEN IN THE WEST COAST/ WINELANDS REGION, WESTERN CAPE PROVINCE: RELATION TO LOW BIRTH WEIGHT"** is my own work, that it has not been previously submitted for any degree or examination in any other university and that all the sources I have used or quoted have been indicated and acknowledge as complete references.

Sharmilah Jaffer November 2008

Signed: …….

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LIST OF ACRONYMS AND ABBREVIATIONS

ACC/SCN	Administrative Committee on Coordination/ Sub Committee on Nutrition
AI	Adequate Intake
BMI	Body Mass Index
BP	Blood Pressure
CHD	Coronary heart disease
CHDS	Child Health Development Project
CI	Confidence Interval
DDS	Dietary diversity score
DRI	Dietary Reference Intake
EAR	Estimated Average Requirement
EuroFIR	European food Information resource Network
FAS	Foetal Alcohol Syndrome
FBDG	Food Based Dietary Guidelines
FFQ	Food Frequency Questionnaire
FOA	Food and Agriculture Organisation
FVS	Food variety score
HEI	Healthy Eating Index
HIV	Human Immune-deficiency Virus
HPT	Hypertension
IUGR	Intrauterine Growth Retardation
IOM	Institute of Medicine
LBW	Low Birth Weight
LBWR	Low Birth Weight Rate
LRI	Lower respiratory Infection

LIST OF ACRONYMS AND ABBREVIATIONS

MAR	Mean Adequate Ratio
MM	Multiple Micronutrient
MTVM	Mutlivitamin-Mineral
MUAC	Mid-upper arm circumference
NAR	Nutrient Adequate Ratio
NBW	Normal Birth Weight
NCPP	National Collaborative Perinatal Project
NFCS	National Food Consumption Survey
NIDDM	Non-insulin dependent diabètes mellitus
NRF	National research Foundation
OR	Odds Ratio
PIH	Pregnancy Induced Hypertension
PMTCT	Prevention of Mother to Child Transmission
RDA	Recommended Dietary Allowance
SA	South Africa
SADHS	South African Demographic and Health Survey
SGA	Small for Gestational Age
STD	Sexually Transmitted Disease
TORCH	Toxoplama gondii, Rubella, Cytomegalovirus and Herpes
UNICEF	United Nations Children's Fund
USDA	United States Department of Agriculture
UTI	Urinary Tract Infection
WC	Western Cape
WHO	World Health Organization

DEFINITION OF KEYWORDS

Pregnancy	the state of being pregnant; the period from conception to birth when a woman carries a developing foetus in her uterus
Low birth weight	: newborn birth weight less that 2500 grams
Preterm birth	: infants born before 37 completed weeks gestation
Intrauterine growth retardation (IUGR)	: a foetus with inadequate foetal growth for gestational age (results in an infant that is small for gestational age-SGA)
Under-nutrition	: an outcome of insufficient food intake and repeated infectious diseases. It includes being underweight (low weight-for-age), stunted (low height-for-age), wasted (low weight-for-height) and deficient in vitamins and minerals (micronutrient malnutrition)
Dietary intake	: that which is ingested or consumed through available foods
Nutrient deficiency	: occurs when the nutrient intake is not in balance with specific requirements for optimal health. It may stem from inadequate ingestion, impaired digestion of absorption, dysfunctional metabolic processing, or increased excretion of essential nutrients
Dietary adequacy	: achievement of the recommended intakes of energy and other essential nutrients is often used and refer to as to dietary quality.
Food frequency questionnaire	: a method of dietary assessment in which the data collected relate to how frequent foods are consumed (e.g. per day, week or month).
Food variety score	: usually defined as the number of different food items consumed over a given reference period.
Dietary diversity score	: usually defined as the number of different food groups consumed over a given reference period.

CHAPTER 1

INTRODUCTION TO THE STUDY

1.1. Introduction

A healthy intrauterine environment is vital for optimal foetal growth and development (Wu et al., 2004) and consequently, weight at birth is a reflection of this experience. Birth weight is not only a good indicator of a mother's health and nutritional status (Merialdi et al., 2003) but also a powerful predictor of a newborn's chance of survival, growth, long-term health and psychological development (Wardlaw, Blanc, & Ahman, 2004).

Low birth weight (LBW) is defined by the World Health Organisation (WHO) as a birth weight of less than 2500 grams. Since birth weight is determined by two processes: duration of gestation and the rate of foetal growth (Kramer, 2003), infants can have a LBW either because they are born preterm i.e. born prior to 37 weeks of gestation (Kramer, 2003; Moore et al., 2004) or because they are born small for gestational age (SGA). Intrauterine growth retardation (IUGR i.e. less than the 10^{th} percentile weight for gestational age) is often used as a proxy for SGA (Kramer, 2003; Merialdi et al., 2003).

The majority of LBW infants in developing countries are due to IUGR, while most LBW infants in developed countries are due to preterm birth (Ramakrishnan, 2004). LBW infants generally suffer higher rates of morbidity and mortality from infectious diseases (Guyatt & Snow, 2004) and often remain underweight, stunted or wasted from the neonatal period through childhood (Li et al., 2003; Neufeld et al., 2004).

LBW is also associated with poor cognitive development (Fernald & Granthan-McGregor, 2002), impaired immune function, and high risks of developing acute diarrhoea or pneumonia. It is estimated that in Bangladesh, almost half of the infant deaths from pneumonia and diarrhoea could be prevented if low birth weight was eliminated (Pojda & Kelly, 1999). Recent evidence shows that impaired intrauterine growth and development increases the risk of developing chronic diseases including hypertension (HPT), non-insulin dependant diabetes mellitus (NIDDM), coronary heart disease (CHD) and stroke in adulthood (Godfrey & Barker, 2000).

The maternal environment is the most important determinant of birth weight. Factors that prevent normal circulation across the placenta cause poor nutrient and oxygen supply to the foetus, restricting growth. These factors may include maternal under-nutrition, malaria (where it is endemic), anaemia, acute and chronic infections such as sexually transmitted diseases (STD's) and urinary tract infections (UTI's), foetal genetic or chromosomal anomalies, primiparity (first-time births), multiple births, as well as maternal disorders or renal diseases such as hypertension (Pojda & Kelly, 1999). Cigarette smoking and preeclampsia pose the highest relative risks for IUGR in developed countries, while alcohol and drug use may also restrict foetal growth (Pojda & Kelly, 1999). In developing countries the most important determinants of IUGR stem primarily from the mother's poor health and nutritional status (Wardlaw, Blanc & Ahman, 2004). In contrast, preterm birth may not be related to nutritional factors. Important causes of preterm birth include: genital tract infection, multiple-birth, pregnancy-induced hypertension (PIH), low pregnancy body mass index (BMI), incompetent cervix, history of prior preterm birth, heavy work and (where prevalent) cigarette smoking (Kramer, 2003).

The importance of maternal lifestyle and behaviour during pregnancy cannot be overemphasized. For the purpose of this study smoking and alcohol are the two lifestyle risk factors examined. The reduction in birth weight that accompanies smoking in pregnancy was first reported on in the 1950's and many studies since have confirmed this finding (McDonald, Armstrong & Sloan, 1992). It is proposed that smoking could affect intrauterine growth in at least 3 different ways. The first mechanism is foetal hypoxia due to reduced maternal blood supply to the placenta. The second is the effect of nicotine causing uterine vasoconstriction (Pollack, Lanntz & Frohna, 2000), and lastly, cyanide components may interfere with foetal oxidative metabolism (Rondo et al., 1997).

Alcohol readily crosses the placenta and even moderate alcohol consumption during pregnancy has a negative effect on foetal growth and development, thus birth weight (Brown, 2008:148). Low birth weight, decreased head circumference and length have been reported to be significantly correlated with exposure to alcohol during the first two months of pregnancy (Day et al., 1989).

1.2. Study Setting

The Western Cape (W.C.) Province of South Africa (S.A.) is home to approximately 220 000 farm workers and their estimated 1.5 million dependents (Dowry, 2007). The West Coast/ Winelands region of the W.C. Province is a primarily rural farming region with five sub-districts: Malmesbury, Paarl, Stellenbosch, Vredenburg and Vredendal. Farms in this region mainly produce wine, deciduous fruit and wheat. The majority of the workers on the farms in the region are Afrikaans-speaking coloured people. Seasonal work demands are high, particularly in the grape and fruit sectors,

and usually draw on female labour from peripheral towns and other farms (London, 1999). In South Africa, farm work has historically been characterised by extremely poor living conditions, including low wages, inadequate housing, poor sanitation, inadequate water supplies and paternalistic and coercive labour relations (London et al., 1998). The apartheid policies enabled this exploitation of farm workers as there then were no laws governing the relationship between farm worker and farmer. Since 1994 many laws were introduced specifically aimed at protecting the rights of this vulnerable community (Shabodien, 2006). It is a common trend for farm worker families to work for the same farmer family for many generations; the farm worker is "passed on" from father to son (Shabodien, 2006). This promotes a culture of poverty among farm worker families as they are trapped in these harsh socioeconomic and environmental conditions for generations.

As evidenced from routine district data, in 1999 there were 9461 births of which 19.2% had a birth weight < 2500g. Rates within some of the sub-districts are even higher: Malmesbury 19%, Paarl 20% and Vredendal 23% (Medical Research Council, 2000a). The Administrative Committee on Co-ordination /Sub-committee on Nutrition (ACC/SCN) consider a LBW rate over 15% to be a "major public health problem" (De Onis, Blossner & Villar, 1998).The Saving Babies 2003-2005 Report, reports a LBW rate of 15.5 % for South Africa (Saving Babies 2003-2005: Fifth Perinatal Care Survey of South Africa, 2007).

From the statistics above it is evident that the West Coast/ Winelands region have unacceptably high rates of LBW infants. LBW has short and long-term consequences for the health of the infant and also often indicates poor health and nutritional status in

the mother (Maart, 2003). Alcohol use and smoking during pregnancy are known risk factors for LBW and are also high in the West Coast/ Winelands region (Jackson, Batiste & Rendall Mkosi, 2007; Maart, 2003).

1.3. Research Problem

Many women living on the commercial farms in the region are at high risk of delivering low birth weight babies as many of the risk factors described in the literature seem to fit their profile. Women on most farms are seen as an extension of the work force and as farm workers they receive low wages, poor housing facilities, access to education is difficult, and health indicators are substandard. These social conditions and the high levels of poverty often lead to food insecurity (Prince, 2004). There is also a high prevalence of smoking and alcohol consumption among women farm workers (Shabodien, 2006) even during pregnancy (Jackson, Batiste & Rendall Mkosi, 2007).

Cigarette smoking has been found to be associated with a less healthy diet (lower intake of fruit and vegetables) in men and females (Osler et al., 2002) and in pregnant women (Olafsdottir et al., 2006). Unhealthy alcohol drinking patterns may go hand-in-hand with unhealthy eating habits according to recent research examining diet quality of individuals who drink any kind of alcoholic beverage. They found that as the quantity increased from 1 to ≥ 3 drinks/ drinking per day, the mean healthy eating index (HEI) score decreased from 65.3 (95% CI: 63.4, 67.1) to 61.9 (95% CI: 60.5, 63.2). It was also found that people who drink the largest quantities of alcohol; even infrequently; have the poorest quality diets i.e. the lowest mean HEI score, 58.5 (95 percent CI: 55.5, 61.5), was observed among drinkers who consumed the highest

quantity at the lowest frequency. Conversely, people who drink the least amount of alcohol; regardless of drinking frequency; have the best quality diets. The Health Eating Index (HEI), measures how closely an individuals diet conforms to the U.S Department of Agricultures (USDA) recommendations regarding vegetables, fruit, grains, meat and milk as well as total fat, cholesterol, and sodium consumption (Breslow, Guenther & Smothers, 2006).

The association regarding smoking and alcohol with diet quality needs to be investigated in the study population. However, based on the above premises it is speculated that the overall diet quality (i.e. variety and/ or diversity) may also adversely be affected by smoking and alcohol.

1.4. Research Hypothesis

A relationship exists between poor dietary quality during pregnancy and low birth weight in women in the West Coast/ Winelands region.

1.5. Study aim

The aim of this case-control study is to determine the association of dietary quality in pregnant women in the West Coast/ Winelands region with infant low birth weight.

1.6. Study objectives

The study sets out to:

1) Describe the weight (at 1st antenatal visit) and height of mothers with low birth weight infants and with normal birth weight infants.
2) Describe the dietary intake of pregnant women based on food variety and diversity scores (i.e. food variety score (FVS) and dietary diversity scores (DDS).
3) Determine the association between the dietary scores (FVS and DDS) and infant birth weight.
4) Determine the association between the dietary scores (FVS and DDS) and maternal socioeconomic/ demographic characteristics.
5) Determine the association between the dietary scores (FVS and DDS) and smoking and/or alcohol intake.

1.7. Delimitation of the study area/Assumptions

The study was conducted at Paarl Hospital, which is the regional referral hospital for the West coast / Winelands region. The Paarl district serves a population of 200 000 people, and is part of the West coast / Winelands region, which has a population of 530 000. The study focused on pregnant women who delivered their babies at the Paarl Hospital (Jackson, Batiste & Rendall Mkosi, 2007).

A pilot review was conducted in 2000 on the delivery register at Paarl hospital. The aim of the review was to investigate the expected deliveries per month, the rates of low birth weight, pre-term birth and small for gestational age (defined as LBW at term). The total births for 2000 were 3870, with an average of 323 per month. The

overall LBW was 21.4%, pre-term delivery rate was 10.2% and term low birth weight was 11.2% (Jackson, Batiste & Rendall Mkosi, 2007). Thus it is evident that a substantial amount of low birth weight babies are delivered at this hospital

In developing countries and in this study population, many factors contribute to the poor health and nutritional status of childbearing-aged women and thus, to the occurrence of LBW. This mini-thesis will focus on the dietary intake of women during the pregnancy as well as on the interaction between dietary intake and other lifestyle risk factors (alcohol and smoking). The latter presents a major problem based on the profile of the West coast / Winelands region who presents high rates of these potentially preventable lifestyle risk factors.

This study included the following assumptions: LBW babies at Paarl Hospital are representative of LBW babies in the West coast/Wine lands region; and dietary recall postpartum will be an accurate reflection of maternal nutritional intake during pregnancy.

1.8 Short background of the Project

This mini thesis forms part of the Healthy Childbearing Study on low birth weight, funded by the South African National Research Foundation (NRF) since 2001 as a five-year student-based research project. The main aim of the study was to examine the problem of high rates of low birth weight infants being reported in the West Coast / Winelands region. The results on the association between the non-dietary aspects of the standard questionnaire (i.e. lifestyle and/ or behavioural risk factors including

alcohol, smoking, and stress during pregnancy) and birth weight has been presented in other publications:

- Jackson, D (ed.) (2004).Healthy Childbearing Study- West Coast/ Winelands District Western Cape Province: Formative research results 2002-2003. Cape Town: School of Public Health, University of the Western Cape.
- Jackson, D.J., Batiste, E., and Rendall Mkosi, K. (2007). Effect of smoking and alcohol use during pregnancy on the occurrence of low birth weight in a farming region in South Africa. Paediatric and Perinatal Epidemiology, 21 (5): 432-440.
- Maart, L.C. (2003). Knowledge, Attitudes and Practices related to lifestyle factors among childbearing women in the Western Cape, West Coast/ Winelands region. Unpublished Master's thesis. School of Public Health. Univeristy of the Western Cape.

As a NRF bursary holder, specializing in human nutrition I conducted a secondary analysis on the database with the main focus on evaluating the dietary intake of pregnant women in the West Coast/ Winelands region, and assessing the effect thereof on birth weight. The study design, population, sampling and data collection methods described below are in accordance with that of the primary study.

1.9 Conclusion

This chapter has briefly outlined the major issues addressed by the larger study as well as introduced the focus of this secondary analysis. The next chapter will provide an extensive literature review.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

There are many contributing factors to the occurrence of LBW, but in developing countries poor health and nutritional status of the mother is the major determinant (Wardlaw, Blanc, & Ahman, 2004). This literature review aims to provide an overview of the prevalence of LBW as well as describe the effect of the mother's nutritional factors both before and during pregnancy on birth outcome, i.e. LBW. The review will also include a discussion on the effect of maternal behavioural factors (alcohol and smoking) on birth weight.

An additional purpose of this literature review is to specify what is meant by "maternal nutrition". Maternal nutrition comprises of anthropometric factors such as pre-pregnancy weight-for-height (i.e. body mass index –BMI); maternal stature and gestational weight gain (which partly reflects the balance between energy intake and energy expenditure), as well as the dietary intake of macronutrients (protein, carbohydrate, and fat) and micronutrients (vitamins and minerals) (Kramer, 1998).

2.2. Prevalence of LBW

Low birth weight remains a significant and public health problem in many parts of the world. It is estimated that at least 20 million infants with LBW are born world wide every

year, representing a global Low Birth Weight Rate (LBWR) of 15.5%. The level of LBW in developing countries i.e. (16.5%) is more than double the level in developed regions (7%). Further, more than 95% of LBW babies are born in developing countries (Wardlaw, Blanc & Ahman, 2004). However, the prevalence of LBW varies widely among developing countries: 30-55% in South Central Asia versus 15-25% in Sub-Saharan Africa and 10-20% in Latin America (Ramakrishnan, 2004). In countries where the prevalence of LBW is very high, most LBW infants are growth restricted (IUGR) rather than preterm (Kramer, 2003; Ramakrishan, 2004; Fall et al., 2003).

The LBW rates in many developing countries are higher than the goal of less than 10% that was established by the 1990 World Summit for Children (Ramakrishnan, 2004). However, it should be noted that, more that half (58%) of the births in the developing world are not weighed due to many of the deliveries occurring at home. As a result, much of the available data may be biased toward hospital deliveries, and thus may be an underestimation of the true prevalence of LBW (Wardlaw, Blanc & Ahman, 2004)**.**

In South Africa the overall low birth weight rate (LBWR) reported by the 2003-2005 Saving Babies Report was 15.5% and in the Western Cape Province it was 18.1% in 2006. When compared to the rest of the country, the Western Cape Province has a higher LBWR; this could probably be explained by the higher LBWR in the rural areas in the province. To illustrate this, routine district data for the West Coast/ Winelands region in the WC Province reported a LBWR of 19.2% in 1999 and rates within some of the sub-districts were even higher: Malmesbury 19%, Paarl 20% and Vredendal 23% (Medical

Research Council, 2000a). According to the Administrative Committee on Co-ordination /Sub-committee on Nutrition (ACC/SCN) a LBW rate over 15% is considered a "major public health problem" (De Onis, Blossner & Villar, 1998).

2.3. Causes of low birth weight

Pre-maturity and IUGR are the two main causes of LBW. However, the etiological determinants of preterm birth and IUGR are different, so treating them as a single entity i.e. as LBW, can hinder the progress of developing preventative interventions (Kramer, 2003). However, many studies in developing countries report the data as LBW, as it is difficult to identify prematurity, as many women are not certain of their gestational age (Guyatt & Snow, 2004), also due to late and infrequent access to prenatal care (Kramer, 2003). Table 2.1 lists the most important etiologic determinants of preterm birth and IUGR in developing countries.

2.3.1. Preterm birth

There are many determinants of preterm birth amongst which are genital tract infection, multiple birth, pregnancy-induced hypertension, low pre-pregnancy BMI, incompetent cervix, history of prior preterm birth, heavy work and (where prevalent) cigarette smoking. A short interval (<6 months) between pregnancies is often reported as a determinants of preterm birth or IUGR (Kramer, 2003).

Table 2.1: The determinants of preterm birth and intrauterine growth retardation in developing countries

Preterm birth	Intrauterine growth retardation
Genital tract infection	Low energy intake, low gestational weight gain
Multiple birth	Low pre-pregnancy body mass index
Pregnancy-induced hypertension	Short stature
Low pre-pregnancy body mass index	Malaria
Incompetent cervix	Cigarette smoking
Prior preterm birth	Primiparity
Abruptio placentae	Pregnancy-induced hypertension
Heavy work	Congenital anomalies
Cigarette smoking	Other genetic factors

Source: (Kramer, 2003)

2.3.2. Intrauterine growth retardation (IUGR)

The maternal environment is an important determinant of fetal growth. Maternal nutrition is a major influence on the intrauterine environment as it encompasses the complete supply line of maternal intake, circulating concentrations, uteroplacental blood flow, and nutrient transfer across the placenta (James & Stephenson, 1998). Any factors that prevent normal circulation across the placenta cause poor nutrient and oxygen supply to the fetus, restricting growth (Pojda & Kelly, 1999). There are maternal and uteroplacental factors that could restrict foetal growth. The maternal pre-pregnancy factors include a low pre-pregnant BMI, and poor periconceptual nutritional status e.g. folate deficiency can affect embryogenesis. Maternal causes of IUGR during pregnancy include low pre-pregnancy weight and small maternal size, high parity and poor weight gain, especially in latter half of pregnancy (could be associated with poverty, adolescence, anorexia nervosa,

food faddism). Chronic illness- such as malabsorption, diabetes, renal disease and hypertension, acute and chronic infections (such as sexually transmitted diseases (STD) and urinary tract infections (UTI), malaria (where it is endemic) are also common causes of IUGR. Maternal behavioural factors such as smoking, drug and alcohol use influences maternal nutrition and decreases oxygen availability to foetus (high altitude, severe maternal anaemia), thus affecting foetal growth (Vandenbosche & Kirchner, 1998).

Inadequate placental growth, uterine malformations, decreased uteri-placental blood flow (e.g. toxaemias of pregnancy, diabetic vasculopathy) and multiple gestations results in uteroplacental insufficiency (Vandenbosche & Kirchner, 1998).

Infectious causes of foetal growth delay account for 10 percent of all cases of IUGR. These causes include the "TORCH" group: toxoplasma gondii, rubella, cytomegalovirus, and herpes simplex virus types 1 and 2) and other potential pathogens include hepatitis A and hepatitis B, parvovirus B19, human immunodeficiency virus (HIV) and syphilis (Vandenbosche & Kirchner, 1998).

2.3.2.1 Symmetric versus asymmetric growth retardation

The effect of growth restriction depends on the timing of the growth-retarding factor. When growth restriction is experienced during early foetal life, it will cause a symmetrically (or proportional) growth retarded foetus, characterized by a normal ponderal index, but the length, weight, head and abdominal circumference are all below the 10^{th} percentile for a given gestational age (i.e. a stunted newborn); while growth

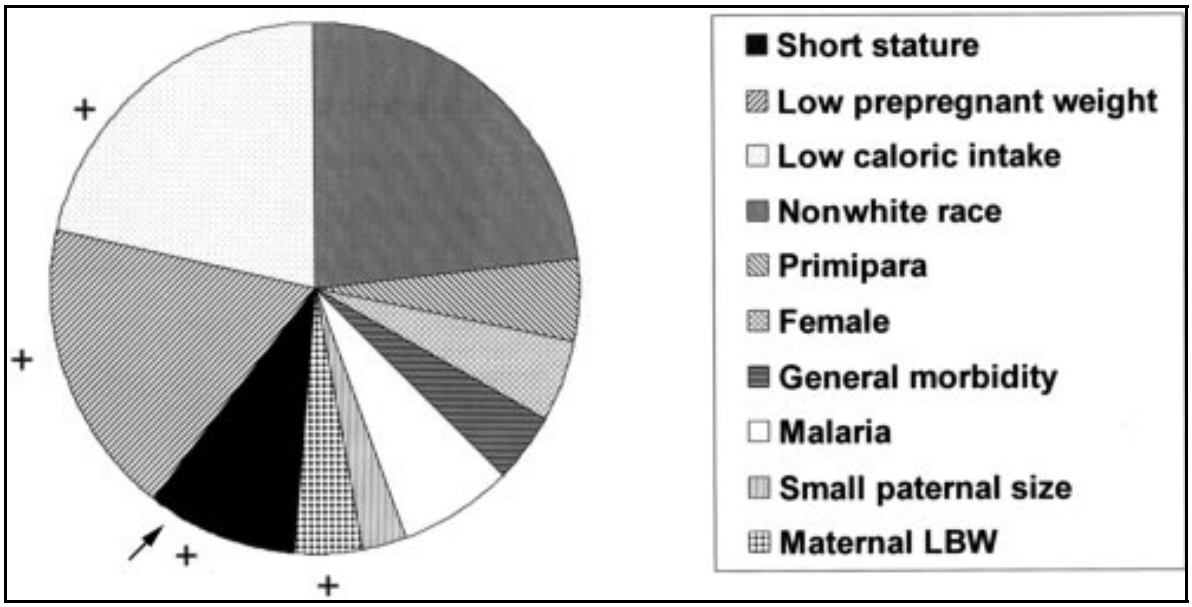
restriction late in pregnancy will cause asymmetrical growth retardation (or disproportionate) characterised by normal length and head circumference but low weight - due mainly to a lower proportion of visceral and fat tissue (i.e. a wasted newborn), the ponderal index is low (Curtis & Rigo, 2004). The ponderal index is a measure of leanness or an indicator of wasting in infants and is calculated as [body weight (g) X 100/ (length $(cm)^3$] Ashworth, Morris & Lira, 1997).

2.4. Risk factors for LBW

2.4.1. Maternal nutritional status and LBW

In developing countries the main direct causes of intrauterine growth retardation (IUGR) are nutritional (Wardlaw, Blanc, & Ahman, 2004). IUGR occurs when women suffer from low weight and short stature before pregnancy (poor nutritional status at conception) and then gain too little weight during pregnancy, primarily because of inadequate dietary intake (they do not consume enough food) or because infection compromises the absorption or utilization of the food they do eat. These nutritional causes account for more than 50% of the cases of LBW in many developing countries. Each of these direct causes is discussed below. See Figure 2.1 which highlights the nutritional determinants of low birth weight (Ramakrishnan, 2004).

FIGURE 2.1: The determinants of low birth weight (LBW) in developing countries

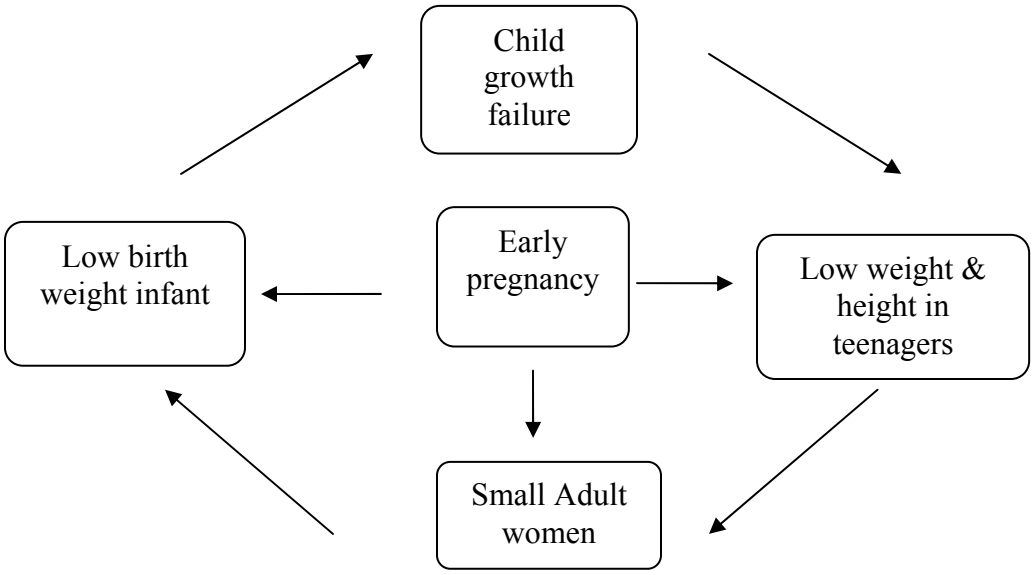


A plus sign indicates a nutritional factor. The key to the shading starts with the arrow indicating short stature, in a clockwise direction. (Female in the key refers to female child). Source: Ramakrishan, 2004

2.4.1.1. Maternal stature

Maternal stature and pre-pregnancy weight, which are the result of genetic and environmental influences before pregnancy, are well established determinants of birth size, particularly in developing countries (Kramer, 1987). According to the second ACC/SCN report, 1992 cited in Ramakrishnan (2004), LBW is often the result of the classic pattern in developing countries i.e. the intergenerational cycle of growth failure, see Figure 2.2 - female low birth weight neonates often continue to experience a pattern of growth failure and in turn become stunted children, small teenagers and then small adult women who most likely have children at an early age (which further reduces their opportunity to reach optimal body size with adequate nutrient stores before conception) and thereby, results in the next generation of low birth weight infants. Thus, the cycle of low birth weight continues.

Figure 2.2: Intergenerational cycle of growth failure



Source: Ramakrishan, 2004 (adapted from: Administrative Committee on Coordination/ Sub-committee on Nutrition Second report on the world nutrition situation. Geneva: ACC/SCN, WHO, and Washington, DC, 1992)

Strong evidence of major intergenerational effects in humans has come from studies showing that a woman's birth weight influences the birth weight of her offspring (Phillips, 2006). Analysis on an Illinois dataset of birth records of African American and White infants born between 1989 and 1991 and their mothers born between 1956 and 1975, found that maternal low birth weight is a risk factor for infant IUGR and this relationship is consistent across maternal age, education, marital status, prenatal care, cigarette smoking, and racial subgroups (Simon et al., 2006).

2.4.1.2. Pre-pregnant Body Mass Index (BMI)

The nutritional status before pregnancy and during the first few weeks of pregnancy is most important as by this time most of the cell organisation, differentiation and organogenesis will have already taken place (James & Stephenson, 1998). Women who are underweight before pregnancy are more likely to deliver preterm and give birth to a LBW infant. Further, the risk for a LBW baby is increased for underweight women if they fail to gain adequate weight during pregnancy (Fowles, 2004). A cohort study conducted in South Carolina supports this finding. They found that women with an underweight preconception BMI and inadequate weight gain during pregnancy were 1.9 times more likely to deliver a LBW infant (Hulsey et al., 2005).

2.4.1.3. Maternal weight gain during pregnancy

Several studies have suggested an association between maternal weight gain and low birth weight (Hulsey et al., 2005; Strauss & Dietz, 1999). Pregnant women who gain too much weight are likely to deliver infants who are larger for gestational age, and the women are likely to retain the weight after delivery. These women are also at an increased risk for complications such as hypertension during pregnancy and gestational diabetes (Baeten, Bukusi, & Lambe, 2001). In contrast, woman who gain too little weight during pregnancy are at risk of giving birth to infants who weigh much less than expected (Abrams, Altman, & Pickett, 2000; Siega-Riz, Adair, & Hobel, 1996). The rate of weight gain in pregnancy appears to be as important to birth outcomes as is the total weight gain. Hence, low weight gain in early, middle and late pregnancy are likely to affect the foetus differently (Siega-Riz, Adair, & Hobel, 1996). For underweight and normal weight

women, rates of gain of less that 0.25kg per week in the second half of pregnancy, and less than 0.37kg per week in the third trimester, doubles the risk of preterm delivery and SGA infants. For overweight and obese women, rates of gain less than 0.25kg per week in the third trimester also doubles the risk of preterm birth. Whereas, third trimester weight gain exceeding ± 0.7 kg per week add little to birth weight in normal weight or heavier women, and may increase postpartum weight retention (Brown, 2008:100-101).

The National Collaborative Perinatal Project (NCPP) collected data prospectively in 12 university medical centres across the United States. The women enrolled were mainly from a mixed racial, urban population. The Child Health and Development Study (CHDS) was conducted in the San Fransico Bay within the Kaiser health system. These women were mainly from a white suburban population. These cohorts examined the relationship between maternal weight gain in individual trimesters and the risk of IUGR in 10 696 women. They found that low maternal weight gain in the first trimester, defined as < 0.1kg per week, had no significant effect on the prevalence of IUGR. However, in both studies low weight gain in the second and third trimesters, defined as < 0.3 kg per week, significantly increased the risk of IUGR. This risk was even higher after controlling for other factors known to affect foetal weight such as maternal height, BMI, parity, smoking, toxaemia and diabetes (Strauss & Dietz, 1999).

2.4.2. Maternal behavioural factors and LBW

2.4.2.1. Smoking during pregnancy

The negative effect of maternal smoking on birth weight was reported on in the 1950's and many studies have since confirmed this finding. Maternal smoking during pregnancy has been shown to be associated with an increased risk of preterm birth, low birth weight and SGA (Mcdonald, Armstrong & Sloan, 1991). It is proposed that smoking could affect the intrauterine growth through three different mechanisms. The first mechanism is foetal hypoxia due to reduced maternal blood supply to the placenta. The second is the effect of nicotine causing vasoconstriction (Pollack, Lanntz & Frohna, 2000) and lastly, cyanide compounds may interfere with foetal oxidative metabolism (Rondo et al., 1997).

In a cohort of 5166 live births in Brazil in 1993 it was established that there was a direct dose-response association between the number of cigarettes smoked and the risk for growth retardation. They also concluded that the effect of maternal smoking on low birth weight was more attributed to IUGR rather than preterm delivery. The risk for IUGR was 2.07 times higher in mothers who smoked and, women's whose partner's smoked was also at higher risk of having a child with growth retardation (Horta et al., 1997). The Generation R study in the Netherlands showed that passive smoking in late pregnancy is associated with adverse effects on weight and gestational age at birth (Jaddoe et al., 2008). A South African cohort of 1593 women with singleton live births observed a lower mean birth weight of 165 g for babies of smoking mothers ($p=0.005$). However, passive smoking did not affect birth weight significantly in this population (Steyn et al., 2006)

Berstein et al. (2005) found smoking to have a greater effect on reduction of foetal growth velocity than preterm birth and further demonstrated that third trimester smoking consumption to be the strongest predictor of low birth weight. An estimated 27g reduction in birth weight was seen with each addition cigarette smoked in the third trimester.

Smoking cessation before the second trimester was found to reduce the risk of LBW to almost that of non-smokers i.e. have babies with similar birth weight patterns as non-smokers. The risk was also consistently reduced in women who cut down their consumption (Horta et al., 1997).

It is has also been suggested that cigarette smoking is associated with low maternal weight gain; however, the mechanism by which this occurs is not clear. It has been hypothesised that smoking reduces appetite so that women who smoke consume less calories than those who do not smoke, resulting in low weight gain during pregnancy (Furuno, Gallicchio & Sexton, 2004). This hypothesis has been supported by some studies, but not others (Perkins, 1992; Rantakallio & Hartikainen-Sorri, 1981)

Data from a study of 265 pregnant women reported no difference in the mean maternal weight gain between smokers and non-smokers (14.4 kg vs. 13.9 kg, respectively, $p=0.80$). However, a greater proportion of smokers were categorised as having low maternal weight gain compared to non-smokers. The regression analysis showed that the odds of a low maternal weight gain were 1.34 times greater for smokers than non-

smokers (OR = 1.3, 95% CI 0.73, 2.67). This result did not change after adjusting for daily caloric intake, age, and length of gestation. These findings indicate that the adverse effect of smoking on maternal weight gain during pregnancy is independent of caloric intake (Furuno, Gallicchio & Sexton 2004).

Despite S.A's prominent antismoking policy, cigarette smoking still accounts for a large burden of preventable disease and 8-9% premature mortality (Groenewald et al., 2007).

2.4.2.2. Alcohol consumption during pregnancy

Alcohol readily crosses the placenta and for the developing foetus, without the fully developed enzymes to break it down, the alcohol remains longer in foetal circulation. Alcohol exposure at critical periods of growth and development can permanently impair organ and tissue formation and growth. Even moderate alcohol consumption during pregnancy has a negative effect on infant birth weight (Brown, 2008). Alcohol consumption during the first two months of pregnancy have been reported to be significantly correlated with LBW, decreased head circumference and length at birth (Day et al., 1989). The consumption of 4 or more drinks a day, or occasional episodes of 5 or more drinks in a row, is considered heavy alcohol intake (or binge drinking) during pregnancy. Approximately 40% of the foetuses born to heavy drinkers will develop Foetal Alcohol Syndrome (FAS) (Brown, 2008: 148). Thus the growth retarding effect of alcohol on the foetus may occur at a lower level of alcohol consumption, than is required to produce FAS.

According to the South African Demographic and Health Survey (SADHS) of 1998, one-third of the current drinkers reported risky drinking over weekends i.e.5 or more drinks per day for men and 3 or more drinks per day for women (SADHS, 1998). In the Western Cape Province, 34% of urban women drink and 46-51% of rural women drink during pregnancy (Croxford & Viljoen, 1999). Thus, it should come as no surprise that this province not only has the highest rates of FAS in South Africa, but the highest rates in the world. This is the devastating repercussion of the 'dop system' i.e. a system where farmer workers received alcohol as partial payment for their work. Although it has been made illegal after 300 years of implementation, it has promoted and sustained a culture of alcohol intake (May et al., 2005; McKinstry, 2005).

The harmful effects of alcohol exposure during pregnancy may be related to the poor dietary intakes of some women who consume alcohol regularly in pregnancy, as well as the negatives effects of alcohol on the availability of certain nutrients (Brown, 2008: 148).

2.4.3. Human Immune Deficiency Virus (HIV)

The HIV pandemic is a major problem in SA. In 2005 27.9% of South African pregnant women were positive at the time of booking at an antenatal facility nationally and 15% in the WC (Actuarial Society of South Africa, 2005). In a case-control study in Kenya (177 HIV-positive versus 326 HIV-negative), 9% of all HIV positive mothers gave birth to LBW babies. In the symptomatic group 17% gave birth to LBW infants and of the

asymptomatic group 6% gave birth to LBW infants. Overall the mean birth weight in infants of HIV positive mothers were significantly lower than control mothers (3090 versus 3220g, p= 0.005) (Braddick et al., 1990).

2.5. Consequences of LBW

2.5.1. Neonatal and infant morbidity and mortality

Low birth weight is a major determinant of neonatal and infant mortality (Wardlaw, Blanc, & Ahman, 2004).The risk of neonatal death for infants weighing 2000-2499 g at birth is estimated to be four times higher than for infants weighing 2500-2999 g, and ten times higher than for infants weighing 3000-3499 g (Ashwoth, 1998). Interference in growth may influence cognitive performance. A positive association between birth weight in the normal range and cognitive function has been observed in young adults (Sorensen et al., 1997). IUGR infants suffer from impairment of most immune functions and have an increased risk of diarrhea and pneumonia (Pojda & Kelly, 1999). This contributes to the high mortality rates seen in these infants. According to the South African National Burden of Disease Study the leading causes of death in children less than five years of age in the W.C. Province in 2000 was HIV/AIDS (one-fifth of all deaths), diarrhoea, low birth weight and lower respiratory infection (LRI); a similar pattern was shown for boys and girls in this age group. Low birth weight, diarrhea, lower respiratory infections and protein energy malnutrition account for 30% of the childhood deaths. These deaths are largely preventable through the delivery of the standard primary health care package (Bradshaw et al, 2003).

Reducing the incidence of LBW by at least one third between 2000 and 2010 is one of the major goals of 'A World fit for Children', the Declaration and Plan of Action adopted by the United Nations General Assembly. The reduction of LBW would contribute significantly towards the Millennium Development Goals (MDG) for reducing child morality (Wardlaw, Blanc, & Ahman, 2004).

2.5.2. Growth of infants and children

Stunting at birth and during childhood is associated with adverse consequences such as increased risk of morbidity and mortality, reduced intellectual performance, and later outcomes such as reduced work capacity (Martorell et al., 2001) and increased risk of stunting in adulthood (Ashworth, Morris & Lira, 1997;).

Some of these problems may be improved if LBW infants experience good postnatal catch-up growth i.e. accelerated growth; and achieve a similar body size compared with other children of the same age later in life (Curtis & Rigo, 2004). However, not all children catch up; and stunting in early life increases the risk of shortness in adulthood (Ashworth, Morris & Lira, 1997).

Despite the normalisation of childhood height and weight in growth retarded foetuses, recent research on foetal and early postnatal growth suggests that rapid growth in children may be detrimental later in life (Caballero & Popkin, 2002; Victora et al., 2001)

The cause of this is not known but may be that catch-up growth alters body composition in later life (Victora et al., 2001).

According to the National Food Consumption Survey (NFCS) in South Africa stunting (height-for-age < -2SD) was the most prevalent (21.6%) nutritional disorder affecting children 1-9 years. The prevalence of severe stunting (height-for-age < -3SD) in children living on commercial farms was found to be 12.5%, in rural areas (8%) and in tribal areas (7%), all of which was higher than the national average of 6.5% (Labadarios et al., 1999).

2.5.3. Obesity in children

According to the NFCS the prevalence of combined overweight and obesity at the national level was 17.1% in children 1-9 years (Labadarios et al., 1999). Hence the problem of overweight and obesity in children has become a matter of growing concern and the risk of adult morbidity and mortality that may follow childhood-onset of obesity is potentially of great public significance.

A longitudinal cohort study of children (n=162) in rural villages of the Limpopo Province (S.A) followed from birth reported a high prevalence of stunting (48%), overweight (22%) and obesity (24%) at three years, while 31(19%) of the children were both stunted and overweight. Being underweight at birth and having rapid weight gain within the first year of life increased the risk of being overweight at three years six-fold. Demographic associations with being overweight at this age included: having a mother younger than 20

years old, having the mother as the main caregiver and having a working mother (Mamabolo et al., 2005). The results from these studies highlight the importance of evaluating both undernutrition and overnutrition in populations.

Over the last few years, the prevalence of overweight and obesity has increased rapidly in the low and middle income countries of the developing world (Popkin, 2001) far more rapidly than in the higher income countries (Popkin, 2002) The phenomenon nutrition transition encompasses changes in food availability, food preferences, and lifestyle all associated with urbanization and globalization (Popkin, 2001). Countries undergoing nutrition transition present with a dual burden of underweight in children and overweight in its adults population (Caballero & Popkin, 2002). Since the problem of LBW has been observed in the developing world for decades, the ecological factors which comprise the nutrition transition may be the explanation to the recent increased rate of obesity observed in adults born with LBW.

2.5.4. Early onset of chronic diseases of lifestyle

Recent evidence suggest that size, wasting and stunting at birth are associated with Type II diabetes, hypertension and coronary artery disease when reaching middle age (Godfrey & Barker, 2000). This is part of a larger concept i.e. the "foetal origins" hypothesis, also known as the Barker hypothesis which proposes that alterations in foetal nutrition and endocrine status result in development adaptations that permanently change structure, physiology, and metabolism thereby predisposing individuals to cardiovascular

metabolic, and endocrine diseases later in life (Barker, 1995). These permanent changes have been suggested to be adaptations for foetal survival in an inadequate nutritional environment (Godfrey & Barker, 2000).

2.5.4.1. Coronary Heart Disease (CHD)

CHD and its biological risk factors namely: hypertension, non-insulin dependant diabetes (NIDDM), abnormalities in lipid metabolism and blood coagulation are associated with LBW. In studies in which body length at birth were also available, the associations with wasting and stunting at birth are stronger than with LBW alone. These findings led to the hypothesis that CHD and chronic adult conditions are programmed in utero (Barker, 1995).

The first studies reporting an association between birth weight and CHD came from Hertfordshire and Sheffield, United Kingdom. In these cohort studies, CHD mortality among 13249 men decreased progressively with increasing birth weight. The results from 5585 women in Hertfordshire were similar, although the relationships are not as strong as in men (Osmond et al., 1993).

Following the findings in Hetfordshire, several subsequent studies have confirmed the association between LBW and CHD (Rich-Edwards, Stampfer & Manson, 1997) The findings from a study in South India reported that the prevalence of CHD in the men and women aged ≥ 45 years ranged from 15% in those who weighed ≤ 2500g at birth to 4% in those who weighed ≥ 3200g (Stein et al., 1996) This was the first confirmatory evidence from a contemporary developing country. A study among 3302 Finnish men

showed that men who were thin at birth, with low placental weight, had high mortality rates from CHD (Forsén et al., 1997).

2.5.4.2. High Blood Pressure

Hypertension is one of the most common non-communicable diseases in Western societies. Findings from the Jerusalem Perinatal Study on 10 883 subjects (6684 men and 4199 women) born between 1974-6 were inconsistent with several studies who have shown a significant, inverse relation between blood pressure (BP) and birth weight. They found that BP measured at 17 was significantly and positively correlated with BMI and with the mother's weight before pregnancy but not with birth weight and weight gain during pregnancy (Laor et al., 1997).

The initial report of the Birth-to-Ten cohort in S.A. described the relationship between BP and birth weight in 818 children from this cohort at age 5 years. They found systolic BP to be inversely associated with birth weight, independent of current weight height, gestational age, or current socioeconomic status. In fact, for every 1000g increase in birth weight, systolic BP was 3.4mmHg lower (95% CI 1.4, 5.3 mmHg). Also the highest BP was noted in children who fell in the lowest quintile for birth weight and the highest quintile for current weight (Levitte et al, 1999).

2.5.4.3. Diabetes Mellitus

Studies have shown that alterations in pancreas β-cell development at a critical foetal stage lead to Type II diabetes in adulthood. A study of survivors in the Hertfordshire,

records reported that the frequency of Type II diabetes (and of glucose intolerance that precedes it) dropped progressively with increased body weight at birth and at age. The risk of glucose intolerance or diabetes was 6 times higher in those whose birth weight was < 2.5kg, compared to those with birth weights of > 4.3kg; this is after adjustment of adult BMI (Hales et al., 1991).

In the Preston study of 140 men and 126 women, a significant association between glucose intolerance or Type II diabetes and birth weight, head circumference and thinness at birth was found (Phipps et al., 1993). Subsequent studies of about a hundred individuals from the same cohort confirmed that those who were thin at birth had greater insulin resistance, regardless of gestational age, adult BMI and social class, either at birth or at the time of follow-up (Phillips et al., 1994). In a study among 64-year-old men, with birth weights < 2.95 kg of the prevalence of the metabolic syndrome closely associated with Type II diabetes was 22% and fell progressively with increasing birth weight. Among men with a birth weight > 4.31 kg, the prevalence was 6%. Fasting plasma pro-insulin concentrations fell with increasing birth weight but fasting plasma insulin was not related to birth weight (Hales et al, 1991).

The relationship between size at birth and diabetes has not been linear in all studies. In the Pima-Indians, where Type II diabetes prevalence is extremely high, a U-shaped relationship was found. The age adjusted prevalence for birth weights < 2500 g, 2500-4499 g, and ≥ 4500 g were 30%, 17%, and 32%, respectively. It was suggested by the authors that selective survival of LBW infants, which are genetically predisposed to

insulin resistance and diabetes, provides an explanation for the observed relation between LBW and the high prevalence of diabetes. The high incidence of Type II diabetes in high birth weight children was likely to have been caused by a high incidence of gestational diabetes in the mothers (McCance, et al., 1994).

2.6. Nutrition during pregnancy

2.6.1. Nutritional requirements during pregnancy

It is well established that foetal growth and pregnancy demand additional nutrients; this is reflected in the increased dietary recommendations for many micronutrients which are considered necessary to meet the extra nutrient requirements of pregnancy (Ladipo, 2000).

2.6.1.1. Energy

The energy requirement increase during pregnancy, mainly to support the metabolic demands of pregnancy and foetal growth (Ramachandarn, 2002). Metabolism increases by 15% during pregnancy (Mahan & Excott-Stump, 2008: 171). The increased need for energy in pregnancy generally amounts to an extra 1428-1512 KJ/day a day in the second and another 470 KJ/ day in the third trimester (Institute of Medicine, 2002).

2.6.1.2. Protein

Additional dietary protein is needed for protein synthesis related to the expanded uterus, breasts, extra-cellular fluid, as well as for protein synthesis in the foeto-placental

compartment (Mahan & Excott-Stump, 2008: 172). The current Recommended Dietary Allowance (RDA) of 0.66g/kg/day for pregnant women is the same as that for non-pregnant women, in the first half of pregnancy. This increases to 71g/ day in the second half of pregnancy (Institute of Medicine, 2002).

2.6.1.3. Carbohydrates

The estimated average requirement (EAR) is 135 g/day, and the adequate intake (AI) is 175 g/day (Institute of Medicine, 2002). Women should consume a minimum of 175 grams of carbohydrate to meet the foetal brain's need for glucose (Brown, 2008:105).

2.6.1.4. Fat

The amount of fat in the diet should be individualised based on the energy requirement for adequate weight gain (Mahan & Excott-Stump, 2008: 173). There are however, recommendations for *n*-6 (linoleic acid) and *n*-3 (alpha-linolenic acid) polyunsaturated fatty acids i.e. an AI of 13 g/day and AI of and 1.4 g/day, respectively (Institute of Medicine, 2002).

2.6.1.5. Vitamins and minerals

There are certain vitamins and minerals with particular significance for optimal pregnancy outcome. The requirements for these micronutrients can be met by diet alone in some instances and for others supplementation may be necessary.

2.6.2. Macronutrients and foetal growth

2.6.2.1. Energy

Severe energy restriction during pregnancy, which most likely occurs in some developing countries, reduces birth weight. It was noted in the 1945 Dutch Hunger Winter in women who starved before conception and throughout the pregnancy or in the third trimester (Stein et al., 1975). In a five year controlled trial in rural Gambia women were randomised to receive a daily supplementation with high-energy groundnut biscuits (4.3 MJ day^{-1}) for about 20 weeks before delivery. The supplementation increased weight gain in pregnancy and there was a 40% reduced risk of having a LBW baby compared with controls (Ceesay et al., 1997).

2.6.2.2. Protein

Studies of nutrition interventions with balanced energy and protein supplements in pregnancy to reduce low birth weight have been disappointing. In a meta-analysis by Kramer, (2000) of 13 prospective randomised controlled trials, findings were that supplementing the baseline diet with additional calories and protein leads to an increase in maternal weight gain of 17 gram per week and a minimal increase in mean birth weight of 25 grams. There was, however, a decrease in the number of SGA infants (OR of 0.64, CI 0.53-0.73) as well as a decrease in the number of still births and neonatal mortality in the supplemented group.

2.6.2.3. Carbohydrates

A prospective observational study among Southampton mothers of term infants found that a high carbohydrate intake in early pregnancy was related to lower placental weights and babies with lower birth weights. These associations were independent of the mother's height and BMI. This association was especially significant when combined with a low dairy protein intake in late pregnancy (Godfrey et al., 1996).

2.6.2.4. Fat

Uncontrolled epidemiological observational studies suggested that birth weight was increased in mothers who subsisted on a marine diet. The proposed mechanism for this observation was the observation that marine oil supplements prolong gestation thus reducing the incidence of preterm birth and secondarily increasing the mean birth weight (Olsen, 1993). Randomised trials of marine oil supplementation involving mothers of previous preterm or IUGR showed a reduction in preterm infants. However, no effect, independent of length of gestation on birth weight was found (Olsen et al., 2000).

2.6.3. Micronutrients and foetal growth

A deficiency in one or more micronutrient can occur as a result of an inadequate dietary intake, poor dietary quality, poor bioavailability, a higher than normal requirement for a nutrient (Pojda & Kelly, 1999), lack of knowledge about prenatal nutrition, dietary taboos associated with pregnancy (Ladipo, 2000) or a combination of factors. In developing countries where LBW is prevalent; diets are predominantly based on starch staples and

often include little or no animal products and few fresh fruit and vegetables (Arimaond et al., 2008; Ruel, 2002); multiple deficiencies often co-exist and are likely to be a great public health concern (Pojda & Kelly, 1999).

2.6.3.1. Vitamin A

It has not been clearly demonstrated that vitamin A supplementation alone can increase birth weight. A trial in Nepal showed that vitamin A supplementation (7000 *ug* per week*)* can reduce the maternal mortality by 30-50% (West et al., 2000). However, birth weight was not reported as an outcome.

Randomised double-blinded trials conducted among HIV-infected pregnant women in Tanzania (Fawzie et al., 1998) and South Africa (Coutsoudis et al., 1999) showed no effect of vitamin A alone on foetal growth. In both trials no significant effect on mean birth weight was detected however, the prevalence of LBW was slightly lower in the vitamin A group when compared to the placebo group who received an iron-folate supplement.

A similar clinical control trial in Malawi on 697 HIV-infected pregnant women showed a mean birth weight of 2895g ± 31g in the vitamin A group and a mean birth weight of 2805g ± 32g (p=0.05) in the placebo group who received an iron-folate supplement. Respectively, the proportions of LBW were 14% and 21% (p=0.03) (Kumwenda et al., 2002).

2.6.3.2. Folic Acid

There is large body of literature, mainly from developed countries, reporting on folic acid in pregnancy and some have shown positive associations between maternal folate status and birth weight and others show inconsistent results. A study among 882 women on the influence of dietary and circulating folate on preterm delivery and infant birth weight reported that both low dietary intakes of folate (≤ 240*ug*/day) and lowered concentrations of serum folate measured at 28 weeks gestation were associated with a two-fold increased risk of preterm delivery and LBW. This association existed even after controlling for several maternal characteristics reflecting poor nutritional status (Scholl et al., 1996).

Women, who are potentially at risk; from common genetic polymorphisms that alter folate metabolism or from environmental factors associated with folate, may benefit the most through an improved diet (Scholl & Johnson, 2000). For example, randomised control trial in South African by Baumslag, (1970) has shown women administered iron alone (200mg/ day) or in combination with folic acid (5mg/ day) had no effects on the folate status among the white South African women who were studied. However, the African rural women, whose diet comprised mainly of maize meal porridge, the mean birth weight was increased by nearly 0.45 kg and the risks of bearing an infant weighing < 2.5 kg was reduced four-fold with folic acid supplementation (Scholl & Johnson, 2000).

2.6.3.3. Iron

In a review of 44 non-intervention studies, the relationship between hemoglobin or hematocrit, birth weight and percentage of LBW was investigated. In 26 of the 44 studies, anaemia, lower hemoglobin or hematocrit or low ferritin levels were associated with a higher prevalence of LBW (Ramussen, 2001). In addition, maternal iron deficiency anemia during pregnancy reduces fetal and subsequent neonatal iron stores (Allen, 2000).

In a randomized double-blind controlled trial in Tanzania, 259 pregnant women between 8 and 34 weeks gestation were enrolled in an 8 week supplementation study. The objective was to test the effect of a micronutrient-fortified beverage containing 11 micronutrients (iron, iodine, zinc, vitamin A, vitamin C, niacin, riboflavin, folate, vitamin B-12, vitamin B-6 and vitamin E) on hemoglobin, iron and vitamin A status. Hematological parameters were measured at baseline and at the end of the supplementation period. The supplement resulted in a 4.16g/L increase in hemoglobin concentration and a 3.0g/L increase in ferritin and reduced the risk of anemia and iron deficiency anemia by 51% and 56%, respectively. The risk of iron deficiency was reduced by 70% among those who had iron deficiency at baseline and by 92% among those who had adequate stores. The micronutrient-fortified beverage may be a useful and convenient preventative measure, one that could help improve the nutritional status of women both before and during pregnancy and thereby help avoid some of the potential maternal and fetal consequences of micronutrient deficiencies (Makola et al., 2003)

Iron and folate supplementation during pregnancy improve maternal hemoglobin levels at birth and 6 weeks after birth, but there is little evidence on any other effects on maternal and infant birth outcomes (Allen, 2000).

2.6.3.4. Zinc

King (2000a) reported that zinc deficiency during pregnancy increase the risk of fetal growth restrictions, congenital anomalies, LBW, and preterm delivery and increase the incidence of pregnancy induce hypertension (PIH), intrapartum hemorrhage, and prolonged labour.

2.6.3.5. Iodine

The benefits of iodine on endemic cretinism and goiter have been well established (Costella & Osrin, 2003). Inadequate iodine intake during pregnancy could result in fetal loss, still births, cretinism and mental retardation in the infant. In areas of moderate to severe iodine deficiency, supplementation has reduced reproductive loss, morbidity and adverse foetal outcomes (Fall et al., 2003). A nonrandomized trial in Algeria compared the benefits of oral administration of 0.5 ml of Lipiodol at various intervals i.e. 1 to 3 months prior to conception, during the first month of pregnancy and during the third month of pregnancy. The study reported a significant decrease in the prematurity, stillbirth, and spontaneous abortion rates in the treated groups. Although the mean birth weight was similar across the three treatment groups (3400g), it was significantly higher than the untreated controls (Chauoki & Benmilloud, 1994).

2.6.3.6. Magnesium

Magnesium supplementation during pregnancy may be able to reduce fetal growth retardation and preeclampsia, and increase birth weight. A meta-analysis of six trials included in the Cochrane review in 2002; which focused on hypertension as an outcome, showed a beneficial effect of magnesium supplementation on low birth weight and SGA. The only trial from a developing country, being Angola had inadequate birth weight data to draw any conclusions (Makrides & Crowther, 2002).

2.6.3.7. Calcium

During pregnancy, the RDA for calcium increases by 122-167% mainly for skeletal development. Several systemic reviews have shown calcium supplementation given to women at high risk of hypertension during pregnancy or with low dietary intakes of calcium, reduce the incidence of preeclampsia and hypertension, but found no effect on birth weight (Ladipo, 2000). However, a small trial from India showed an increase in mean birth weight (calcium-2731g, n=103 versus placebo-2626g, n=98; p=0.01) as did a trial with Iranian mothers (Punwar et al., 1996).

2.6.3.8. Multiple micronutrient supplements

Even though prenatal multivitamin and mineral supplements are prescribed and consumed regularly, little is known about the benefits thereof in reducing low birth weight.

In a double-blind, factorial randomized controlled trial of multiple micronutrients, HIV positive Tanzanian women were supplemented from 12-27 weeks of pregnancy until the time of delivery with either a multivitamin-mineral (MVTM), a MVTM without vitamin A, vitamin A, or a placebo. There were significant differences of approximately 120g in the mean birth weights for mothers in both groups who consumed the MVTM. Overall the multivitamin supplementation decreased the risk of LBW by 44%, the risk of severe preterm birth (< 34 weeks gestation) by 39%, and SGA by 43% (Fawzie et al., 2007).

A randomized control trial in semi rural Mexico compared the effects of daily multiple micronutrient (MM) supplements with that of iron supplements during pregnancy on infant birth size. They found in the MM group (n=323) a mean birth weight of 2.981g ± 0.391kg and length of 48.61 ± 1.82cm; and in the iron-only group (n=322) a mean birth weight of 2.977g ± 0.393kg and length of 48.66 ± 1.83cm. Hence the anthropometric measurements did not differ significantly between the groups (Ramakrishnan et al., 2003).These findings suggest that multiple micronutrient supplementation during pregnancy does not lead to greater infant size than do iron-only supplementation.

In a randomized double blind, placebo control trial among 200 pregnant women, enrolled between 24-32 weeks gestation, with a BMI < 18.5 kg/m² or hemoglobin level 7-9 g/dl, birth weight of infants (n=146) were analyzed. The intervention group received a multiple micronutrient (MM) supplement of 29 vitamins and minerals (once per day) and the control group received a placebo. Both groups received supplemental ferrous sulphate (60mg/day elemental iron) and 55 ug/dl folic acid. Infants in the micronutrient group

were heavier by 98 g, and measured 0.80 cm longer and 0.20 cm larger in mid-arm circumference compared with the placebo group. Incidence of LBW declined from 43.1% to 16.2% with multi micronutrient supplementation a (a 70% decrease; relative risk, 0.30; 95% CI, 0.13-0.71; P=.006). Compared with iron and folic acid supplementation, the administration of multi micronutrients to undernourished pregnant women may reduce the incidence of low birth weight (Gupta et al., 2007).

2.6.4. Factors affecting eating behaviour during pregnancy

Adequate dietary intake is fundamental to optimize the outcome of pregnancy. However, the presence of perinatal factors may inhibit dietary intake and thereby increase the risk of poor maternal weight gain. These factors include nausea, vomiting, heartburn, bloating, constipation, and diarrhea. These gastrointestinal disturbances could have a negative effect on overall nutrient intake (Dundas & Taylor, 2002).

Pregnant women may develop food preferences and aversions i.e. powerful urges to consume or not to consume particular foods due to changes in the sense of taste and smell. About one in three women experience changes in the way certain food tastes and the odour of foods and other substances. There is increased preference for foods such as sweets, fruits, salty foods and dairy products. The most commonly avoided foods are usually good sources of animal protein, such as meat, lean meats, pork and liver. The most common nasal offenders that may stimulate nausea include, the odour of meat being cooked, coffee, perfume and cigarette smoke (Brown, 2008: 117). There is the belief that

diet influences the ease of birth. For example, some believe that animal-protein foods and excessive weight gain during pregnancy cause more difficult deliveries. Most pregnant women know that low maternal weight gain will produce a small foetus, which in turn will be delivered more easily than a large foetus (King, 2000b).

2.7. Women in developing countries- at risk of undernutrition during pregnancy

Over 200 million women become pregnant each year, most of them in developing countries (WHO, 1997). Many of these women suffer from ongoing nutritional deficiencies (Mora & Nestel, 2000), repeated infections (Wu, et al., 2004) and the long-term cumulative consequences of undernutrition during their own childhood (Mora & Nestel, 2000). Early pregnancy and closely spaced pregnancy women may also increase women's risk of undernutrition during pregnancy, since teenage mothers are themselves still growing, they compete with their own foetus for nutrients and with closely spaced pregnancies there is a progressive reduction of nutritional reserves to the point of nutritional depletion i.e. the maternal depletion syndrome (King, 2003); the latter is already at the onset of pregnancy. Teenage pregnancy is a huge problem in S.A. In 2002 66 000 teenage girls reported pregnancy as the main reason for not attending an educational institution (StatsSA).

Women in developing countries have many roles, including domestic tasks, child care, caring for the elderly and the sick, agricultural production, income-generating activities to attain food security and fetching firewood and water for the household (Kinabo,

Kamukama & Bukuku, 2003; Rao et al., 2003). Most of the activities are strenuous and time consuming and some of them, especially agricultural activities, require high levels of energy expenditure. The energy expenditure of women in rural African communities is considered to be higher than that of men (Kinabo, Kamukama & Bukuku, 2003).

Rao et al. (2003) examined the relationship between maternal nutrition, physical activity and birth size among women in rural India. Dietary intake assessed using a 24 hour recall at 18 and 28 weeks revealed that the total energy and protein intake of these women represented approximately 70-75% of the recommended intakes (Indian Council of Medical Research, 1998) at both points. However, maternal energy intake showed no significant relationships with neonatal size. Maternal activity was inversely related to maternal weight gain up to 28 weeks gestation, birth weight, head circumference and mid-upper arm circumference (MUAC) of the newborn. Maternal activity was measured via a physical activity questionnaire.

Another factor that contributes to undernutrition during pregnancy is a reduction in the dietary intake below the habitual level; and if combined with increased physical activity maternal nutritional status, deteriorates even further. In developing countries the latter often co-exists (Ramachandran, 2002). Seasonality of LBW is a well-known phenomenon in developing countries. As agricultural activities tend to be seasonal hence the overall energy expenditure of women vary from season to season being higher during the rainy season and relatively lower during the dry season. The rainy season also coincides with

low food availability and high food prices (Savy et al., 2006; Kinabo, Kamukama & Bukuku, 2003)

A retrospective cohort study of all live births in three subsistent farming villages of the west Kiang District in the Gambia was conducted. These rural villages have a seasonal agricultural system that revolves around the annual rain season from July to November. They compared the seasonality of prematurity and SGA among 1916 live infants born over 26 years. The LBW incidence in this population was 13.3%, of prematurity was 12.3%, and of SGA was 25.1%. When looking at the month-by-month percentage of SGA, the highest was observed at the end of the hungry season i.e. August to December. There was a gradual increase in the percentage of SGA infants until the lowest incidence in June at 12.9% (Rayco-Solon, Fulford & Prentice, 2005).

In South Africa even though the agricultural sector's contribution to the general economy has declined substantially, it is still a major employer in rural areas. This sector is the part of the formal economy with the lowest wage rate and probably the poorest (or least monitored) working conditions. Women are engaged in farm work as the wife or girl friend of a male farm worker and are seen as an extension of the male labour force. These women are located in extremely harsh social and living conditions; sexual harassment and abuse are common to them. Also the incidence of single parenting is high, and only few mothers receive financial maintenance from the father of the child (Shabodien, 2006).

2.8. A broad overview of dietary assessment methodologies

The purpose of dietary assessments is to measure nutrients, food or eating habits. Hence, the purpose of the dietary assessment will determine the appropriate method to be used. Dietary assessments involve the use of detailed weighed food records, estimated food records, food frequency questionnaires or household surveys (Wrieden et al., 2003). Outlined below are the strengths and weaknesses of each method.

2.8.1. Weighed food records

Here an individual is required to weigh and record each and every item of food and drink prior to consumption. This method is widely used and provides precision of portion sizes, (Wrieden et al., 2003), it is a perfect snapshot of food consumed (Gibney et al, 2007: 70). However, it lends itself to high respondent burden, misreporting, being expensive, and the food composition data is often limited (Wrieden et al., 2003). There is a risk that usual diets might be modified to make the recording process easier; for example, avoiding eating out (European Food Information Resource Network-EuroFIR, 2005).

2.8.2. Estimated food records

Similar to the weighed food record method except that the respondent estimates all food consumed using household measures such as cups or spoons or portion size estimating aides including, food photographs or food models. There is less respondent burden

however and weaknesses include: estimation of portion size, misreporting, expensive, and food composition data is often limited (Wrieden et al., 2003).

2.8.3. 24 hour recall

This is a retrospective assessment method which requires a trained interviewer to prompt the respondent to describe in detail all the food and drink they consumed during the previous 24 hours. There is a low respondent burden, it is suitable for large scale surveys, and can even be administered by telephone. However, it provides an estimation of portion sizes, it is a single observation thus provides a poor measure of habitual or usual dietary intake, it is dependent on memory and thus could lead to under or misreporting (Wrieden et al., 2003). In addition, it cannot be verified that social desirability does no influence self reporting of the previous day's intake (Gibney et al, 2007: 70).

2.8.4. Food Frequency Questionnaire (FFQ)

The FFQ is a retrospective method asking the respondent to report their usual frequency of consumption of each food item from a list of foods for a specific period. Frequency of consumption categories also vary but usually include per day, week or month and therefore aim to capture habitual intake. The length of the food item list can vary depending on the nutrients or foods of interest. With a semi-quantitative FFQ, information about portion size is collected in addition to frequency of consumption. Where portion size information is not obtained; standard food portion sizes are often used

to calculate nutrient intakes. Although there are difficulties implicit in calculating the absolute nutrient intake of individuals from FFQs they are useful for gathering information on groups of individuals as well as for looking at habitual intake of a range of foods. With the FFQ there is a low respondent burden, it is suitable for large scale surveys, and it can be self-reported (Wrieden et al., 2003). Its shortcomings include estimation of portion sizes (though use of food photographs may improve precision), possible overestimation of "healthy foods" (e.g. fruit and vegetables) and validation against some objective reference method improves validity (Wrieden et al., 2003, Gibney et al, 2007: 72-73).

2.8.5. Household food surveys

Information is collected at household level. It is suitable for large scale surveys, and it is designed to monitor diet trends at the population level (e.g. National Food Consumption Survey-NFCS). The fact that the data is not collected at an individual level presents a weakness (Wrieden et al., 2003).

All dietary assessment methods involve measurement error. Random measurement error can be reduced by increasing the number of measurements and thus improving precision. However, systemic measurement error cannot be minimised by extending the number of measurements. These types of errors arise from assessment of the frequency of consumption of foods, portion size, failure to report usual intake and problems of under reporting (European Food Information Resource Network, 2005).

2.9. Factors affecting dietary assessment in developing countries

In developing countries where the main concern is dietary deficiencies, nutrient adequacy, i.e. achievement of the recommended intakes of energy and other essential nutrients, is often used to refer to dietary quality. However, quantifying nutrient intake is often expensive, time consuming and associated with methodological challenges (Ruel, 2002). This can be even more so in African rural populations where they generally eat from one common bowl, making the measurement of individual dietary intake very difficult (Hudson, 1995). Thus in developing countries, methods for assessing diet quality should be simple, inexpensive and practical.

2.10. Assessment of overall diet quality: a shift in focus

2.10.1. Defining overall dietary quality

There has been a move away from characterising dietary patterns according to the intake of single nutrients, to a concept of overall dietary quality (Clausen et al., 2004; Hatloy et al., 1998). Kant (2004) suggested that dietary quality is a dynamic and encompassing measure that captures much more than the effects of isolated nutrients considered alone. However, there seems to be no official definition for dietary quality (Ruel, 2002). The definitions vary widely but, historically dietary quality reflect I) Adequacy: providing all the essential nutrients, fibre and energy sufficient to maintain health; and II) Balance: providing foods of a number of types in proportion to each other, such that foods rich in some nutrients do not crowd out of the diet foods that are rich in other nutrients (Whitney, Cataldo & Rolfes, 2002). With the concern in countries undergoing nutrition

transition being that of overnutrition and excess intake of nutrients and foods there has been a global shift in the definition of dietary quality to include both concepts of nutrient deficiency and overnutrition (WHO/FAO, 1996). Hence the inclusion of the following two principles: III) Energy control: management of food energy intake; and IV) Nutrient density: a focus on foods with more nutrients for less energy (Whitney, Cataldo & Rrolfes, 2002). Therefore, it could be said that dietary quality comprise the above four principles and that a high quality diet is one that limits the amount of fat, saturated fat, cholesterol, sodium, and refined sugars, and incorporates many servings of fruits, vegetables, and whole grain products.

2.10.2. Elements of dietary quality

Assessing dietary quality requires focusing on the nutritional elements or guidelines considered most important in relation to health promotion and disease prevention (Drenowski, 1997). Dietary diversity is considered the key nutritional element of dietary quality (Ruel, 2002) hence the inclusion of the recommendation "eat a variety of foods" in virtually all global dietary guidelines and national food-based dietary guidelines, i.e. the South Africa Food Based Dietary Guidelines (FBDG) (Maunder, Matji & Hlatshway-Molea, 2001).

2.10.3. Measures of dietary quality

There are various measurements or indexes of overall dietary quality; some are based on food or food groups and others are based on nutrients or on nutrients and foods. Dietary

diversity and food variety are generally considered to be measurements of dietary quality, but there are no standard definitions for these terms (Clausen, et al., 2005). The food variety score is usually defined as a simple count of different food items consumed over a reference period; whereas a count of the number of food groups consumed over a certain period usually quantifies the dietary diversity score (Hatloy, Torheim & Oshaug, 1998). The nutrient adequacy ratio (NAR) and the mean adequacy ration (MAR) are examples of indexes based on nutrients. The NAR is the ratio of intake of a nutrient relative to its Recommended Dietary Allowance (RDA) and the MAR is computed by averaging the sum of the NAR's. An example of an index based on nutrients and foods in the Health Eating Index (HEI) which consists of scores for consumption of the suggested number of servings of each of the five food groups; levels of intake of total fat, saturated fat, cholesterol, and sodium and a measure of dietary variety (Kant, 1996).

2.10.4. Dietary diversification in developing countries

The rationale for emphasizing dietary diversity and food variety in developing countries relates to the problem of multiple nutrient deficiencies, often due to reliance on diets predominantly based on starchy staples and including little or no animal products and few fresh fruits and vegetables. These plant-based diets tend to be low in a number of micronutrients, and the micronutrients they contain are often in a form that is not easily absorbed (Arimond et al., 2008, Ruel, 2002).

2.10.5. Dietary diversity and food variety and health outcome

Examples of studies concerning the health benefits of the varied diet include a study of 42,254 American women (mean age, 61 years) - those who consumed a greater number of the recommended foods had a decreased risk of mortality. Women in the highest quartile (median variety score of 15) had an odds ratio of death in a half year period of 0.69 in comparison to the lowest quartile (median variety score of 7) (Kant et al, 2000).

There is less data to support the contribution of dietary diversity to health in developing countries. However, dietary diversity has been linked to improved anthropometry in children 1-3 years in Kenya (Onyango, Koski & Tucker, 1998). In Mali, Hatloy et al. (1998) demonstrated a strong correlation of diversity of fruits and vegetables with overall nutrient adequacy and with specific nutrients such as vitamin A and C. In South Africa, Steyn et al. (2005) demonstrated a strong link between a food variety score and dietary diversity score and height-for-age and weight-for-age z-scores in children 1-9 years.

2.10.6. Overall diet quality and birth weight

Early researchers of the relationship between overall dietary quality and infant birth weight reported a significant positive relation ($r = 0.301$, $P < 0.05$). The quality of the mother's diet was expressed as a nutrient adequacy ratio (NAR) index. They noted that overall dietary quality explained 6% to 8% of the variance in infant birth weight when controlling for maternal age, gestational age, maternal weight at delivery, and smoking status. Moreover, they found that, in the regression analysis, overall dietary quality had a

direct effect on birth weight, whereas 10 of the 12 nutrients examined did not (Phillips & Johnson, 1977).

2.11. Conclusion

It has been well documented that the causes of low birth weight are complex and could include maternal nutritional factors (low pre-pregnant weight, short stature and inadequate weight gain during pregnancy), maternal behavioural factors (e.g. smoking and alcohol), as well as the socioeconomic context of the mother. Researchers assessing dietary intake in pregnant women could focus on specific nutrients i.e. micronutrients or macronutrients, total energy intake etc. and its effect on infant birth weight. However, dietary assessment methodology is vast; it can be very complicated and expensive in terms of money, time, and expertise. Hence, the need in developing countries is for methods which are simple, inexpensive and yet all inclusive and able to assess overall dietary quality. Many researchers have devised and used simple methods, indices and scores to assess overall dietary quality in developed and to a lesser extent in developing countries.

Further lacking is research assessing dietary quality during pregnancy among women from developing countries and its effects on infant birth weight. This study will therefore explore the effects of overall dietary quality on infant birth weight in women from a farming region in the Western Cape Province, South Africa. Chapter 3 will provide a detailed description of the research methodology.

CHAPTER 3

RESEARCH METHODOLOGY

3.1. Introduction

Chapter two reviewed the literature that relates to the research problem. This chapter discusses how the research data was collected and the analysis thereof was conducted. It mainly outlines the research design, the study population, sampling and data collection methods. All of which are in accordance with that of the primary study. The main focus of this secondary data analysis was the development of dietary scores. These dietary scores were to be used in exploring the influence of maternal dietary intake on infant birth weight. However, some of the socioeconomic and socio-demographic variables, included in the primary study, as well as data on maternal smoking and/ or alcohol consumption during pregnancy have been included in the secondary data analysis as they could affect the relationship between dietary intake and low birth weight (see Table 3.1, list of study variables).

3.2. Study Design

A case-control study design (not matched) was used to determine the association between dietary intake during pregnancy and infant birth weight.

3.3. Population

The case and control groups were selected from postpartum women seen at the Paarl Hospital during the study period i.e. mid October 2002 to August 2003.

3.4. Inclusion/ exclusion criteria

The eligibility criteria for the cases were mothers who delivered a live newborn weighing <2500 g, and to be eligible as a control, mothers should have delivered a newborn weighing ≥2500g, during the study period. The study included only mothers with singleton infants. Signed consent was also needed from the eligible mothers. The study excluded all HIV positive mothers as well as mothers who participated in the Prevention of Mother to Child Transmission (PMTCT) cohort study which was running concurrently with this study at Paarl Hospital. This exclusion criterion was included on ethical grounds so as to not burden the women with participation in two research projects which both included interviews during the postpartum period (Jackson, Batiste, & Rendall Mkosi, 2007).

3.5. Sampling procedure

Each morning all infants with a birth weight of <2500g (cases) born during the previous 24 hours were identified from the delivery register. The mothers who were selected were approached at the postnatal ward for their participation in the study. If they met the selection criteria and were willing to participate, written consent was obtained from the mothers. The first infant born at a birth weight of ≥2500g following the birth of a low birth weight infant would become its control. If a control mother refused to participate, the next first mother with a normal birth weight (NBW) baby to consent would become the replacement control. If the chosen control was HIV positive, it was not considered and then the next infant born at birth weight ≥2500g was considered (Jackson, Batiste, & Rendall Mkosi, 2007).

3.6. Sample size

A total of 198 cases (<2500g) and 202 controls (≥2500g) were recruited during the study period.

3.7. Research Instrument

Structured questionnaire

A structured questionnaire based on questions from the South African Demographic Health Survey (SADHS) and other published survey tools i.e. the CAGE questionnaire (Ewing, 1984) and some investigator developed questions was used (Jackson, Batiste, & Rendall Mkosi, 2007) (Appendix A). The information obtained included demographic details, information on socio-economic status, obstetric history, and maternal behavioural factors including smoking, and alcohol consumption.

Medical record review

A record review questionnaire (Appendix B) was used to extract antepartum medical/case history information from the antenatal and delivery records of the mother and the infant (Jackson, Batiste, & Rendall Mkosi, 2007). The record review was adapted from a tool used in midwifery research (Jackson, Lang, Dickinson, & Fullerton, 1994). For the purpose of this secondary data analysis maternal height, weight and number of weeks gestation, all determined at the first antenatal visit, actual birth weights of the infants and its gestational age at birth were extracted from the medical records.

Food frequency questionnaire

The information on dietary intake was collected using a non-quantified food frequency questionnaire (FFQ), which was a component of the structured questionnaire (Appendix A). Bearing in mind the overall aim of the primary study and the fact that the mothers were post delivery, a FFQ was deemed the most appropriate dietary assessment tool to use.

The food frequency questionnaire was developed in consultation with experts in dietary assessment methodology. The FFQ covered 14 food items from the food composition tables: **1.** Meat and poultry; **2**. Fish (including tinned fish); **3**.Eggs; **4**.Bread (white, brown, wholegrain); **5.**Maize meal, rice and samp; **6**.Tinned foods; **7.**Dairy products; **8**.Legumes; **9**.Green leafy vegetables; **10**.Other vegetables (potatoes, onions, leeks, turnips); **11**.yellow/orange vegetables; **12**.Fats/oils; **13**.Sugars; and **14.**Fruit.

Subjects were provided the option of answering in terms of frequency per day, week, and month or never consumed. Food items that were not answered/ or filled-in were considered to reflect non-consumption and were thus coded as 'never'.

The subjects were not requested to estimate the portion size for any of the food items, as the questionnaire was not to be used to estimate nutrient intakes. A copy of the questionnaire can be found in Appendix A.

3.8. Data Collection

The structured questionnaires were administered to the case and control groups by the interviewer. The postpartum women were taken through the questionnaire in privacy at the bedside, in their preferred language by an interviewer and their answers were recorded by the interviewer. The interviewers were trained in administering all components of the questionnaire and record review.

Maternal weight and height is routinely measured and recorded at antenatal clinics by the staff nurse on duty. The field researcher obtained the recorded anthropometric measurements i.e. weight (at first antenatal visit) and height from the medical records. The number of weeks gestation at first antenatal was also obtained from the medical records.

The infant birth weight and gestational age were both extracted from the medical records and not obtained from the interview. Birth weight (in grams) was the first recorded infant weight obtained after birth. Gestational age was the estimate recorded in the medical records, and is assumed to be the best available clinical estimate.

3.9. Data capturing

Questionnaires were checked for completeness on site before the interviewers departed. If any missing data was identified the interviewers would do the necessary to complete the questionnaires. All of the data from the structured questionnaires, medical record reviews, as well as the information from the FFQ was coded and captured in Excel and imported in EPI Info 2002 and SAS for statistical analysis.

3.10. Study variables

From the structured questionnaire and record review questionnaire, the variables included in Table 3.1 below were used for this secondary analysis.

Table 3.1: Study variables and source

	Study variables	**Source**
Socio-demographic factors	Maternal age Marital status Maternal education	Questionnaire
Socio-economic factors	Employment status Maternal income Number of dependents/ live children Financial support from the father of the baby Secondary income e.g. grants	Questionnaire
Maternal behavioural factors	Smoking (yes/ no) Alcohol (yes/ no)	Questionnaire Record review questionnaire
Anthropometric assessment	Maternal height (cm) Maternal weight (kg)-at 1st antenatal visit No of weeks gestation- at 1st antenatal visit	Record review questionnaire
Dietary assessment	Food variety score (FVS) Dietary diversity score (DDS)- daily and weekly	Food frequency questionnaire
Birth outcome	Infant birth weight (g) Gestational age (weeks)	Record review questionnaire

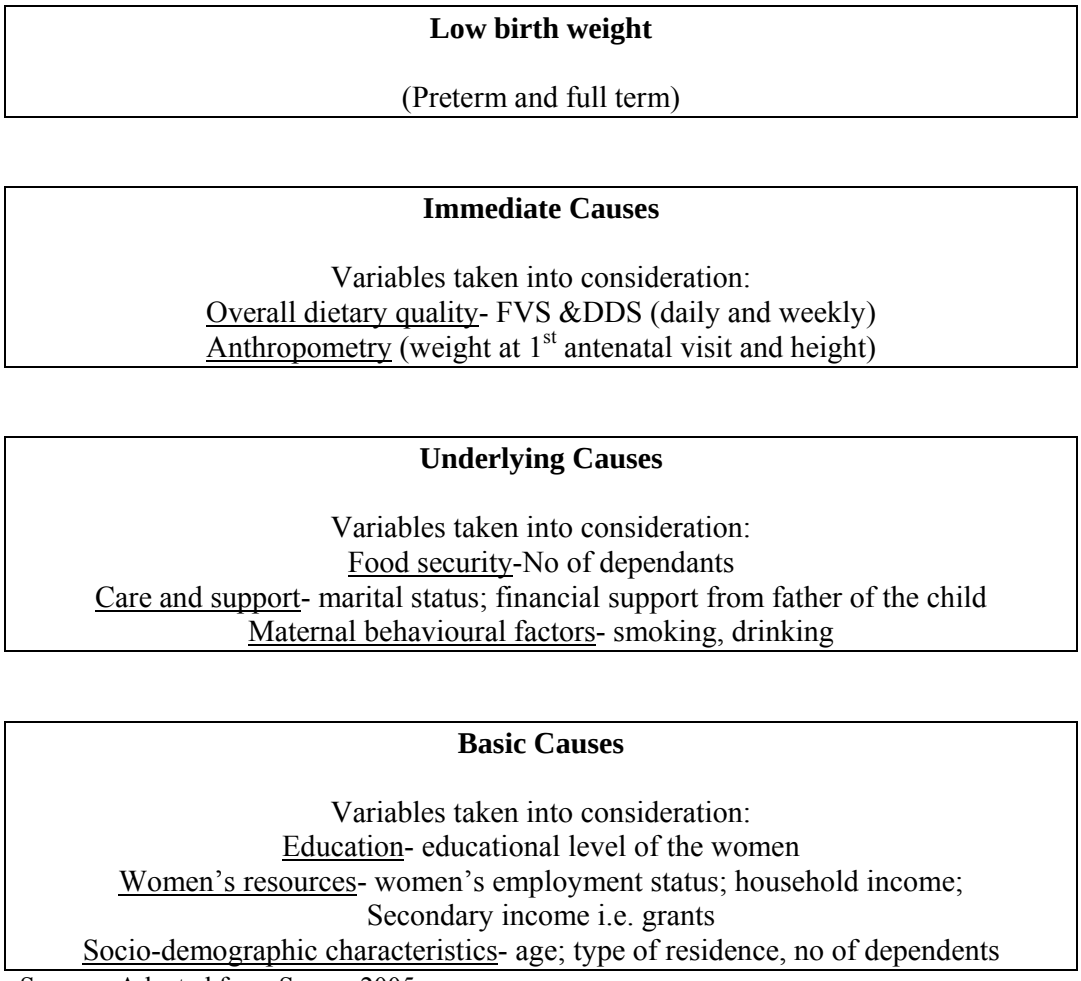
3.11. Conceptual framework for analysis

The primary objective of this secondary analysis was to study the association between maternal dietary quality and low birth weight. But this relation is obviously influenced by the women's environment. In this study population there is in fact a wide range of behavioural, demographic, socio-economic and care- related factors that have an

impact on the women's nutritional status and/ or on the quality of their diet and in turn, infant birth weight. The results of the behavioural risk factors and its effect on LBW in this population (i.e. alcohol, smoking, and stress during pregnancy) have been presented in other publications.

A conceptual framework for the secondary analysis was developed based on UNICEF's conceptual framework – a diagram of the causes of malnutrition – as well as on the framework by Savy et al. (2005) who studied the relationship between dietary scores and women's nutritional status. The use of a conceptual framework (see Figure 3.1), makes it possible to classify all the factors affecting the relationship being studied.

Figure 3.1: Conceptual Framework



Source: Adapted from Savey, 2005

3.12. Data management

3.12.1. Socioeconomic and socio-demographic data

The information obtained included demographic details, information on socio-economic status, obstetric history, and maternal behavioural factors including smoking, and alcohol consumption.

The continuous responses for age was combined into three categories i.e. ≤19years; 20-34 years and ≥35years. For the variable measuring level of education, the continuous responses were recoded as: no schooling; some primary school education; and some secondary school education. The categorical responses for marital status were combined to present: single/ never married; married (monogamous); and married (polygamous). The continuous responses for the number of dependents/or number of children were recoded as 1-2, 3-4, and > 4 children.

Smoking and alcohol habits during pregnancy were based on participants' self reported response during the interview. These responses from the interview were recoded to present a "yes" or "no" to smoking and/ or alcohol consumption. The responses were also cross checked against the medical records.

3.12.2. Anthropometric data

The maternal weight (at the first antenatal visit) and height were used to describe the differences in maternal anthropometry of mothers with normal birth weight and low birth weight infants. Due to the mother's late registration or poor attendance at the antenatal clinic, regular weight recordings were unavailable for many mothers in the study population. Hence, further calculations and determination of body mass index (BMI) was not done.

3.12.3 Dietary data

The 14 food items included in the FFQ were used as the basis for the construction of the dietary scores. Two dietary scores were developed viz. a food variety score (FVS) and a dietary diversity score (DDS).

3.12.3.1 Food Variety Score (FVS)

Food variety is usually defined as the number of food items consumed over a reference period (Hatloy, Torheim, & Oshaug, 1998). However, in this study the FVS was quantified using the concept of a weighting/ scoring system suggested by Hoddinott (2002); where the weights reflect the number of times the food items were consumed over a reference period. A similar weighting system was also described by Clausen et al. (2005) in Botswana. For this study the researcher devised a weighting/ scoring system based on the weekly frequency of consumption of food items, this is described below.

The frequency of consumption estimates indicated by the subjects for each food item was converted to times consumed per week (Example: 2 servings /day =14 servings/ week and 2 servings per month = 0.5 servings per week). A scoring system was based on the frequency of intake per week: a score of 7 was assigned to a daily or more than once per day frequency of consumption; a frequency of consumption between 1-6 times/ week was scored the actual frequency per week i.e. 1-6; and a frequency of consumption < 1 time per week was scored a 0. A food variety score was calculated by summing the weekly frequency scores i.e. (0-7) for each food item. However, the weekly frequency scores of only 12 food items were summed in the scoring of the FVS as the weekly frequency score of sugar, as it primary provides energy and few or

no micronutrients, was excluded as well as the weekly score of tinned foods, as its contents were not specified. Hence, the minimum and maximum FVS possible to acquire by the subjects was (0-84). As a result of this scoring system (based on the frequency per week), only foods consumed at least once weekly contributed to the FVS.

An example of scoring the FVS:

Based on the data from the FFQ (12 food items); meat/ poultry, 3 times per week = 3; maize meal porridge, 3 times per week = 3; fish, less than weekly = 0; eggs, 4 times per week = 4; bread, more than once per day = 7; milk, 5 times per week = 5; legumes, 1 time per week = 1; fats, more than once per day = 7; fruit, 2 times per week= 2 and all the other foods less than once per week = 0. Sum for FVS = 3 +3 + 0 + 4 + 7 + 5 + 1 + 7 + 2 = 32.

3.12.3.2 Dietary Diversity Score (DDS)

The DDS is usually defined as the number of food groups consumed over a reference period (Hatloy, Torheim, & Oshaug, 1998). The reference period for the DDS usually ranges from one to three days, but seven days is also often used, and periods up to fifteen days have been reported (Drewnowski et al, 1997).

The most commonly used diversity indicators are the 6, 9, 13 and 21-food group indicators. The most aggregated diversity indicator has six major food groups. The more disaggregated 9, 13, and 21 food groups, disaggregate the nutrient-dense food groups (animal-source foods, fruits and vegetables) more than the staple foods (Arimond et al., 2008). See Table 3.2.

Table 3.2 Examples of food groups summed in diversity indicators

6- group indicator	9- group indicator	13- group indicator	21- group indicator
All starchy staples	All starchy staples	-All starchy staples	-Grains and grain products -All starchy staples
All legumes and nuts	All legumes and nuts	-All legumes and nuts	-Cooked dry beans and peas -Soybeans and soy products -Nuts and seeds
All dairy	All dairy	-All dairy	-Milk/ yoghurt -Cheese
Other animal source foods	-Organ meat -Eggs -Flesh foods and the small animal protein	-Organ meat -Eggs -Small fish eaten with bones.	-organ meat -eggs -small fish eaten with bones
		-All other flesh foods and small animal protein	-Large whole fish/ dried fish/ shellfish and other seafood
			-Beef, pork, veal, lamb, goat, game meat. -Chicken, duck, turkey, pigeon, guinea hen, game birds. -Insects, grubs, snakes, rodents and other small animals
-Vitamin A-rich fruits and vegetables	- Vitamin A-rich dark green leafy vegetables -Other vitamin A-rich fruits and vegetables	-Vitamin A-rich dark green leafy vegetables -Vitamin A-rich deep yellow/orange/red vegetables -Vitamin A-rich fruits	-Vitamin A-rich dark green leafy vegetables -Vitamin A-rich deep yellow/orange/red vegetables
			-Vitamin A-rich fruits
-Other fruits and vegetables	-Other fruits and vegetables	-Vitamin C-rich vegetables	-Vitamin C-rich vegetables
		-Vitamin C-rich fruits -All other fruits and vegetables	-Vitamin C-rich fruits -All other fruits and vegetables
			-All other fruits

Source: Arimond et al., 2008

The DDS used in this study is an adapted version of the 6-food group indicator which includes: starchy staples, legumes and nuts, dairy, animal source foods, vitamin A-rich fruits and vegetables and other fruits and vegetables. The food items included in our FFQ was best suited for classification into the above 6 food groups as apposed to the 9, 13, or 21-food group indicators. However, the information gathered on fruit was inclusive of all types and thus could not be separated into vitamin A-rich fruits and other fruits as in the original 6-food group indicator. Commonly used are the 5 food groups as included in the Food Guide Pyramid: grains, fruits, vegetables, dairy, and meat. However, this researcher preferred the inclusion of legumes as a major food group.

Legumes are unique foods because of their rich nutrient content, including starch, vegetable protein, dietary fibre, oligosaccharides, phytochemicals, vitamins and minerals. Legumes are inexpensive sources of plant protein which can be substituted for animal-protein sources in the diet. From a health promoting perspective including legumes in the diet is important in meeting the dietary recommendations to improve the nutritional status of the undernourished and the overnourished as well as reducing the risk for chronic disease (Venter & Eyssen, 2001). For these reasons it is important to include legumes as a focus in nutrition messages and guidelines. Hence, the inclusion of legumes as an indictor food group in the construction of the DDS.

The 12 food items included in the FFQ were classified into a 6-food group indicator as follows:

- Meat group comprised of (meat and poultry; fish, including tinned fish; and eggs);

- Bread group comprised of (bread, maize meal; rice and samp);
- Milk group comprised of (dairy products-milk, cheese, yoghurt);
- Vegetable group comprised of (green leafy vegetables, yellow/orange vegetables and other vegetables e.g. potatoes, onions, cabbage);
- Fruit group comprised of all fruit varieties; and
- Legume group comprised of (legumes-lentils, beans, split peas).

A dietary diversity score (DDS) was calculated as the number of food groups (total = 6; meat, bread, milk, vegetables, fruit, and legumes) consumed per day and per week i.e. daily dietary diversity score (daily- DDS) and weekly dietary diversity score (weekly-DDS), respectively. Each food group was counted only once, resulting in a possible score of 0-6 for both the daily-DDS and the weekly-DDS. The DDS for both daily and weekly consumption was determined, as it cannot be assumed that when any food group is consumed weekly, that it is consumed on a daily basis.

The remaining food items such as fats/oils and sugar/sweets were excluded from the DDS, as these foods primarily provide energy but few or no micronutrients. Tinned foods as reported in the questionnaire, were also excluded, as the types of tinned foods consumed were not specified i.e. its contents could have been any of the following: fruit, legumes, meat, mixed meals etc., thus the information was not specific enough.

3.13. Analysis of data

For this secondary analysis the data was firstly analysed to describe the differences between the NBW controls and LBW case babies (i.e. total sample). Secondly, the premature babies (gestational age < 37 weeks) were singled out as the premature case group (<2500g) and premature control group (≥2500g); the differences between these two groups were compared. Thirdly, the full term babies (gestational age ≥ 37 weeks) were singled out as the term LBW cases i.e. <2500g and term NBW controls i.e. ≥2500g and the differences between these two groups were analysed. The statistical analysis was conducted using SAS.

For the socioeconomic and socio-demographic variables (such as maternal age, education, marital status, employment status, salary, financial support from the father of the child, secondary income, no of dependents, and type of residence) frequency tables were used to explore the data and summarise the findings. Differences between groups for the above-mentioned variables (categorical) were tested with the Chi-square test. Where the sample sizes were too small due to many missing values, the Fisher's exact test was used instead.

Descriptive analysis to determine the mean, standard deviations, median, minimum and maximum was carried out for maternal height, maternal weight, (at 1st antenatal visit), number of weeks gestation (at 1st antenatal visit), infant birth weight. The mean, standard deviations, median, minimum and maximum range for the food variety score (FVS) and the daily dietary diversity score (daily-DDS) and weekly dietary diversity score (weekly-DDS) was determined for all the case and control groups.

For continuous variables (maternal weight, height, gestational age, FVS, daily-DDS, weekly-DDS) differences between groups were analysed with an independent Wilcoxin test (for two groups), or analysis of variance test i.e. the Kruskal-Wallis test (two or more groups). The Kruskal-Wallis test is a non parametric method for testing equality of population medians among groups.

Differences between groups for categorical variables (such as smoking versus non-smoking, drinking versus non-drinking and for the group who practiced both smoking and alcohol consumption versus those who practiced none or either were tested with the Chi-square test. Where the sample sizes were too small due to many missing values, the Fisher's exact test was used instead.

Correlation analysis was done to determine associations between dietary scores and socioeconomic and socio-demographic characteristics as well as between dietary scores and maternal smoking and alcohol consumption.

3.14. Data reliability and validity

The questionnaires were translated into Afrikaans and translated back into English. It was piloted amongst 6 women at Paarl hospital after which adjustments were made before the final implementation of the study. To validate the participant's responses, cross-questioning on responses to smoking, alcohol, nutrition and stress were done during the interviews. The interviewers received extensive training by the primary investigators and supervisor in administering all components of the questionnaire (including the food frequency questionnaire) and record review. To ensure data

quality the primary investigator conducted quality checks by doing a sample of duplicate record review and observation items. A ninety-eight percent agreement was seen (Jackson, Batiste, & Rendall Mkosi, 2007).

As a secondary analysis, this study does have limitations in terms of absolute reliability and validity of the calculated score for food variety and dietary diversity as "tinned foods" was not specific enough and had to be excluded from the food variety and dietary diversity scoring. Tinned foods were consumed by the majority of case and control mothers in the total sample, the full term and the preterm group. However, it is estimated that the impact of this is negligible based on the mean weekly frequency of consumption of tinned foods, by the all the above-mentioned groups, being only about 2 times per week (equal distribution).

3.1.5. Limitations

Some methodological limitations should be mentioned. The findings of this study cannot be generalised to all communities in South Africa because the study sample was purposefully selected to represent the women living and /or working on and around farms in the West Coast/Winelands region. The use of a food frequency questionnaire may lend itself to over or underestimation as it is dependant on the respondents' ability to recall their dietary intake. However, a non-quantified FFQ was appropriate especially in terms of it being a simple and rapid method of gathering information regarding habitual dietary behaviour and since interviews were conducted postpartum; the lower respondent burden of a FFQ was an advantage.

3.1.6. Ethical Statement

The primary study received ethical approval by the Higher Degrees Committee of the University of the Western Cape. The purpose and nature of the study was explained to the participants. Written consent was obtained from each participant before the interviews were conducted, see Appendix C. Participants were ensured confidentiality and informed that they could withdraw from the study at anytime without question. To ensure confidentiality, each participant was assigned a study number that was used on all data collection forms. No subjects' names or other identifying information appeared on any data collection forms or electronic data files (Jackson, Batiste, & Rendall Mkosi, 2007). This researcher used the confidential database for analysis and never accessed the names of the participants so as to maintain confidentiality and ethical standards. As a secondary analysis of the confidential data, this study did not require signed informed consent separate from that originally obtained from the subjects.

3.17. Conclusion

Chapter three has explained in depth the research methodology of this secondary data analysis in which the primary aim was to assess the dietary intake of pregnant women in the West Coast / Winelands region and determine its relation with low birth weight. As mentioned in chapter 1, this mini thesis forms part of the Healthy Childbearing study on low birth weight, funded by the South African National Research Foundation (NRF) since 2001 as a five-year student-based research project. This nutritional analysis was also supported by an NRF student bursary granted to the researcher. The main focus here was to construct dietary scores that could be used to evaluate the

dietary intake of pregnant women. Hence the food variety score (FVS) and the dietary diversity score (DDS) was constructed. These scores were used to explore the influence of maternal dietary intake on infant birth weight. The next chapter will show detailed results of the research.

CHAPTER 4

RESULTS

4.1. Introduction

This chapter provides a summary of the findings of the survey. The findings are described by means of frequency tables and appropriate inferential statistical techniques. The analysis was carried out for the total sample i.e. LBW cases (<2500g, n=198) versus NBW controls (≥2500g, n=202), then separately for the full term infants only (gestational age ≥ 37 weeks) and the preterm infants only (gestational age < 37 weeks) i.e. full term LBW cases (n=104) versus the full term NBW controls (n=199); and preterm LBW cases (n=94) versus preterm NBW controls (n=3), respectively (see Table 4.1). Hence the findings of the survey will be presented as stated above i.e. for the total sample (case/control), the full term (case/control), and the preterm (case/control) groups.

Table 4.1: Total number of preterm and full term infants in the study population

	Case (LBW) (<2500g)	**Control (NBW)** (≥2500g)	**Total**
Preterm	94	3	97
Full term	104	199	303
Total sample	198	202	400

4.2. Relationship between infant birth weight and gestational age at birth

Total sample

In the total sample (n=400) there were 198 LBW cases (BW <2500g) and 202 NBW controls (BW ≥2500g). Of the 198 LBW cases 94 (47.5%) were born premature (less than

37 completed weeks gestation) and 104 (52.5%) were full term (≥ 37 completed weeks gestation); thus the latter reflecting intrauterine growth retardation. The mean gestational age for the LBW cases in the total sample was 36 weeks (22-40 weeks) and for the control group it was 40 weeks (35-43 weeks).

Full term

The mean gestational age for the full term LBW cases, was 38 weeks (37-40 weeks) and for the control group it was 40 weeks (37-43 weeks).

Preterm

The mean number of weeks gestation for the preterm cases was 34 weeks (22-36 weeks) and 36 weeks (35-36 weeks) for the preterm controls.

Included in Table 4.2 are the mean, standard deviation (± SD), minimum and maximum birth weights for the total sample, the full term and the preterm case and control groups. The full term infants had a higher mean birth weight in both the case and control group.

Table 4.2: Mean infant birth weight

		Mean (g)	(±SD)	Birth weight range (g)
Total sample	**Case** (<2500g) n= 198	1998.71#	355.3	640-2490
	Control (≥2500g) n= 202	3097.18#	416.7	2500-4540
Full term only	**Case** (<2500g) n= 104	2164.35#	208.1	1600-2490
	Control (≥2500g) n= 199	3105.88#	413.6	2500-4540
Preterm only	**Case** (<2500g) n= 94	1815.5	393.4	640-2460
	Control(≥2500g) n= 3	2520	34.6	2500-2560

Kruskal-Wallis (ANOVA)

There was a significant difference in the mean gestational age between the case and control groups in the total sample as well as in the full term group i.e. (Kruskal-Wallis test, p=0.0001) and (Kruskal-Wallis test, p=0.0001), respectively. There was no significant difference in the mean gestational age in the preterm case and control group (Kruskal-Wallis test, p=0.1497).

4.3 Relationship between infant birth weight and socioeconomic and socio-demographic characteristics

Details describing the socioeconomic and socio-demographic (SESD) background of the subjects are in Table 4.3.

Total sample

There was a significant difference in the level of education and type of housing between the case and control mothers in the total sample i.e. (χ^2, p=0.0003) and (χ^2, p=0.0114), respectively.

Full term

Analysis with only the full term infants, showed a significant difference in maternal age (χ^2, p=0.0493), level of education (χ^2, p=0.0001), type of housing (χ^2, p=0.0083), the number of dependants (χ^2, p=0.0142) and financial support from the father (χ^2, p=0.0055); between the case and control mothers.

Preterm

In the preterm group only financial support from the father was found to be significantly different between the case and control group (χ^2, p= 0.0074).

Table 4.3: Key maternal socioeconomic and socio-demographic (SESD) characteristics

SESD Variables	Total sample Case (<2500g) n= 198	Total sample Control (≥2500g) n= 202	Full term Case (<2500g) n= 104	Full term Control (≥2500g) n= 199	Preterm Case (<2500g) n= 94	Preterm Control (≥2500g) n= 3
Age	p=0.213 #		p=0.0493 #		p=0.3323 #	
≤ 19yrs	16.2	13.4	12.5	13.6	20.2	-
20-34	68.7	76.2	67.3	76.4	70.2	66.7
≥35	15.2	10.4	20.2	10.1	9.6	33.3
Education	p= 0.0003 ‡		p= 0.0001 ‡		p=0.3555 ‡	
None	-	0.5	-	0.5	-	-
Primary school	37.4	19.5	44.1	19.7	30.1	-
Secondary school	62.6	80.0	55.9	79.8	69.9	100.0
Marital status	p=0.5876 ‡		p=0.6662 ‡		p=1.000 ‡	
Single/never married	25.3	23.6	28.4	24.0	21.7	-
Married (monogamous)	74.2	74.9	70.6	74.5	78.3	100.0
Married (polygamous)	0.5	1.5	1.0	1.5	-	-
Employment	p=0.4804†		p=0.1471†		p=0.5666†	
Yes	21.7	24.8	17.3	25.1	26.6	-
no	78.3	75.3	82.7	74.9	73.4	100.0
Salary	p=0.3118 ‡		p=0.4608 ‡		*	
≤ R200	2.4	-	-	-	4.2	-
R300-R500	16.7	8.0	16.7	8.0	16.7	-
R600-R700	26.2	18.0	27.8	18.0	25.0	-
R800-R1000	31.0	38.0	22.2	38.0	37.5	-
> R1000	23.8	36.0	33.2	36.0	16.7	-
Father support	p=0.1479 ‡		p= 0.0055 ‡		p= 0.0074 ‡	
Yes	81.8	84.2	85.6	84.4	77.7	66.7
No	14.1	14.9	8.7	15.1	20.2	-
Sometimes	4.0	1.0	5.8	0.5	2.1	33.3
Secondary income (grant)	p=0.4880 ‡		p=0.1359 ‡		p=0.0927 ‡	
Disability	2.0	0.5	3.9	0.5	-	-
Child support	18.3	20.3	19.4	19.6	17.0	66.7
Unemployment	4.1	3.0	4.9	3.0	3.2	-
other	75.6	76.2	71.8	76.9	79.8	33.3
No. of dependants	p=0.1125 ‡		p= 0.0142 ‡		p=0.0636 ‡	
1-2	64.0	73.3	57.3	73.4	71.3	66.7
3-4	31.5	24.3	37.9	24.6	24.5‡	-
> 4	4.6	2.5	4.9	2.0	4.3	33.3
Type of residence	p=0.0114 ‡		p=0.0083 ‡		p=0.1217 ‡	
Brick	79.8	86.1	76.9	86.9	83.0	33.3
Wendy	4.0	7.4	5.8	7.5	2.1	-
Shack in yard	5.1	2.5	3.9	2.0	6.4	33.3
Squatter camp	11.1	4.0	13.5	3.5	8.5	33.3

* No statistical test calculated. † Fishers Exact test ‡ Chi Square # Kruskal-Wallis

The SESD variables, namely marital status, employment status, household salary and secondary income (e.g. social grants), was not significantly different between the case and control groups in total sample, the full term nor the preterm group.

4.4. Relationship between infant birth weight and maternal anthropometric data

Table 4.4 shows the mean, standard deviation (±SD), minimum and maximum weight (at 1st antenatal visit), and height for the case and control mothers in the total sample, the full term and the preterm case and control groups.

Table 4.4: Mean, (± SD), minimum and maximum of maternal anthropometric data

	Total sample Case (<2500g) n= 198	**Total sample Control (≥2500g) n= 202**	**Full term Case (<2500g) n= 104**	**Full term Control (≥2500g) n= 199**	**Preterm Case (<2500g) n= 94**	**Preterm Control (≥2500g) n= 3**
Weight (kg)	p= 0.0002		p= 0.0002		p= 0.8349	
Mean(±SD) (min-max) n	59.80 (13.4) (37.5-112.1) n=152	65.88 (15.4) (43.5-112.0) n=177	58.89 (12.2) (42.1-94.5) n=82	65.98 (15.4) (43.3-112.0) n=174	60.89 (14.7) (37.5-112.) n=70	60.05 (17.4) (48.0-80.0) n=3
Height (cm)	p= 0.0475		p= 0.0570		p=0.9062	
Mean(±SD) (min-max) n	159.93 (7.4) (129.0-178.0) n=138	161.97 (8.2) (142.0-188.0) n=169	159.78 (7.4) (138.0-178.0) n=77	161.99 (8.2) (142.0-188.) n=167	160.1 (7.5) (129.0- 177.0) n=61	160.5 (0.7) (160.0-161.0) n=2

Kruskal Wallis Test (ANOVA)

Total sample

There was a significant difference in both the weight (Kruskal-Walllis test, p=0.0002) and height (Kruskal-Wallis test, p=0.0475) between the case and control mothers in the total sample.

Full term

The maternal weight was significantly different (Kruskal-Walllis test, p=0.0002) between the full term case and control groups, however, maternal height was not found to be significantly different (Kruskal-Walllis test, p=0.0570).

Preterm

Both maternal weight and height were not significantly different across the preterm case and control groups (Kruskal-Wallis test, p=0.8349) and (Kruskal-Wallis test, p=0.9062), respectively.

4.5. Relationship between infant birth weight and maternal smoking and/ or alcohol consumption

Table 4.5 includes a summary of the number of case and control mothers who smoked, and/ or consumed alcohol during the index pregnancy. Data is provided for the total sample, the full term infants and the preterm infants.

Total sample

In the total sample there was a significant difference in the number of case and control mothers who smoked (χ^2, $p< 0.0001$), consumed alcohol (χ^2, $p< 0.0001$), and those who both smoked and consumed alcohol during the index pregnancy (χ^2, $p< 0.0001$).

Full term

There was a significant difference in the number of full term case and control mothers who smoked (χ^2, p< 0.0001), consumed alcohol (χ^2, p< 0.0001) and those who both smoked and consumed alcohol during the index pregnancy (χ^2, p< 0.0001).

Preterm

There was no significant difference in the number of case or control mothers who smoked (χ^2, p=0.3634), consumed alcohol (χ^2, p=0.9270), or those who both smoked and consumed alcohol (χ^2, p=0.3634).

Table 4.5: Maternal smoking and/ or alcohol consumption

	Total sample Case (<2500g) n= 198	**Total sample Control (≥2500g) n= 202**	**Full term Case (<2500g) n= 104**	**Full term Control (≥2500g) n= 199**	**Preterm Case (<2500g) n= 94**	**Preterm Control (≥2500g) n= 3**
Smoking	p< 0.0001		p< 0.0001		p=0.3634	
Yes	124 (62.6%)	73 (36.1%)	68 (65.4%)	72 (36.2%)	56 (59.6%)	1 (33.3%)
No	74 (37.4%)	129 (63.9%)	36 (34.6%)	127 (63.8%)	38 (40.4%)	2 (66.7%)
Alcohol	p< 0.0001		p< 0.0001		p=0.9270	
Yes	74 (37.4%)	38 (18.8%)	45 (43.3%)	37 (18.6%)	29 (30.9%)	1 (33.3%)
No	124 (62.6%)	164 (81.2%)	59 (56.7%)	162 (81.4%)	65 (69.2%)	2 (66.7%)
Smoke & Alcohol	p< 0.0001		p< 0.0001		p=0.3634	
Yes	66 (33.3%)	27 (13.4%)	40 (38.5%)	27 (13.6%)	26 (27.7%)	-
No	132 (66.7%)	175 (86.6%)	64 (61.5%)	172 (86.4%)	68 (72.3%)	3 (100%)

‡ Chi Square test (ANOVA)

4.6. Relationship between infant birth weight and dietary intake (non quantified food frequency questionnaire)

4.6.1 Frequency of food consumption and infant birth weight

Shown in Tables 4.6(a), 4.6(b), and 4.6(c) are the mean weekly frequency of consumption for the 14 food items as listed in the food frequency questionnaire. As mentioned in chapter 3, the daily and monthly frequencies were converted into frequencies per week. For example the mean weekly frequency of consumption for bread was between 14 and 15.5 times per week for the case and control infants in the total sample, the full term and preterm groups.

Table 4.6 (a): Weekly mean consumption of the 14 food items – Total sample

Food item	Case (<2500g) n	Mean (±SD)	Min- Max	Control (≥2500g) n	Mean (±SD)	Min-Max	P-value
Meat/poultry	190	6.3 (5.1)	1-35	196	6 (3.3)	1-21	0.3261
Fish	153	3.1 (3.5)	1-21	163	2.7 (3.3)	1-21	0.1021
Eggs	169	3.9 (3.4)	0.25-21	169	3.7 (3.2)	0.25-21	0.5866
Bread	193	14.9 (6.4)	7-35	194	15.5 (7.1)	7-42	0.5637
Maize meal, samp, rice	178	8.7 (3.4)	7-28	186	9.2 (3.7)	7-21	0.1079
Tinned foods	165	1.9 (1.9)	0.25-14	177	2.1 (2.1)	0.25-14	0.8449
Milk	152	8.0 (7.89)	1-56	171	7.9 (7.7)	1-42	0.6216
Legumes	125	1.7 (1.7)	0.25-7	133	1.9 (2.8)	0.25-48	0.9468
GLV *	191	6.2 (2.7)	1-21	196	6.4 (5.3)	1-49	0.1745
Y/OV**	187	3.8 (4.0)	0.25-21	193	4.1 (4)	0.25-28	0.1532
OV ***	170	3.7 (4.3)	1-35	179	3.6 (2.8)	1-14	0.1111
Fats	191	16 (8.2)	1-42	202	16.8 (8.7)	1-42	0.3557
Sugar	172	8.2 (8.8)	1-49	178	9.6 (9.0)	1-42	0.0465
Fruit	181	11.7 (9.6)	1-49	188	12.4 (9.7)	1-42	0.4338

Cases (n=198), control (n=202) ∞n vary due to missing values
Kruskal Wallis Test (ANOVA)
* GLV-green leafy vegetables;
** Y/OV-yellow/orange vegetables,
***OV-other vegetables (may include potato, onion, cabbage)

Table 4.6 (b): Weekly mean consumption of the 14 food items - Full term only

Food item	Case (<2500g) n	Mean (± SD)	Min-Max	Control (≥2500g) n	Mean (± SD)	Min-Max	P-value
Meat/poultry	102	6.4 (5.7)	1-35	193	6.0 (3.3)	1-21	0.2623
Fish	83	2.8 (3.4)	1-21	161	2.7 (3.4)	1-21	0.4983
Eggs	91	3.9 (3.9)	0.25-21	166	3.7 (3.2)	0.25-21	0.8448
Bread	101	15.3 (5.8)	7-28	191	15.5 (7.0)	7-42	0.9220
Maize meal, samp, rice	93	8.1 (3.3)	7-28	183	9.1 (3.6)	7-21	0.0081
Tinned foods	88	1.7 (1.9)	0.25- 14	174	2.1 (2.1)	0.25- 14	0.2540
Milk	78	6.4 (6.7)	1-35	168	8.0 (7.7)	1-42	0.1459
Legumes	68	1.6 (1.4)	0.25-7	130	1.9 (2.8)	0.25-28	0.9169
GLV *	100	6.3 (2.5)	1-21	193	6.4 (5.3)	1-49	0.0817
Y/OV**	97	3.6 (4.5)	0.25-21	190	4.0 (3.8)	0.25-28	0.0352
OV ***	90	3.8 (5.1)	1-35	177	3.6 (2.8)	1-14	0.0550
Fats	102	16.5 (8.3)	1-35	199	16.8 (8.7)	1-42	0.9107
Sugar	89	6.5 (7.3)	1-28	175	9.7 (9.1)	1-42	0.0006
Fruit	95	11.1 (8.8)	1-35	185	12.5 (9.8)	1-42	0.2840

Full term cases (n=104), full term control (n=199) ∞n vary due to missing values
Kruskal-Wallis Test (ANOVA)
*GLV-green leafy vegetables; **Y/OV-yellow/orange vegetables; *** OV-other vegetables (may include potato, onion, cabbage)

Table 4.6 (c): Weekly mean consumption of the 14 food items - Preterm only

Food item	Case (<2500g) n	Mean (± SD)	Min-Max	Control (≥2500g) n	Mean (± SD)	Min-Max	P-value
Meat/poultry	88	6.1 (4.3)	1-21	3	5.3 (2.9)	2-7	0.8938
Fish	70	3.5 (3.7)	1-21	2	2.0 (0)	2-2	0.8596
Eggs	78	4.0 (2.8)	0.25-14	3	1.5 (1.3)	0.5-3.0	0.1007
Bread	92	14.5 (7.0)	7-35	3	14.0(12.1)	7-28	0.6631
Maize meal, samp, rice	85	9.2 (3.5)	7-21	3	16.3 (4.0)	14-21	0.0050
Tinned foods	77	2.2 (2.0)	0.25-7	3	1.0 (0)	1-1	0.2492
Milk	74	9.6 (8.5)	1-56	3	5.3 (7.5)	1-14	0.1921
Legumes	57	1.8 (1.9)	0.25-7	3	1.0 (0)	1-1	0.7393
GLV *	91	6.0 (2.9)	1-21	3	8 (5.6)	3-14	0.5113
Y/OV**	90	3.9 (3.4)	0.25-21	3	9.3 (10.1)	3-21	0.1935
OV ***	80	3.5 (3.1)	1-21	2	3.0 (0)	3-3	0.5349
Fats	89	15.4 (8.2)	1-42	3	21 (7)	14-28	0.1915
Sugar	83	10.1 (9.9)	1-49	3	5.7 (7.2)	1-14	0.3222
Fruit	86	12.4 (10.4)	1-49	3	6.0 (7.0)	1-14	0.2181

Cases (n=94), control (n=3) ∞n vary due to missing values
Kruskal-Wallis Test (ANOVA)
*GLV-green leafy vegetables; ** Y/OV-yellow/orange vegetables; ***OV-other vegetables (may include potato, onion, cabbage)

Most of the food items listed in Tables 4.6(a), 4.6(b), and 4.6(c) have been combined into 6 food groups: Bread, Meat, Vegetables, Milk, Legumes and Fruit as seen in Tables 4.7(a), 4.7(b) and 4.7(c).

Table 4.7 (a.): Weekly mean consumption of the 6 food groups-Total sample

Food groups	Case (<2500g) n	Mean (± SD)	Min-Max	Control (≥2500g) n	Mean (±SD)	Min-Max	P-value
Bread/ cereals*	196	22.6 (8.2)	7-49	202	23.4 (9.0)	7-49	0.4296
Meat**	194	3.8 (2.2)	1-11	201	3.5 (2.1)	1-15	0.1340
Vegetables***	197	3.4 (2.3)	1-14	202	3.8 (2.4)	1-10	0.1730
Milk	152	8.0 (7.89)	1-56	171	7.9 (7.7)	1-42	0.6216
Legumes	125	1.7 (1.7)	0.25-7	133	1.9 (2.8)	0.25-48	0.9468
Fruit	181	11.7 (9.6)	1-49	188	12.4 (9.7)	1-42	0.4338

Total cases (n=198), Total controls (n=202) ∞n vary due to missing values
Kruskal-Wallis Test (ANOVA)
* Bread/cereals (bread or maize meal, samp and rice)
** Meat (meat, poultry, fish, eggs)
*** Vegetables (green leafy, orange/ yellow, and other vegetables- potatoes, onions, cabbage)

Table 4.7 (b): Weekly mean consumption of the 6 food groups- Full term only

Food groups	Case (<2500g) n	Mean (± SD)	Min-Max	Control (≥2500g) n	Mean (± SD)	Min-Max	P-value
Bread/ cereals*	103	22.4 (7.7)	7-49	199	23.3 (9.0)	7-49	0.5215
Meat **	103	3.9 (2.2)	1-9	198	3.5 (2.1)	1-15	0.1098
Vegetables ***	103	3.2 (2.0)	1-10	199	3.8 (2.4)	1-10	0.1006
Milk	78	6.4 (6.7)	1-35	168	8.0 (7.7)	1-42	0.1459
Legumes	68	1.6 (1.4)	0.25-7	130	1.9 (2.8)	0.25-28	0.9169
Fruit	95	11.1 (8.8)	1-35	185	12.5 (9.8)	1-42	0.2840

Full term cases (n=104), Full term control (n=199) ∞n vary due to missing values
Kruskal-Wallis Test (ANOVA)
*Bread/cereals (bread or maize meal, samp and rice)
** Meat (meat, poultry, fish, eggs)
***Vegetables (green leafy, orange/ yellow, and other vegetables- potatoes, onions, cabbage)

Table 4.7 (c): Weekly mean consumption of the 6 food groups- Preterm only

Food groups	Case (<2500g) n	Mean (±SD)	Min-Max	Control (≥2500g) n	Mean (±SD)	Min-Max	P-value
Breads/ cereal*	93	22.8 (8.8)	7-49	3	30.3 (10.7)	21-42	0.1852
Meat**	91	3.7 (2.2)	1-11	3	3.3 (1.5)	2-5	0.8968
Vegetables ***	94	3.7 (2.5)	1-14	3	5.3 (1.1)	4-6	0.1118
Milk	74	9.6 (8.5)	1-56	3	5.3 (7.5)	1-14	0.1921
Legumes	57	1.8 (1.9)	0.25-7	3	1.0 (0)	1-1	0.7393
Fruit	86	12.4(10.4)	1-49	3	6.0 (7.0)	1-14	0.2181

Preterm cases (n=94), Preterm control (n=3) ∞n vary due to missing values
Kruskal-Wallis Test (ANOVA)
*Bread/cereals (bread or maize meal, samp and rice)
** Meat (meat, poultry, fish, eggs)
***Vegetables (green leafy, orange/ yellow, and other vegetables- potatoes, onions, cabbage)

Total sample

The bread/ cereals group makes up the bulk of food items consumed per week by both the case and control mothers. Only 1% of the case mothers in the total sample, did not consume any items from this food group weekly i.e. bread or cereals (maize, samp and rice). Whereas all the control group mothers consumed food items from the bread/ cereal group weekly.

In general more case and control mothers consumed vegetables as compared to fruit on both a daily and weekly basis. In the total sample 9% of the case and 3% of the control mothers did not consume any fruits weekly whereas, in the case mothers less than 1% did not consume any vegetables weekly. All control mothers did consume vegetables weekly in the total sample. However, vegetable intake was low, consumed only 3 and 4 times per week whereas; fruits were consumed 11.7 and 12.4 times per week in the case and control mothers, respectively.

In the total sample food items from the meat group (meat, poultry, eggs, and fish including tinned fish) were on average consumed about 4 times per week by both the case and control mothers. However, legumes were only consumed twice per week by the case and control mothers. Less than 10% of the case and control mothers consumed legumes on a daily basis. More than half of the case (55%) and control (52%) mothers in the total sample did not consume any items from the milk group daily.

Sugar was on average consumed about 8 and 10 times per week in the case and control mothers, respectively. There was a significant difference in the weekly frequency of consumption of sugar between the case and control mothers in the total sample (Kruskal-Wallis test, p=0.0465).

Full term

The bread/ cereals group makes up the bulk of food items consumed per week by both the case and control mothers. Only 1% of the case mothers in the full term group did not consume any items from this food group weekly i.e. bread or cereals (maize, samp and rice). Whereas all the control group mothers consumed food items from the bread/ cereal group weekly. There was a significant difference in the weekly consumption of cereals between the full term case and control mothers (Kruskal-Wallis test, p=0.0081).

Vegetables were generally consumed by more of the case and control mothers in the full term group both daily and weekly as compared to fruit. In the full term group 9% of the case and 7% of the control mothers did not consume any fruits weekly. Less than 1% of the case and control mothers in the full term group did not consume vegetables weekly.

However, vegetables consumption is low, consumed only 3.2 and 3.8 times per week, whereas fruits were consumed 11.1 and 12.5 times per week in the case and control mothers, respectively. There is a significant difference in the weekly consumption of yellow/orange coloured vegetables between the full term case and control mothers (Kruskal-Wallis test, p=0.0352).

Food items from the meat group (meat, poultry, eggs, and fish including tinned fish) were on average consumed about 4 times per week by both the case and control mothers. However legumes were only consumed about twice per week by both the case and control mothers. Only 4% of the case and 6% of the control mothers in the full term group consumed legumes daily. Majority of the case (64%) and control (52%) mothers did not consume items from the milk group daily. There was a significant difference in the number of case and control mothers who consumed milk and/ or milk products daily (Fisher's Exact test, p=0.038629).

Sugar was on average consumed about 7 and 10 times per week in the case and control mothers, respectively The weekly frequency of consumption of sugar was found to be significantly differently between the full term case and control mothers (Kruskal-Wallis test, p=0.0006).

Preterm

The bread/ cereals group makes up the bulk of food items consumed per week by both the case and control mothers. Only 1% of the case mothers in the preterm group did not consume any items from this food group weekly i.e. bread or cereals (maize, samp and

rice). Whereas all the control group mothers did consume food items from the bread/ cereal group weekly. There was a significant difference in the weekly frequency of maize consumption between the preterm case and control mothers (Kruskal-Wallis test, p=0.0050).

Vegetables were consumed by more of the preterm case and control mothers when compared to fruit on both a daily and weekly basis. In the preterm group 9% of the case mothers did not consume fruits weekly, however all their controls (n=3) consumed fruits weekly. All of the case and control mothers in the preterm group consumed vegetables weekly**.**

Food items from the meat group (meat, poultry, eggs, and fish including tinned fish) were on average consumed about 4 and 3 times per week in the case and control mothers, respectively. However legumes were only consumed about twice per week by the case and control mothers. Only 7% of the case mothers in the preterm group consumed legumes on a daily basis. None of the three control mothers consumed legumes on a daily basis. More than half (56%) of the case and (33%) of the control mothers in the preterm group did not consume any items from the milk group daily. There was no significant difference in the weekly frequency of consumption of sugar between the preterm case and control mothers (Kruskal-Wallis test, p=0.3222).

Although fats/ oils were not included in the 6 food groups it is important to note that food items from this food group was consumed most frequently per week by the case and groups in the total sample, the full term and the preterm group. Fats and oils may have been included in the diet as a spread and/ or in the preparation of food.

4.6.2 Weekly frequency scores (0-7) and infant birth weight

In Table 4.8(a) and 4.8(b) are the mean weekly frequency of consumption scores for the 14 food items and the 6 combined food groups, respectively. As mentioned in chapter 3, a daily or more than once per day frequency of consumption was scored a 7; a frequency of consumption between 1-6 times/ week was scored the actual frequency per week i.e. 1-6; and a frequency of consumption < 1 time per week was scored a 0.

Total sample

In the case and control mothers the bread/ cereal group (7± 0 versus 7± 0) had the highest mean weekly frequency score, followed by fat (6.8 ±1.0 versus 6.8 ±0.9), green leafy vegetables (5.9 ±2 versus 5.5 ± 2.3) and fruit (5.7± 2.2 versus 5.9± 2.1). The mean weekly frequency score for sugar was significantly different between the case and control mothers of the total sample (Kruskal-Wallis test, p=0.0262).

Full term

In the case and control mothers the bread/ cereal group (7± 0 versus 7± 0) had the highest mean frequency score, followed by fat (6.8± 1.0 versus 6.8± 1.0), green leafy vegetables (6.1± 1.9 versus 5.5± 2.3) and fruit (5.7± 2.2 versus 5.9± 2.1). There was a significant difference in the mean weekly frequency scores for green leafy vegetables (Kruskal-Wallis test, p=0.0246), yellow/ orange vegetables (Kruskal-Wallis test, p=0.0237), other vegetables (potatoes, onions, cabbage) (Kruskal-Wallis test, p=0.0392), and sugar (Kruskal-Wallis test, p=0.0005), between the full term case and control mothers

Preterm

In the case and control mothers the bread/ cereal group (7± 0 versus 7± 0) had the highest mean frequency score, followed by fat (6.8± 0.9 versus 7.0± 0), green leafy vegetables (5.7± 2.1 versus 5.7± 2.3) and fruit (5.8± 2.2 versus 3.7± 3.1). There was no significant difference, in the mean frequency scores for any of the food items, between the case and control mothers in the preterm group.

Table 4.8(a): Mean weekly frequency scores (0-7) for the 14 food items in relation to birth outcome

Food groups	Total sample Case (<2500g)	Total sample Control (≥2500g)		Full term Case (<2500g)	Full term Control (≥2500g)		Preterm Case (<2500g)	Preterm Control (≥2500g)	
	Mean (± SD)	Mean (± SD)	P-value	Mean (± SD)	Mean (± SD)	P-value	Mean (± SD)	Mean (± SD)	P-value
Meat /poultry	5.1 (2.3)	5.4 (2.2)	0.1190	4.9 (2.3)	5.4 (2.2)	0.0591	5.2 (2.3)	5.3 (2.9)	0.9695
Fish	2.7 (2.1)	2.3 (2.0)	0.1064	2.4 (1.9)	2.4 (2.0)	0.5155	3.0 (2.2)	2.0 (0)	0.8592
Eggs	3.6 (2.6)	3.5 (2.6)	0.6625	3.4 (2.6)	3.5 (2.6)	0.7178	3.8 (2.7)	1.3 (1.5)	0.0998
Bread	7 (0)	7 (0)	1.000	7 (0)	7 (0)	1.000	7 (0)	7 (0)	1.000
Maizemeal ,samp, rice	7 (0)	7 (0)	1.000	7 (0)	7 (0)	1.000	7 (0)	7 (0)	1.000
Tinned foods	1.9 (1.8)	2 (1.9)	0.8425	1.6 (1.5)	2.0 (1.9)	2.531	2.1 (2)	1 (0)	0.2489
Milk	5 (2.5)	4.8 (2.7)	0.3851	4.3 (2.7)	4.8 (2.7)	0.2283	5.7 (2.2)	3 (3.5)	0.0551
Legumes	1.6 (1.7)	1.7 (1.8)	0.8997	1.5 (1.5)	1.7 (1.8)	0.8425	1.7 (2.0)	1.0 (0)	0.7380
GLV *	5.9 (2)	5.5 (2.3)	0.0600	6.1 (1.9)	5.5 (2.3)	0.0246	5.7 (2.1)	5.7 (2.3)	0.9248
Y/OV**	3.3 (2.7)	3.6 (2.7)	0.1439	2.9 (2.7)	3.6 (2.7)	0.0237	3.7 (2.8)	4.7 (2.1)	0.3562
OV ***	3.2 (2.5)	3.4 (2.4)	0.0959	3.1 (2.6)	3.4 (2.4)	0.0392	3.3 (2.4)	3.0 (0)	0.5344
Fats	6.8 (0.98)	6.8 (0.9)	0.7223	6.8 (1.0)	6.8 (1.0)	0.9753	6.8 (0.9)	7.0 (0)	0.6747
Sugar	4.5 (2.7)	5.1 (2.5)	0.0269	4.0 (2.7)	5.1 (2.5)	0.0005	5.0 (2.5)	3.3 (3.2)	0.2644
Fruit	5.7 (2.2)	5.9 (2.1)	0.5729	5.7 (2.2)	5.9 (2.1)	0.3810	5.8 (2.2)	3.7 (3.1)	0.1068

* GLV-green leafy vegetables ** Y/OV-yellow/orange vegetables; ***OV-other vegetables (may include potato, onion, cabbage) # Kruskal -Wallis Test (ANOVA)

Table 4.8(b): Mean weekly frequency scores (0-7) for the 6 food groups in relation to birth outcome

Food groups	Total sample Case (<2500g)	Total sample Control (≥2500g)		Full term Case (<2500g)	Full term Control (≥2500g)		Preterm Case (<2500g)	Preterm Control (≥2500g)	
	Mean (± SD)	Mean (± SD)	P-value	Mean (± SD)	Mean (± SD)	P-value	Mean (± SD)	Mean (± SD)	P-value
Bread/ Cereal*	7 (0)	7 (0)	1.000	7 (0)	7 (0)	1.000	7 (0)	7 (0)	1.000
Meat **	3.7 (1.9)	3.3 (1.7)	0.1373	3.8 (1.9)	3.3 (1.7)	0.1119	3.6 (1.9)	3.3 (1.5)	0.8967
Vegetables ***	3.3 (1.9)	3.6 (2.0)	0.1818	3.2 (1.9)	3.6 (2.0)	0.1099	3.5 (2.0)	5.3 (1.2)	0.1116
Milk	5 (2.5)	4.8 (2.7)	0.3851	4.3 (2.7)	4.8 (2.7)	0.2283	5.7 (2.2)	3 (3.5)	0.0551
Legumes	1.6 (1.7)	1.7 (1.8)	0.8997	1.5 (1.5)	1.7 (1.8)	0.8425	1.7 (2.0)	1.0 (0)	0.7380
Fruit	5.7 (2.2)	5.9 (2.1)	0.5729	5.7 (2.2)	5.9 (2.1)	0.3810	5.8 (2.2)	3.7 (3.1)	0.1068

* Bread/ cereal (bread or maize meal samp and rice)
** Meat (meat/chicken, fish, egg)
*** Vegetables (green leafy, orange/ yellow, and other vegetables- potatoes, onions, cabbage)
# Kruskal-Wallis Test (ANOVA)

There was no significant difference in the mean frequency scores for the 6 food groups, between the case and control groups in the total sample, the full term and the preterm group.

4.6.3 Dietary scores and infant birth weight

The FVS was determined for each individual by summing the frequency scores (0-7) of the 12-food items (excluding sugar and tinned foods) of thus the resulting FVS ranged from (0-84). The daily and weekly DDS was determined by counting the number of food groups consumed per day and per week respectively. Each food group was counted only once. The resulting daily and weekly DDS ranged from (0-6). In Table 4.9 is a summary of the

mean, ±SD, minimum and maximum FVS and DDS-daily and DDS-weekly for the total sample, and the full term infants and the preterm infants separately.

Table 4.9: Mean (± SD) of dietary scores: FVS, daily-DDS, and weekly-DDS

Dietary scores	Case (<2500g)	Control (≥2500g)	Full term (<2500g)	Full term (≥2500g)	Preterm (<2500g)	Preterm (≥2500g)
	Mean (± SD) (min-max)	Mean (± SD) (min-max)	Mean (± SD) (min-max)	Mean (± SD) (min-max)	Mean (± SD) (min-max)	Mean (± SD) (min-max)
FVS	p=0.3316		p=0.0088		p=0.5454	
	52.1 (10.4) (24-84)	53.0 (9.0) (28-78)	51.1 (9.3) (24-73)	53.1 (9.0) (28-78)	53.1 (11.5) (25-84)	49.0 (8.2) (40-56)
DDS-daily	p=0.2266		p=0.0216		p=0.4432	
	3.7 (1.1) (0-6)	3.8 (1.0) (1-6)	3.5 (1.0) (0-6)	3.8 (1.0) (1-6)	3.8 (1.2) (1-6)	3.3 (1.5) (2-5)
DDS-weekly	p=0.0487		p=0.2691		p=0.0584	
	5.3 (0.8) (1-6)	5.4 (0.7) (3-6)	5.3 (0.9) (1-6)	5.4 (0.7) (3-6)	5.3 (0.7) (3-6)	6.0 (0) (6-6)

* FVS=food variety score
** DDS-daily = dietary diversity score-daily
*** DDS-weekly= dietary diversity score-weekly
# Kruskal Wallis Test (ANOVA)

4.6.3.1 Food Variety Score (FVS)

Total sample

The mean FVS was 52 for the case and 53 for control mothers in the total sample. There was no significant difference found in the FVS (χ^2, p=0.3316) between the case and control mothers.

Full term

The mean FVS was 51 and 53 in the case and control groups, respectively. There was a significant difference in the FVS (Kruskal-Wallis test, p=0.0088) between the full term case and control mothers.

Preterm

The mean FVS was 53 and 49 in the case and control group, respectively. The FVS was no significant difference between the preterm case and control mothers (Kruskal-Wallis test, p=0.5454).

4.6.3.2 Dietary Diversity Score (DDS)

Total sample

The mean weekly-DDS was 5 in both the case mothers and control mothers whereas; the mean daily-DDS was 4 for both the case and control mothers. Further, 86% of the case mothers consumed items from 5 or 6 of the six food groups on a weekly basis, and the remaining 14% consumed items from 1, 3 or 4 of the six food groups weekly. In the control group 90% of the mothers consumed items from 5 or 6 of the six food groups on a weekly basis, and the remaining 10% consumed items from 3 or 4 of the six foods groups on a weekly basis. Majority of the case (31%) and control (33%) mothers consumed items from 4 of the six food groups on a daily basis. Only 26% of the case and 29% of the control mothers consumed items from 5 or 6 of the six food groups daily (percentages not presented). There was no significant difference in the daily-DDS (Kruskal-Wallis test, p=0.2266) however, the weekly-DDS (Kruskal-Wallis test, p=0.0494) was significantly different between the case and control mothers in the total sample.

Full term

The mean weekly-DDS was 5 in both the case mothers and control mothers whereas; the mean daily-DDS was 4 for both the case and control mothers. Majority of the case (84%) and control (90%) mothers consumed items from 5 or 6 of the six food groups on a weekly

basis, and the remaining cases (16%) consumed items from 1, 3 or 4 of the six food groups weekly whereas; the remaining controls (10%) consumed items from 3 or 4 of the six food groups. On a daily basis only 15 % of the case mothers and 29 % of the control mothers consumed items from 5 or 6 of the six food groups. Majority of the cases (70%) consumed items from 3 or 4 of the six food groups and the remaining 15 % consumed items from 1 to 3 of the six food groups daily. The majority of the controls (62%) consumed items from 3 or 4 of the six food groups whereas; the remaining 9% consumed items from 1 or 2 food groups daily (percentages not presented). No significant difference was found in the weekly-DDS (Kruskal-Wallis test, p=0.2691) between the case and control mothers. However, a significant difference existed in the daily-DDS (Kruskal-Wallis test, p=0.0216) between the full term case and control mothers.

Preterm

The mean weekly-DDS was 5 in the case mothers and 6 in the control mothers whereas; the mean daily-DDS was 4 in the case and 3 in the control mothers. Further, 88% of the case mothers consumed items from 5 or 6 of the six food groups on a weekly basis, and the remaining 12% consumed items from 3 or 4 of the six food groups weekly. All 3 of the control mothers consumed items from all six food groups weekly. In the case group only 37% of the mothers consumed items from 5 or 6 of the six food groups daily whereas the majority (63%) consumed between 1 and 4 of the six food groups on a daily basis (percentages not presented). Of the 3 control mothers, each consumed items from 2, 3 or 5 of the six food groups daily. However, there was no significant difference in the daily-DDS (Kruskal-Wallis test, p=0.4432) and the weekly-DDS (Kruskal-Wallis test, p=0.0584) between the preterm case and control mothers.

4.7. Smoking and/ or alcohol consumption and dietary intake

4.7.1 Frequency of food consumption and maternal smoking and/ or alcohol consumption

In Tables 4.10 and 4.11 is the mean weekly frequency of consumption for the 14 food items and the 6 food groups, respectively. The results in the tables are summarised for the smokers versus non-smokers, the drinkers versus non-drinkers and for the mothers who practiced both smoking and drinking versus those who practiced none or either.

Smoking

The bread/ cereals group i.e. bread or maize makes up the bulk of food items consumed per week by both the smokers and non-smokers. Only 2 (0.99%) of the smokers did not consume any items from this food group daily nor weekly whereas, all non-smokers did.

Food items from the meat group (meat, poultry, eggs, and fish, including tinned fish) were consumed on average about 3.8 and 3.5 times per week by the smokers and non-smokers, respectively. Majority of the smokers (72%) and non-smokers (74%) consumed items from the meat group daily. However, legumes were consumed on average only 2 times per week by both the smokers and non smokers. There was a significant difference in the weekly frequency of consumption of legumes between the smokers and non-smokers (Kruskal-Wallis test, p=0.0429). There was also a significant difference in the number of smokers and non-smokers who consumed legumes weekly.

Among the smokers, 86% consumed vegetables and 65% consumed fruit daily. The mean frequency of consumption of vegetables was 3.4 and 3.8 times per week for the smokers

and non-smokers, respectively. There was a significant difference in the mean weekly frequency of consumption of green vegetables (Kruskal-Wallis test, p=0.0191), yellow/ orange vegetables (Kruskal-Wallis test, p=0.0120), and other vegetables including potatoes, onions and cabbage (Kruskal-Wallis test, p=0.0390), between the smokers and non-smokers.

Only 43% of the smokers and 50% of the non-smokers consumed items from the milk group daily and on a weekly basis, 76% and 87%, respectively. There is a significant difference in the number of mothers who consumed milk and/ or milk products weekly (Fisher Exact test, p=0.0094) between smokers and non-smokers. However, the mean weekly frequency of consumption of milk was not significantly different between smokers and non-smokers (Kruskal-Wallis test, p=0.4143).

The mean weekly frequency of consumption of sugar was found to be significantly different between the smokers and non-smokers (Kruskal-Wallis test, p= 0.0271).

Although fats/ oils were not included in the 6 food groups it is important to note that food items from this food group was consumed most frequently per week across all groups: smokers and non-smokers, drinkers and non-drinkers and by those who were both smokers and drinkers and those who practiced neither. Fats and oils may have been included in the diet as a spread and/ or in the preparation of food.

Table 4.10: Weekly mean consumption of the 14 food items in relation to maternal smoking and/ or drinking

Food groups	Smoking		Alcohol		Smoking & alcohol	
	Yes	No	Yes	No	Yes	No
	Mean (±SD) n=197	Mean (±SD) n=203	Mean (±SD) n=112	Mean (±SD) n=288	Mean (±SD) n=93	Mean (±SD) n=307
Meat/poultry	p=0.8803		p=0.2556		p=0.0967	
	6.2 (4.4) 1-35 n= 192	6.1 (4.2) 1-28 n= 194	5.8 (3.9) 1-21 n= 111	6.3 (4.4) 1-35 n= 275	5.6 (4.0) 1 - 21 n= 92	6.3 (4.3) 1 - 35 n= 294
Fish	p=0.6127		p=0.3986		p=0.8161	
	3.1 (3.8) 1-21 n= 160	2.7 (3.0) 1-21 n= 156	3.2 (3.7) 1-21 n= 93	2.8 (3.3) 1-21 n= 223	3.0 (3.5) 1 - 21 n= 77	2.9 (3.4) 1 - 21 n= 239
Eggs	p=0.4577		p=0.3775		p=0.4652	
	3.9 (3.3) 0.3-21 n= 167	3.7 (3.4) 0.3-21 n= 171	4.1 (3.7) 0.3-21 n= 96	3.7 (3.2) 0.3-21 n= 242	4.1 (3.9) 0.3 - 21 n= 78	3.7 (3.1) 0.3 - 21 n= 260
Bread	p=0.5669		p=0.2449		p=0.4432	
	15.5 (7.1) 7-42 n=191	14.9 (6.4) 7-35 n= 196	15.9 (6.9) 7-35 n= 109	15.0 (6.7) 7-42 n= 278	15.8 (7.1) 7 - 35 n= 91	15.0 (6.6) 7-42 n= 296
Maize meal, samp, rice	p=0.1217		p=0.2007		p=0.3264	
	8.7 (3.4) 7-28 n= 177	9.2 (3.7) 7-21 n= 187	8.5 (3.1) 7-21 n= 102	9.1 (3.8) 7-28 n= 262	8.6 (3.1) 7 - 21 n= 85	9.1 (3.7) 7 - 28 n= 279
Tinned foods	p=0.0749		p=0.0101		p=0.0005	
	2.1 (1.9) 0.3 - 7 n= 168	1.9 (2.1) 0.3 - 14 n= 174	2.6 (2.5) 0.3 - 14 n= 96	1.8 (1.7) 0.3 - 14 n= 246	2.7 (2.4) 0.3 - 7 n= 78	1.8 (1.8) 0.3 - 14 n= 264
Milk	p=0.4143		p=0.0144		p=0.1140	
	7.7 (7.2) 1-35 n= 148	8.1 (8.1) 1-56 n= 175	6.5 (6.7) 1-28 n= 76	8.4 (8.0) 1-56 n= 247	6.9 (7.0) 1 - 28 n= 60	8.2 (7.9) 1 - 56 n= 263
Legumes	p=0.0429		p=0.0906		p=0.0425	
	1.8 (1.7) 0.3 - 7 n= 169	1.8 (2.9) 0.3 - 28 n= 153	2.0 (2.0) 0.3 - 7 n= 98	1.7 (2.5) 0.3 - 28 n= 224	2.0 (2.0) 0.3 - 7 n= 80	1.7 (2.4) 0.3 - 28 n= 242
GLV*	p=0.0191		p=0.0994		p=0.3106	
	6.3 (2.8) 1-28 n= 190	6.3 (5.3) 1-49 n= 197	6.7 (4.9) 1-49 n= 110	6.1 (4.0) 1-35 n= 277	6.3 (2.6) 1 - 21 n= 91	6.3 (4.6) 1 - 49 n= 296
Y/OV**	p=0.0120		p=0.1495		p=0.2085	
	3.6 (4.0) 0.3-21 n= 185	4.2 (4.0) 0.3-28 n= 195	3.6 (3.6) 0.3 - 21 n= 106	4.1 (4.2) 0.3 - 28 n= 274	3.6 (3.8) 0.3 - 21 n= 88	4.0 (4.1) 0.3 - 28 n= 292
OV ***	p=0.0390		p=0.1694		p=0.1000	
	3.4 (3.8) 1-35 n= 164	3.9 (3.4) 1-21 n= 185	3.5 (4.2) 1-35 n= 94	3.7 (3.4) 1-21 n= 255	3.4 (4.5) 1 - 35 n= 76	3.7 (3.3) 1 - 21 n= 273
Fats	p=0.4992		p=0.9313		p=0.6161	
	16.2 (8.7) 1-42 n= 193	16.6 (8.3) 1-42 n= 200	16.7 (9.4) 1-42 n= 109	16.3 (8.1) 1-42 n= 284	16.4 (9.6) 1 - 42 n= 91	16.4 (8.2) 1 - 42 n= 302
Sugar	p=0.0271		p=0.1849		p=0.1237	
	8.2 (8.8) 1-42 n= 174	9.6 (9.1) 1-49 n= 176	8.1 (8.3) 1-35 n= 99	9.3 (9.2) 1-49 n= 251	8.0 (8.5) 1 - 35 n= 83	9.2 (9.1) 1 - 49 n= 267
Fruit	p=0.7174		p=0.0096		p=0.0844	
	12.1 (10.0) 1-42 n= 178	12.0 (9.4) 1 - 49 n= 191	10.5 (10.0) 1-42 n=101	12.6 (9.5) 1 - 49 n= 268	10.9 (10.1) 1 - 42 n= 84	12.4 (9.6) 1 - 49 n= 285

*GLV-green leafy vegetables; ** Y/OV-yellow/orange vegetables; *** OV-other vegetables (may include potato, onion, cabbage)

Table 4.11: Weekly mean consumption of the 6 food groups in relation to maternal smoking and/ or alcohol consumption

Food groups	Smoking		Alcohol		Smoking and Alcohol	
	Yes	No	Yes	No	Yes	No
	Mean (±SD) n=197	Mean (±SD) n=203	Mean (±SD) n=112	Mean (±SD) n=288	Mean (±SD) n=93	Mean (±SD) n=307
Breads/ cereal*	p=0.8762		p=0.7080		p=0.8356	
	23.0 (8.9) (7-49) n=195	22.9 (8.4) (7-49) n=203	23.2 (8.8) (7-42) n=112	22.9 (8.6) (7-49) n=286	23.3 (8.8) 7-49 n=93	22.9 (8.6) 7-49 n=305
Meat **	p=0.5290		p=0.8109		p=0.4504	
	3.8 (2.3) 1-12 n=174	3.5 (2.0) 1-15 n=177	3.7 (2.2) 1-11 n=98	3.5 (1.8) 1-15 n=253	3.8 (2.3) 1-11 n=82	3.6 (2.1) 1-15 n=305
Vegetables ***	p=0.1166		p=0.0494		p=0.0674	
	3.4 (2.2) 1-10 n=159	3.8 (2.4) 1-14 n= 164	3.3 (2.2) 1-10 n=90	3.8 (2.4) 1-14 n= 233	3.3 (2.3) 1-10 n=75	3.7 (2.3) 1-14 n=248
Milk	p=0.4143		p=0.0144		p=0.1140	
	7.7 (7.2) 1-35 n= 148	8.1 (8.1) 1-56 n= 175	6.5 (6.7) 1-28 n= 76	8.4 (8.0) 1-56 n= 247	6.9 (7.0) 1 - 28 n= 60	8.2 (7.9) 1 - 56 n= 263
Legumes	p=0.0429		p=0.0906		p=0.0425	
	1.8 (1.7) 0.3 - 7 n= 169	1.8 (2.9) 0.3 - 28 n= 153	2.0 (2.0) 0.3 - 7 n= 98	1.7 (2.5) 0.3 - 28 n= 224	2.0 (2.0) 0.3 - 7 n= 80	1.7 (2.4) 0.3 - 28 n= 242
Fruit	p=0.7174		p=0.0096		p=0.0844	
	12.1 (10.0) 1-42 n= 178	12.0 (9.4) 1 - 49 n= 191	10.5 (10.0) 1-42 n=101	12.6 (9.5) 1 - 49 n= 268	10.9 (10.1) 1 - 42 n= 84	12.4 (9.6) 1 - 49 n= 285

*Bread/cereals (bread or maize meal, samp and rice)
** Meat (meat, poultry, fish, eggs)
***Vegetables (green leafy, orange/ yellow, and other vegetables- potatoes, onions, cabbage)
Kruskal-Wallis Test (ANOVA)

Alcohol consumption

The bread/ cereals group makes up the bulk of food items consumed per week by both the drinkers and non drinkers. Only 2 (0.7%) of the non-drinkers did not consume any items from this food group daily nor weekly i.e. bread or maize.

Food items from the meat group (meat, poultry, eggs, and fish, including tinned fish) were consumed on average about 3.7 and 3.5 times per week by the drinkers and non-drinkers,

respectively. Majority of the drinkers (71%) and the non-drinkers (74%) consumed items from the meat group on a daily basis.

Only 10 (9%) of the drinkers and 13 (5%) of the non-drinkers consumed legumes daily. Legumes were consumed on average only 2.0 and 1.7 times per week by the drinkers and non-drinkers, respectively. More drinkers (76%) than non-drinkers (62%) consumed legumes weekly. There was a significant difference in the number of mothers who consumed legumes weekly (Fisher exact test, p=0.088) but no significant difference in the weekly frequency of consumption of legumes (Kruskal-Wallis test, p=0.0906) between the drinkers and non-drinkers

More drinkers (86%) than non-drinkers (82%) consumed vegetables daily. However, fewer drinkers (59%) than non-drinkers (73%) consumed fruit daily. The mean frequency of consumption for vegetables was 3.3 and 3.8 times per week and for fruit it was 10.5 and 12.6 times per week for the drinkers and non-drinkers, respectively. There was a significant difference in the mean weekly frequency of consumption of vegetables (Kruskal-Wallis test, p=0.0494 and fruit (Kruskal-Wallis test, p=0.0096), between the drinkers and non-drinkers.

Only 34% of the drinkers and 52% of the non-drinkers consumed items from the milk group daily and on a weekly basis 69% and 86%, respectively. There is significant difference in the number of mothers who consumed milk daily (Fisher Exact test, p=0.0017) and weekly (Fisher Exact test, p=0.0001) between drinkers and non-drinkers.

The mean frequency of consumption of milk and/ or milk products was 6.5 and 8.4 times per week in the drinkers and non-drinkers, respectively. There was a significant difference in the mean weekly frequency of consumption of milk between drinkers and non-drinkers (Kruskal-Wallis test, p=0.0144).

The mean weekly frequency of consumption of tinned foods was found to be significantly different between the drinkers and non-drinkers (Kruskal-Wallis test, p=0.0101).

Smoking and alcohol consumption

The mean weekly frequency of consumption of legumes and tinned foods was found to be significantly different between the mothers who both smoked and drank alcohol and those who practiced none or either i.e. (Kruskal-Wallis test, p=0.0425) and (Kruskal-Wallis test, p=0.0005).

4.7.2. Weekly frequency scores (0-7) and maternal smoking and/ or alcohol consumption

Tables 4.12(a) outline the mean weekly frequency scores for the 14 food items and Table 4.12(b) for the 6 combined food groups: Bread, Meat, Vegetables, Milk, Legumes and Fruit, respectively. The mean weekly frequency scores are summarised for the smokers versus non-smokers, the drinkers versus non-drinkers and for the mothers who practiced both smoking and drinking versus those who practiced none or either.

Smoking

The mean scores for green leafy vegetables (Kruskal-Wallis test, p=0.0011), yellow/ orange vegetables (Kruskal-Wallis test, p=0.0092), other vegetables including potatoes, onions, cabbage (Kruskal-Wallis test, p=0.0374), legumes (Kruskal-Wallis test, p=0.0354) and sugar (Kruskal-Wallis test, p=0.0260), were significantly different between the smokers and non-smokers.

Alcohol consumption

The mean weekly frequency scores of milk (Kruskal-Wallis test, p=0.0171), fruit (Kruskal-Wallis test, p=0.0054) and tinned food (Kruskal-Wallis test, p=0.0100) were significantly different between the drinkers and non-drinkers.

Smoking and Alcohol consumption

The mean weekly frequency scores of legumes and tinned foods were significantly different between mothers who both smoke and drank alcohol and those who practice none or either i.e. (Kruskal-Wallis test, p=0.0306) (Kruskal-Wallis test, p=0.0004), respectively.

Table 4.12(a): Mean weekly frequency scores (0-7) for 14 food items in relation to maternal smoking and/ or alcohol consumption

Food groups	Smoking		Alcohol		Smoking and Alcohol	
	Yes	No	Yes	No	Yes	No
	Mean (±SD) n=197	Mean (±SD) n=203	Mean (±SD) n=112	Mean (±SD) n=288	Mean (±SD) n=93	Mean (±SD) n=307
Meat/poultry	p=0.7542		p=0.2136		p=0.0677	
	5.3 (2.2)	5.0 (2.4)	5.0 (2.4)	5.3 (2.2)	4.9 (2.4)	5.4 (2.2)
Fish	p=0.6520		p=0.4162		p=0.8336	
	2.5 (2.0)	2.7 (2.1)	2.7 (2.1)	2.4 (2.0)	2.5 (2.0)	2.5 (2.0)
Eggs	p=0.4317		p=0.4089		p=0.5189	
	3.6 (2.6)	3.7 (2.6)	3.7 (2.6)	3.5 (2.6)	3.7 (2.6)	3.5 (2.6)
Bread	p= 1.000		p=1.0000		p=1.0000	
	7 (0)	7 (0)	7 (0)	7 (0)	7 (0)	7 (0)
Maize meal samp, rice	p= 1.000		p=1.0000		p=1.0000	
	7 (0)	7 (0)	7 (0)	7 (0)	7 (0)	7 (0)
Tinned foods	p=0.0663		p=0.0100		p=0.0004	
	2.1 (1.9)	2.5 (2.3)	2.5 (2.3)	1.7 (1.6)	2.7 (2.4)	1.7 (1.6)
Milk	p=0.2838		p=0.0171		p=0.1282	
	4.7 (2.7)	4.3 (2.8)	4.3 (2.8)	5.1 (2.5)	4.5 (2.8)	5.0 (2.5)
Legumes	p=0.0354		p=0.0686		p=0.0306	
	1.7 (1.7)	1.9 (2.0)	1.9 (2.0)	1.5 (1.7)	2.0 (2.0)	1.5 (1.7)
GLV *	p=0.0011		p=0.0985		p=0.1621	
	6.1 (1.9)	6.0 (1.9)	6.0 (1.9)	5.6 (2.2)	6.0 (1.9)	5.6 (2.2)
Y/OV**	p=0.0092		p=0.1860		p=0.2352	
	3.1 (2.7)	3.3 (2.8)	3.3 (2.8)	3.5 (2.7)	3.3 (2.8)	3.5 (2.7)
OV ***	p=0.0374		p=0.1765		p=0.0967	
	3.0 (2.3)	3.6 (2.5)	3.1 (2.4)	3.4 (2.4)	3.0 (2.4)	3.4 (2.4)
Fats	p=0.2438		p=0.6801		p=0.5684	
	6.9 (0.8)	6.8 (1.1)	6.9 (0.8)	6.8 (1.0)	6.9 (0.7)	6.8 (1.0)
Sugar	p=0.0260		p=0.2392		p=0.1101	
	4.5 (2.7)	5.1 (2.5)	4.5 (2.7)	4.9 (2.6)	4.4 (2.8)	4.9 (2.6)
Fruit	p=0.2476		p=0.0054		p=0.0836	
	5.7 (2.2)	5.9 (2.1)	5.3 (2.5)	6.0 (2.0)	5.4 (2.4)	5.9 (2.1)

*GLV-green leafy vegetables
**Y/OV-yellow/orange vegetables
***OV-other vegetables (may include potato, onion, cabbage)
Kruskal-Wallis Test (ANOVA)

Table 4.12(b): Mean weekly frequency scores (0-7) for 6 food groups in relation to maternal smoking and/ or alcohol consumption

Food groups	Smoking		Alcohol		Smoking and Alcohol	
	Yes	No	Yes	No	Yes	No
	Mean (±SD) min-max n=197	Mean (±SD) min-max n=203	Mean (± SD) min-max n=112	Mean (±SD) min-max n=288	Mean (±SD) min-max n= 93	Mean (±SD) min-max n= 307
	p=1.0000		p=1.0000		p=1.0000	
Breads/ cereal*	7 (0)	7 (0)	7 (0)	7 (0)	7 (0)	7 (0)
	p=0.7542		p=0.8127		p=0.4518	
Meat **	3.6 (2.0)	3.4 (1.70	3.6 (1.9)	3.5 (1.8)	3.7 (2.0)	3.5 (1.8)
	p=0.1256		p=0.0517		p=0.0707	
Vegetables***	3.3 (1.9)	3.6 (2.0)	3.2 (2.0)	3.6(1.9)	3.1 (2.0)	3.6 (1.9)
	p=0.2838		p=0.0171		p=0.1282	
Milk	4.7 (2.7)	4.3 (2.8)	4.3 (2.8)	5.1 (2.5)	4.5 (2.8)	5.0 (2.5)
	p=0.0354		p=0.0686		p=0.0306	
Legumes	1.7 (1.7)	1.9 (2.0)	1.9 (2.0)	1.5 (1.7)	2.0 (2.0)	1.5 (1.7)
	p=0.2476		p=0.0054		p=0.0836	
Fruit	5.7 (2.2)	5.9 (2.1)	5.3 (2.5)	6.0 (2.0)	5.4 (2.4)	5.9 (2.1)

*Bread/cereals (bread or maize meal, samp an rice)
** Meat (meat, poultry, fish, eggs)
***Vegetables (green leafy, orange/ yellow, and other vegetables- potatoes, onions, cabbage)
Kruskal Wallis Test (ANOVA)

4.7.3. Dietary scores and maternal smoking and/ or alcohol consumption

The mean, ± SD, minimum and maximum food variety scores (FVS) and dietary diversity scores i.e. daily-DDS and weekly-DDS is included in Table 4.13(a) and Table 4.13(b). The dietary scores are summarised for the smokers versus non-smokers, the drinkers versus non-drinkers and for the mothers who practiced both smoking and drinking versus those who practiced none or either.

4.7.3.1 Food Variety Score (FVS)

Smoking

The mean FVS was 52 and 53 in the smokers and non-smokers, respectively. The FVS was not significantly different between the smokers and non-smokers (Kruskal-Wallis test, p=0.2634).

Alcohol consumption

The mean FVS was 52 and 53 in the drinkers and non-drinkers, respectively. The FVS was not significantly different between the drinkers and non-drinkers (Kruskal-Wallis test, p=0.0909).

Smoking and Alcohol consumption

The mean FVS was 51 in mothers who both smoked and consumed alcohol. However, the mean FVS was 53 in mothers who only smoked, those who only consumed alcohol and those who practiced neither smoking nor drinking.

Table 4.13: Mean (± SD) of dietary scores: FVS, DDS-daily, and DDS-weekly in relation to maternal smoking and/ or alcohol consumption

Dietary scores	Smoking		Alcohol		Smoking & Alcohol	
	Yes	No	Yes	No	Yes	No
	Mean (±SD) n=197	Mean (±SD) n=203	Mean (±SD) n=112	Mean (±SD) n=288	Mean (±SD) n=93	Mean (±SD) n=307
FVS	p=0.2634		p=0.0909		p=0.2556	
	52.1 (9.8) (24-78)	53.0 (9.7) (25-84)	51.5 (10.7) (24-84)	53.0 (9.3) 25-84	51.2 (11.4) 24-78	53.0 (8.2) 25-84
DDS-daily	p=0.1924		p=0.0148		p=0.0204	
	3.7 (1.1) 0-6	3.8 (1.0) 1-6	3.6 (1.2) 1-6	3.8 (1.0) 0-6	3.6 (1.2) 1-6	3.8 (1.0) 0-6
DDS-weekly	p=0.6445		p=0.7262		p=0.3914	
	5.4 (0.8) 1-6	5.4 (0.7) 3-6	5.3 (0.8) 3-6	5.4 (0.8) 1-6	5.3 (0.8) 3-6	5.4 (0.8) 1-6

*FVS=food variety score *DDS-daily = dietary diversity score-daily *DDS-weekly= dietary diversity score-weekly
Kruskal-Wallis Test (ANOVA)

4.7.3.2. Dietary Diversity Score (DDS)

Smoking

The mean weekly DDS was 5 in both the smokers and the non smokers whereas; the mean daily DDS was 4 for both the smokers and non-smokers. Further, 87% of the smokers consumed items from 5 or 6 of the six food groups on a weekly basis, and the remaining 13% consumed items from 3 or 4 of the six food groups weekly. Among the non-smokers 89% consumed items from 5 or 6 of the six food groups on a weekly basis, and the remaining 11% consumed items from 3 or 4 of the six foods groups weekly. Majority of the smokers (37%) consumed items from 4 of the six food groups daily Majority of the non-smokers (35%) consumed items from 3 of the six food groups daily. Only 28% of the smokers and 27% of the non-smokers consumed items from 5 or 6 of the six food groups daily (percentages not presented). There was no significant difference in the daily DDS (Kruskal-Wallis test, p=0.1924) and the weekly DDS (Kruskal-Wallis test, p=0.6445) between the smokers and non-smokers.

Alcohol consumption

The mean weekly DDS was 5 for both the drinkers and non-drinkers whereas; the mean daily DDS was 4 for both drinkers and non-drinkers. Further, 88% of the drinkers and non-drinkers consumed items from 5 or 6 of the six food groups on a weekly basis, and the remaining 12% consumed items from 3 or 4 of the six food groups weekly. Majority of the drinkers (34%) and non-drinkers (31%) consumed items from 4 of the six food groups daily. Only 23% of the drinkers and 29% of the non-drinkers consumed items from 5 or 6 of the six food groups daily (percentages not presented). There was a significant difference in the daily DDS (Kruskal-Wallis test, p=0.0148) however, the weekly DDS (Kruskal-

Wallis test, p=0.7262) was not significantly different between the drinkers and non-drinkers.

Smoking and Alcohol consumption

There was a significant difference in the mean daily DDS (Kruskal-Wallis test, p=0.0204) however, the mean weekly DDS (Kruskal-Wallis test, p=0.3914) was not significantly different between mothers who both smoked and consumed alcohol and those who practice either or none.

4.8. Correlation analysis

4.8.1 Relationship between dietary scores and infant birth weight

The spearman rank correlation between predictor independent variables and the dependant variable i.e. infant birth weight (as a continuous variable) was carried out to determine the association between the dietary scores and low birth weight. This correlation analysis included only the full term infants as analysis with preterm infants would need controlling for gestational age. Table 4.14 explain the relationship between full term infant birth weight and the FVS, daily-DDS and weekly-DDS.

Table 4.14: Spearman rank correlation coefficients between dietary scores and infant birth weight.

		FVS	Daily DDS	Weekly DDS
Infant birth weight (g)*	r^2 p-value n=	0.10579 0.0664 302	0.15022 0.0088 303	0.06248 0.2783 303

*Full term infants only

The correlation analysis indicates that the daily-DDS may be good predictors of full term low birth weight. This is demonstrated by the p-value, which are less than 0.05.

It's not typical to do a correlation with an ordinal variable (birth weight) against a dichotomous variable i.e. smoking (yes/no) and alcohol (yes/no). The results of a Wilcoxin Rank Sum Test showed a significant association between full term birth weight and smoking and alcohol consumption.

4.8.2 Relationship between dietary scores and maternal socioeconomic and socio-demographic characteristics

The spearman rank correlation was carried out to determine the association between maternal socioeconomic and socio-demographic characteristics and the dietary scores i.e. FVS, daily-DDS and weekly-DDS, see Table 4.15

Table 4.15: Spearman rank correlation coefficients between dietary scores and maternal socioeconomic and socio-demographic (SESD) characteristics

		FVS	Daily-DDS	Weekly- DDS
Age	r^2	0.00543	-0.05294	-0.00739
	p-value	0.9138	0.2909	0.8829
	n=	399	400	400
Education	r^2	0.12983	0.13625	0.00226
	p-value	0.0099	0.0067	0.9643
	n=	394	395	395
Income	r^2	0.09906	0.09376	-0.21834
	p-value	0.3475	0.3740	0.0365
	n=	92	92	92
No of dependents	r^2	0.02543	0.02288	0.10244
	p-value	0.6126	0.6483	0.0406
	n=	399	400	400

The correlation analysis indicates that maternal education may be a good predictor of the FVS and the daily-DDS. Household income and the number of dependants may be good predictors of weekly-DDS.

Because of the categorical nature of marital status, employment status, father support, secondary income and type of residence, they could not be entered into a correlation analysis. However, analysis of variance demonstrated a significant difference in the FVS (χ^2, p= 0.0047) and the daily-DDS (χ, p=0.0004) of mothers living in brick housing, wendy houses, a shack in someone's yard and squatter camps.

Table 4.16: Dietary scores and maternal socioeconomic and socio-demographic (SESD) characteristics

SESD Variables	FVS	Daily-DDS	Weekly-DDS
Marital status	p=0.4695	p=0.9940	p=0.5338
Single/never married	52.0(±9.6)	3.7 (±1.1)	5.3 (±0.8)
Married (monogamous)	52.6 (±9.8)	3.8 (±1.1)	5.4 (±0.8)
Married (polygamous)	59.8 (±6.1)	3.7 (±1.0)	5.5 (±0.6)
Employment	p=0.1547	p=0.0385	p=0.4202
Yes	54.0 (±10.2)	4 (±1.1)	5.4 (±0.7)
no	52.1 (±9.6)	3.7 (±1.1)	5.3 (±0.8)
Father support	p=0.4945	p=0.3110	p=0.7077
Yes	52.5 (±9.3)	3.8 (±1.1)	5.4 (±0.8)
No	53.6 (±11.7)	3.8 (±1.2)	5.4 (±0.7)
Sometimes	49.3 (±11.6)	3.3 (±1.0)	5.2 (±0.8)
Secondary income (grant)	p=0.8812	p=0.1582	p=0.0767
Disability	51.5 (±9.0)	2.4 (±1.5)	4.0 (±1.7)
Child support	52.1 (±11.4)	3.7 (±1.2)	5.3 (±0.8)
Unemployment	54.6 (±9.5)	4.0 (±1.0)	5.4 (±0.6)
other	52.6 (±9.3)	3.8 (±1.0)	5.4 (±0.7)
Type of residence	p=0.0047	p=0.0004	p=0.3165
Brick	53.3 (±9.7)	3.8 (±1.1)	5.3 (±0.8)
Wendy	50.2 (±6.9)	3.5 (±0.8)	5.5 (±0.8)
Shack in yard	50.6 (±12.7)	3.5 (±1.3)	5.1 (±0.8)
Squatter camp	47.2 (±9.1)	3.1 (±1.0)	5.3 (±0.7)

Kruskal-Wallis Test (ANOVA)

4.8.3 Relationship between dietary scores and maternal smoking and/ or alcohol intake consumption

Table 4.17: Mean (± SD) of dietary scores: FVS, DDS-daily, and DDS-weekly in relation to maternal smoking and/ or alcohol consumption

Smoke and drink	Dietary scores	Mean (SD)	Median	Min-max
Yes, Yes	FVS	51.2 (11.4)	50	24-78
	DDS-daily	3.6 (1.2)	3	1-6
	DDS-weekly	5.3 (0.8)	5	3-6
Yes, No	FVS	52.9 (8.0)	53	28.71
	DDS-daily	3.8 ((1.0)	4	0-6
	DDS-weekly	5.4 (0.8)	6	1-6
No, Yes	FVS	53.1 (6.6)	54	39-63
	DDS-daily	3.7 (0.7)	4	3-5
	DDS-weekly	5.5 (0.8)	6	3-6
No, No	FVS	53.0 (10.0)	52	25-84
	DDS-daily	3.9 (1.1)	4	1-6
	DDS-weekly	2.4 (1.6)	5	3-6

*FVS=food variety score
*DDS-daily = dietary diversity score-daily
*DDS-weekly= dietary diversity score-weekly
Kruskal-Wallis Test (ANOVA)

The four categories for smoking and alcohol are not ordinal therefore correlation analysis was not carried out. However, the researcher compared the mean dietary scores between the groups included in Table 4.17. There was no significant difference in the daily DDS (Kruskal-Wallis test, p=0.1073), the weekly DDS (Kruskal-Wallis test, p=0.3603) nor the FVS (Kruskal-Wallis test, p=0.2556) between these four categories.

4.9. Regression analysis

Simple linear regression was further carried out to explore the relationship of individual predictor variables: FVS, daily DDS, smoking and alcohol with the response variable (full term low birth weight).

Table 4.18: Simple linear regression analysis of each predictor and a response variable (full term birth weight)

Variable	DF	Parameter estimate	Standard error	R-square	Pr > | t |
FVS	1	-1.77903	5.32772	-0.33	0.7387
Daily-DDS	1	70.12190	48.11767	1.46	0.1461
Smoking	1	246.01241	69.63231	3.53	0.0005
Alcohol	1	197.11036	78.58061	2.51	0.0127

The p-values for smoking and alcohol are very small, which suggests that their coefficients are significantly different from zero. The p-values of FVS and daily-DDS are not significantly different from zero. This suggests that the relationship between both FVS and daily-DDS and full term LBW may be mediated by other variables i.e. smoking and/ or alcohol.

4.10. Conclusion

The results of this secondary analysis showed that full term LBW contributed more than half (53%) the incidence of total LBW in this population, indicating a substantial IUGR component in this population. There was a positive association with the daily-DDS and full term low birth weight and there seems to be a trend towards a higher FVS being associated with a higher infant birth weight in the full term group. The FVS and the daily-DDS were

significantly different between the full term case and control mothers. In the total sample the weekly-DDS was significantly different between the case and control mothers. The dietary scores were not significantly different between the preterm case and control mothers. The latter may be a result of there only being three controls and this might have influenced the statistical findings on controls. There was no significant difference in the FVS, daily-DDS and the weekly-DDS in the mothers who were only smokers, or only drinkers nor those who both smoked and consumed alcohol and those who practiced neither. Maternal education is positively associated with the FVS and the daily-DDS whereas; the household income and the number of dependants are positively associated with the weekly-DDS.

CHAPTER 5

DISCUSSION

5.1 Introduction

This chapter highlights and discusses the important issues that emerged from the results and further discusses the results within the context of the study objectives and recent literature.

Adequate nutrition during pregnancy is important for a healthy pregnancy outcome (Fowles, 2004). This implies not only that pregnant women need to consume adequate amounts of food that results in appropriate weight gain but also that they consume a nutritionally adequate quality diet. For the purpose of this study, an adequate quality diet will be defined as one with food variety and dietary diversity. A lack of dietary variety is thought to contribute to low micronutrient intakes, (Maunder, Matji & Hlatshwayo-Molea, 2001; Savy et al., 2006).

In an ideal world, young women consume a variety of foods for optimal nutrition, particularly, during the childbearing years in preparation for a healthy pregnancy and baby (Pick et al., 2005). However, this is often difficult to achieve in resource-poor environments with diets being dominated by starchy staples, little or no animal products and few fresh fruit and vegetables (Arimond et al., 2008; Ruel, 2002). Globally, women of reproductive age represent one group vulnerable to suffer from deficiencies; among others are infants and young children, and the elderly (Arimond et al., 2008). Poverty, poor access to health care and a diet that has often been

inadequate in quality and quantity places these women at nutritional risk and in turn at risk for low birth weight infants (Watts et al., 2006).

For the above reasons dietary assessment is important as it enables the identification of poor or desirable dietary intake, and is essential in identifying risks of nutrient deficiencies, possibilities for dietary improvement, and the need for supplementation in individual pregnant women (Laraia et al., 2007). Recent public health focus has been placed on capturing overall diet quality as apposed to assessing the intake of specific nutrients in relation to a health outcome (Clausen, et al., 2004; Hatloy et al., 1998). This has lead to the development of food variety scores and dietary diversity scores as proxies for measuring overall dietary quality (Savy et al., 2005). These scores have successfully been shown to reflect dietary quality (Torheim et al. 2003, 2004).

However, it is difficult to compare results of FVS and DDS because of variations in how these indicators have been constructed and classified. Some studies in developed and developing countries have used a variety of food and food group classification systems, different number of food groups and various reference periods (Ruel, 2002). In an attempt to overcome some of these inconsistencies the Healthy Eating Index (HEI) and the Diet Quality Index (DQI) have been developed (Kant, 2006).

The HEI is a food-based index developed by the US Department of Agriculture (USDA) to measure how well an individual's diet adheres to US national guidelines with regards to servings per day of fruit, vegetables, milk, meat, grains as well as total fat intake, saturated fat, cholesterol, sodium and variety (Breslow et al., 2006). A

recent study assessing the usefulness of the HEI in measuring overall quality of the diet in pregnant women found that macronutrient intake was similar to that of non pregnant women, but micronutrient intake (iron and folate) for pregnant women were exceedingly low. This may be due to the dependency on supplements during pregnancy, or due to the inadequacy of the HEI to assess micronutrient intake in pregnant women. There is therefore a need for an adapted HEI to include sensitive measure micronutrient intake especially those of concern during pregnancy i.e. calcium, vitamin D, folate and iron (Pick et al., 2005).

The Diet Quality Index for Pregnancy (DQI-P), an adapted DQI, includes an assessment of eight dietary components: servings of vegetables, fruit, and grains; folate, iron, calcium (presented as % RDA); percent calories from fat and meal pattern score (meal/ snack pattern). An investigation of the association between pregravid BMI and diet quality reported a modest association between pregrvid weight status and diet quality (Laraia et al., 2007). These indices provide more detailed explanations of diet quality than do assessments that use only total energy intake or intake of specific nutrients. The DQI incorporates foods and nutrients into their assessment as opposed to the HEI and thus is suitable to use in assessing diet quality of pregnant women using supplements (Watts et al., 2006). However, these indices are more complex and time consuming (Steyn et al., 2005), they require information on portion size; therefore they would not be suitable for use in this secondary analysis.

5.2 Dietary intake

This secondary analysis provides a profile of the dietary intake of pregnant women in the West Coast/ Winelands region based on food variety and dietary diversity. Such information is important as it could form the basis for appropriate nutrition counselling and development of appropriate nutrition interventions for pregnant women in this population.

The only statistically significant different weekly frequency of consumption was recorded for sugar consumption (higher for control mothers of total sample), maize (higher for control mothers of preterm and full term infants) and yellow/ orange vegetables (higher for control mothers of preterm infants). Although not statistically different, there seems to be a trend with a mean weekly frequency of consumption of most other food items i.e. bread, maize meal, tinned foods, legumes, green leafy vegetables, yellow/orange vegetables, fats, sugar and fruit, being higher in mothers with normal birth weight infants (≥ 2500g) – total sample and full term group – except for meat, fish, eggs and other vegetables which is lower. These findings seem to suggest that mothers of infants with higher birth weights tend to eat a greater variety of food items more frequently per week than do mothers of LBW infants. Meat is the only food group for which the weekly frequency of consumption is lower (although not statistically significant) in the control mothers as compared to case mothers in the total sample, the full term and the preterm group. This might be a reflection of the lower proportionate consumption relative to the inclusion of other food items in the diet of the control mothers.

Although overall the mean weekly frequency of consumption for each food item and for each of the six food groups seems to reflect a nearly adequate diet, it is misleading.

The highest weekly frequency score was recorded for bread group indicating that the highest weekly frequency of consumption in this population is from bread, maize meal, samp or rice. A similar result was found by Steyn et al. (2005) in South African children 1-9 years where the highest frequency of consumption was from the cereal, root and tuber group. These findings are in line with the South African Food Based Dietary Guideline: "making starchy foods the basis of most meals". Cereals and grains are the most economic sources of dietary energy (Vorster & Nell, 2001) and with fortification of maize flour and bread flour being mandatory in South Africa since 2003, there is additional micronutrient benefits to this practice.

Legumes is the food group with the lowest weekly frequency score, thus indicating the lowest weekly frequency of consumption i.e. 1-2 times per weeks across the total sample, the full term and the preterm group. Legumes are rich and economical dietary sources of good quality protein, carbohydrate, soluble and insoluble dietary fibre and a variety of vitamins and minerals (Venter & Eyssen, 2001). It is for the above reasons that the researcher included legumes as a major food group when selecting the indictor food groups to comprise the DDS. From a health promoting perspective including legumes in the diet is important in meeting the dietary recommendation to improve the nutritional status of both the undernourished and the overnourished (Venter & Eyssen, 2001).

Of particular concern is the finding that more than half the case and control mothers in the total sample and the full term group did not consume food items from the milk group daily. In addition, mothers who did consume food items from this food group did so about eight times per week and this amounts to an average of once per day. If we assume that this is one glass of milk or yoghurt, or some milk in tea/ coffee or over porridge, this does not meet the pregnancy recommendation of 2-3 servings of milk per day. Calcium is an essential micronutrient for pregnancy and the best food sources include dairy products, some legumes and green leafy vegetables, and small fish, particularly if the bones are consumed. However, the findings indicate that milk and legumes are not consumed by many nor consumed frequently enough to provide sufficient calcium. Green leafy vegetables are consumed on average 6 times per week; however the phytates from a diet mostly comprised of breads and cereals could prevent adequate calcium absorption. A study assessing the association of milk consumption during pregnancy with increased birth weight in a Danish population found that milk consumption (drinking ≥ 6 glasses/day versus drinking no milk/day) was inversely associated with the risk of SGA and directly associated with both LGA and mean birth weight. However, the researchers could not confirm either the fat-soluble substance or the milk protein as the causative factor (Olsen et al., 2007).

Fruit was the second most frequently consumed food group after bread, i.e. weekly frequency score (5.7± 2.2). Together the weekly frequency of fruit and vegetable consumption amounts to an average frequency of about 2 times per day. From this finding it seems unlikely that many women in this population will meet the "5-a-day recommended intake of fruit and vegetables per day (400g/day) (WHO, 2003). According to a study by Schneider et al. (2007) the mean per capita intake of fruit and

vegetables for all ages was 235 g/d for males and 226 g/d for females in South Africa in 2000. This represents ± 3 servings (80g each) of fruit and vegetables per day. South Africans note affordability, availability and taste preference as the primary constraints to eating fruit and vegetables. Fruits and vegetables are good sources of many vitamins and minerals, so it would be money well spent however; it may not be the most economical in terms of cost and, in the case of vegetables, preparation time as well. Also because many fresh fruit and vegetables are highly perishable, the lack of refrigeration may be a problem for poorly-resourced individuals (Love & Sayed, 2001).

This study found a significant difference in the FVS ($p=0.008$) between the full term case and control mothers. Further, a positive correlation was illustrated between the FVS and infant birth weight in the full term group ($r =0.10579$, $p=0.0664$). Although not statistically significant, it does seem to suggest a trend that increased frequency of consumption of different food items per week has a positive effect on full term infant birth weight.

However, some methodological considerations need to be kept in view when interpreting the above findings. The FVS used in this study is based on the responses to 12 food items and it may be that important food items have been omitted from the food list. However, data from a study examining the dietary intake of adult women in South Africa, based on secondary analysis of dietary studies including the National Food Consumption Survey (NFCS) and the South African Demographic and Health Study (SADHS), identified the following: sugar, tea, maize porridge, brown bread, coffee, white bread, potatoes, hard margarine and milk as the most commonly

consumed foods (Steyn & Nel, 2006). Hence this would suggest that no major food item has been omitted. Further, the FVS used has not previously been validated. Also it is difficult to compare the present findings of the FVS with other studies as each study has its own definition of what a food item is and how the FVS is constructed and calculated.

The food variety takes into account all food items consumed. Hence, a relatively high FVS could be achieved if many foods from only one or a few food groups are consumed. Thus, used alone it could incorrectly reflect a favourable quality of the diet (Hatloy et al., 1998). However, with the DDS food groups were counted only once thus, eating many servings from one of the 6 food group (e.g. breads) did not improve the DDS. The FVS correlated significantly with the daily-DDS ($p < 0.0001$) and the weekly-DDS ($p < 0.0001$).

A higher percentage of control mothers in the total sample and in the full term group consumed 5 or 6 of the six food groups daily and weekly. In the total sample the weekly-DDS was significantly different ($p=0.0494$) between the case and control mothers. The FVS ($p=0.0088$) and daily-DDS (0.00216) were significantly different between the case and control mothers in the full term group. Further, a positive and significant correlation was illustrated between the daily-DDS and full term LBW. This indicates the FBDG "Enjoy a variety of foods" is most appropriate for a healthy pregnancy. Several studies have shown that both the FVS and DDS reflect dietary quality in terms of meeting nutrient needs, however with stronger relationships between outcomes and scores constructed on food groups (Hatloy et al., 1998; Ogle, Hung, & Tuyet, 2001) as is the case in this study.

None of the dietary scores were found to be significantly different between the preterm groups. This could be because the intra-individual variation in the diet was low between the preterm case and control groups or because there are only three preterm controls, which limits statistical power.

5.3 Dietary intake and maternal socioeconomic and socio-demographic characteristics.

The primary study reported all its findings for the total sample case and controls. The results showed no significant association between low birth weight and maternal age, employment status, household income, number of dependents or parity. However, when we look at known risk factors for low birth weight; longer gestation, maternal employment status, higher income, and fewer pregnancies have been associated with improved infant birth weight. Maternal education and the type of residence were the only socioeconomic and socio-demographic determinants of low birth weight in this population – detail of these findings are discussed elsewhere (Jackson et al, 2007).

Maternal level of education may be considered the most important determinant of LBW according to a study conducted in Iran, and this effect was related to inadequate pregnancy weight gain (Maddah, et al., 2005). This result could be due to a lack of knowledge on the importance of a healthy weight gain during pregnancy due to inadequate access to formal or informal education (including nutrition, health and family planning) and vocational training (Gillespie & Mason, 1991). A study in Russia also revealed maternal education as the most important determinant and further, almost a double risk for LBW in women with secondary education compared

with those having at least 3 years of university studies (Grjibovski, Bygren, & Svartbo, 2002).

An objective of this study was to assess the association between maternal socioeconomic and socio-demographic characteristics and dietary intake. This secondary analysis demonstrated a positive and significant correlation ($r = 0.128$, $p=0.0099$) between maternal education and both the FVS and the daily-DDS ($r =0.1363$, $p=0.0067$). Evidence suggests that women's education affects almost all aspects of her coping and caring capacity (Gillespie & Mason, 1991). Evidence from developed countries concluded that women make informed efforts to improve their diet and that pregnancy can be viewed as an opportunity for the adoption of positive dietary change (Verbeke & Bourdeaudhuij 2007). In developing countries many women enter pregnancy with a poor nutritional status and thus in this situation intervention prior to pregnancy may be more beneficial. A study by Doyle et al. (1999) assessed the feasibility of an inter-pregnancy intervention programme with mothers of LBW babies. Women kept seven-day food dairies and those with inadequate nutrient intakes received nutrition counselling and were invited to participate in a six month intervention programme. The intervention included a monthly group event: cooking demonstrations, tasting sessions of unfamiliar nutrient-dense foods, talks on nutrition for the whole family, healthy alternative shopping at supermarkets, and during the six month period two newsletters were produced and sent to participants. A post intervention seven-day diary was kept at the end of the programme. The results showed a 5% increase in intake of few of the nutrients, and a general trend towards improved dietary intake. Counselling on its own proved to be unlikely to improve nutritional status (Doyle et al., 1999).

The mean daily-DDS was significantly different (p= 0.0385) between mothers employed and earning an income (4± 1.1) and the unemployed mothers (3.7± 1.1). This finding is in line with the expectation that being unemployed decreases your purchasing power thus affects household food security and limits variety in the diet. Even though, the majority of all case and control mothers in the total sample, the full term and preterm group are unemployed, women being employed and earning an income, minimal as it may be, was seen to contribute to the diversity of the diet. Evidence suggests that control of household income by women tends to have a favourable impact on child health, education and clothing. In general, female access to resources usually leads to overall improvements in family welfare (Gillespie & Mason, 1991).

However, there was a negative but significant correlation ($r = -0.2183$, $p = 0.0365$) between household income and the weekly-DDS. The negative relationship demonstrates that as the household income increases the weekly-DDS decreases. This may be that the household income generally is extremely low and thus not sufficient to sustain sufficient food for the week. It could also be speculated that women had limited control over the household income or if they were paid a weekly wage, as is often the case in this geographical area, this money could more than likely be supporting the drinking and smoking habits of these women as social drinking on the weekend has been shown to be prevalent in this population (Jackson et al., 2007).

Generally there is limited scope of income opportunities for women in rural areas. On the farms their assistance is called upon on an ad hoc basis, during harvest time, thus this offers no sustainable income for women. The lack of education may be a contributory factor in securing employment outside of farm work.

There was a significant difference in the mean FVS (p= 0.0047), and the mean daily-DDS (p= 0.0004) between mothers residing in the various types of the housing. The mean FSV (53± 9.7) and daily-DDS (3.9± 1.1) was highest in mothers residing in brick housing and lowest in mothers residing in squatter camps i.e. mean FVS (47.2± 9.1) and daily-DDS (3.1± 1.0).

There was a positive and significant correlation (r = 0.1024, p = 0.0406) between the number of dependents and the weekly-DDS. Although a significant correlation exists, it is relatively weak. The positive relationship demonstrates that the more children the mother has the higher her weekly-DDS.

Many studies have assessed whether the DDS could be used as an indicator of household food security. In these studies dietary variety and diversity were measured at household level. Dietary diversity seems to show some promise as a means of measuring food security and monitoring changes and impact (Hoddinott & Yohannes, 2002).

Further investigation into the standardisation and validation of FVS and DDS against golden standards such as repeat 24-hour recalls and dietary records is necessary to ensure its reliability as a quick measure of the quality of dietary intake (Savy, 2005).

5.4 Maternal anthropometry

A low prepregnancy weight and inadequate weight gain during pregnancy are known nutritional risk factors for low birth weight (Fowles, 2004). Data on pre-pregnancy

weight was available for only 37 case (62 kg) and 28 control (54 kg) mothers. Although mothers attended antenatal clinics, the mean number of antenatal visits in the total sample was 4.7 in the case and 6.1 times in the control mothers; this was found to be strongly associated with low birth weight. However, the first antenatal visit was on average at 22 weeks gestation hence, pre-pregnancy weight was not determined for all participants- detail of the above findings is presented elsewhere (Jackson et al, 2007).

Further calculations and use of BMI was not possible in this secondary analysis as a result of the limitations already mentioned. Maternal weight (at 1st antenatal visit) was significantly different between both the case and control mothers in the total sample and the full term group and height was significantly different between the case and control mothers in the total sample. A study in Burkino Faso assessing the association between diet quality and nutritional status in women indicated a clear relationship between both the FVS and DDS and BMI. Women in the lowest tertile of DDS had a higher prevalence of underweight compared to those in the highest tertile. This relationship remained significant even after controlling for socioeconomic and socio-demographic characterizes (Savy et al., 2005). The DDS used in this study included 14 food groups and the FVS was a count of food items, not based on frequency of consumption as in our study.

The above findings emphasize the need for nutritional status assessment prior to and during pregnancy. Also the weight gain in at-risk women needs to be monitored regularly. For this to be possible women need to regularly attend health care services.

Although the primary study did not investigate the reasons for late registration nor poor attendance at antenatal clinics, it can be speculated that it will be in line with what has been reported for other pregnant populations in Cape Town, South Africa, namely, that women either lack knowledge on the importance of antenatal check-ups, the women themselves don't realize that they are pregnant or that women have poor access to relevant health care services (Abrahams, Jewkes & Mvo, 2001). This would indicate the need for informative interventions on the importance of early antenatal visits as this is the most opportune time for prenatal nutritional assessment, the identification of risk factors and the establishment of follow-up visits for nutritional counseling and education to improve birth outcome.

5.5 Dietary intake and maternal smoking and/ or alcohol consumption

Many studies, as did the primary study, related smoking and alcohol consumption during pregnancy to low birth weight. However, a further objective of this study was to explore the association between maternal smoking and/ or alcohol consumption and dietary intake.

The weekly frequency of consumption for the 14 food items and the six foods groups did not vary much among smokers versus non smokers, drinkers versus non drinkers and those who both smoked and consumed alcohol versus those who practiced none or either. This may be as a result of there only being 67 women in the study population who neither smoked nor consumed alcohol during the index pregnancy. Legumes were the only food whose weekly frequency of consumption was significantly different between smokers and non smokers. Whereas the weekly

frequency of consumption of items from the vegetable, milk, and fruit group were significantly different between drinkers and non drinkers. When comparing those who smoked and consumed alcohol to those who practiced none or either, only legumes was significantly different. Comparing the mean dietary scores between the groups mentioned above showed there was no significant difference in the daily DDS (Kruskal-Wallis test, p=0.1073), the weekly DDS (Kruskal-Wallis test, p=0.3603) nor the FVS (Kruskal-Wallis test, p=0.2556). However, in adjusted comparisons the link between daily dietary diversity score and full term low birth weight did not persist. This would indicate that smoking and/ or alcohol may have a mediating effect on the relationship between dietary scores and infant birth weight.

Other studies comparing the diets of smokers versus non smokers, found smokers had higher intakes of sugar, fat and energy, and lower intakes of most vitamins and minerals than those who did not smoke (Dallongeville, 1998).

5.6 Limitations

In retrospect it may have been useful to be able to have identified which of the food groups were most often not consumed on a daily and weekly basis. This information would be useful in planning nutrition interventions. Also, although it was not possible due to a methodological limitation, it could have been useful to use nutritional outcomes including BMI and weight gain during pregnancy, to validate the findings on FVS and DDS.

5.7 Conclusion

The FVS and DDS used in the study was not validated, nonetheless, our study did suggest that mothers of infants with higher birth weights had greater food variety and dietary diversity. Also the FVS and the DDS reflect the socioeconomic and socio-demographic context of the women in this population. Our results also showed that the relationship between daily- DDS and full term LBW may be mediated by smoking and/ or alcohol consumption.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1. Introduction

This chapter concludes the discussion of the findings and includes recommendations to address the important issues that emerged from the results.

6.2. Conclusions

A trend of the effect of maternal dietary intake on infant birth weight was observed in this population, regardless of the fact that no information was available on the amount of food consumed by these women. Thus we can conclude that the composition or quality of dietary intake has an effect on infant birth weight. Maternal diets could be described as having a low micronutrient content based on the low frequency of consumption of fruit, vegetables, dairy products and legumes. Further, we can conclude that maternal diets had a low variety and diversity.

The determinants of food variety and dietary diversity in this population are the level of maternal education, maternal income and the number of dependents. These factors all have an effect on household food security and thus the challenge of how to promote increased dietary diversity in pregnant women in the West Coast/ Winelands region, given the severe socioeconomic constraints, remain. Another challenge is the high prevalence of smoking and drinking during pregnancy, especially since these behavioural factors seem to have a mediating effect on the relationship between dietary intake and infant birth weight.

Although maternal education seems an option, education alone will not sufficiently change the eating behaviour of the women in face of these socioeconomic and socio-demographic factors. A multileveled intervention focused at the immediate, underlying and basic causes of LBW is needed in this population.

However, within the context of nutrition education the following could be considered:

- Promoting the importance of regular visits to health care facilities, particularly family planning and antenatal clinics.
- Promotion of early antenatal visits among all women of childbearing age.
- The importance of appropriate weight status of women prior to pregnancy, by regular monitoring of weight at family planning clinics.
- Promoting regular monitoring of the weight gain pattern, especially in underweight and overweight pregnant women.
- The importance of a varied diet in prevention of micronutrient deficiency and neural tube defects, by promoting routine antenatal iron and folate supplementation.
- Promotion of healthy dietary guidelines during pregnancy, in line with the South African Food Based Dietary Guidelines.
- Dietary assessment for all pregnant women by a dietitian or a nutrition advisor should become part of routine services offered at antenatal clinics.
- Nutrition counselling to be part of routine services at antenatal clinics.
- Educating on the dangers of smoking and drinking during pregnancy.
- Cooking demonstrations on maximising the nutrient content meals.
- Education on nutrient-dense foods options.
- Food/ vegetable gardens, crop diversification.

- Basic household budgeting.
- Promotion of the consumption of fortified products to improve micronutrient status and contribute to dietary diversification.

Within the broader socioeconomic context this need to be considered:

- Improved access to antenatal clinics, by increasing the number of mobile clinics in the farming regions.
- More employment opportunities for women.
- Improved access to the child support grants and other social grants.
- Increased learning opportunities for young and adolescent girls.

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6.3. Recommendations

Although the FVS and the DDS used in the study was not validated it could be useful tools to use for comparing dietary intake between groups. We observed that the DDS could provide more information to describe the types of diets as compared to the FVS. In addition, this score had a significant association with full term low birth weight. The daily-DDS, because of its greater simplicity, could be a useful indicator to be used in situations where detailed dietary intake assessments are not feasible, including in an antenatal clinic in primary health care settings. The DDS enables the quick identification of specific food groups that needs to be targeted in counselling or educational sessions.

Further validation studies of the dietary methodology are needed in this population. Repeated 24 hour recalls or dietary records at regular intervals during pregnancy are

ways to improve the estimation of usual dietary intake. This would also allow for better identification of commonly consumed food items to be included in the food list and in turn comprise the FVS. With the use of the DDS the constructional inconsistencies regarding how many food groups to include also have to be considered.

References

Abrahams N., Jewkes, R. & Mvo, Z. (2001). Health care-seeking practices of pregnant women and the role of the midwife in Cape Town, South Africa. Journal of Midwifery & Women's Health, 46 (4): 240-247.

Abrams, B., Altman, D., Pickett, K. (2000). Pregnancy weight gain: Still controversial. American Journal of Clinical Nutrition, 71 (Suppl.5) 1233S-1241S.

Actuarial Society of South Africa. (2005). ASSA2003 AIDS and Demographic Model, Available at: www.assa.org.za

Administrative Committee on Coordination/ Sub-committee on Nutrition Second report on the world nutrition situation. Geneva: ACC/SCN, WHO, and Washington, DC, 1992)

Allen, L. (2000). Anemia and iron deficiency: Effects on pregnancy outcomes. American Journal of Clinical Nutrition, 71 (supplement 5), 1280S-1284S.

Arimond, M., Torheim, L.E., Wiesmann, D., Joseph, M. & Carriquiry, A. Dietary Diversity as a Measure of Women's Diet Quality in Resource- Poor Areas: Results from rural Bangladesh site. Washington, DC: Food and Nutrition Technical Assistance (FANTA) Project/Academy for Educational Development (AED), March 2008.

Ashworth, A. (1998). Effects of intrauterine growth retardation on mortality and morbidity in infants and young children. European Journal of Clinical Nutrition, 52 (Supplement 1): S34-S42.

Ashworth, A., Morris, S.S. & Lira, P.I.C. (1997). Postnatal growth patterns of full term low birth weight infants in North East Brazil are related to socioeconomic status. Journal of Nutrition, 127(10): 1950-1956.

Baeten, J., Bukusi, E. & Lambe, M. (2001). Pregnancy complications and outcomes among overweight and obese nulliparous women. American Journal of Public Health, 91: 436-440.

Barker, D.J.P. (1995). Fetal and infant origins of coronary heart disease. British Medical Journal, 311: 171-174.

Berstein, I.M., Mongeon, J.A., Badger, G.J., Solomon, L., Heil, S.H. & Higgins, S.T. (2005). Maternal smoking and its association with birth weight. Obstetrics and Gynaecology, 106 (5): 986-991.

Braddick, M.R et al. (1990). Impact of maternal HIV infection on obstetric and early neonatal outcome. AIDS, 4 (10): 1001-1005.

Bradshaw, D., Groenewald, P., Laubscher, R., Nannan, N., Nojilana, B., Norman, R., Pieterse, D. & Schneiders, M. Initial Burden of Disease Estimates for South Africa, 2000. Cape Town: South Africa: South African Medical Research Council, 2003.

Breslow, R.A.; Guenther, P.M. and Smothers, B.A. (2006). Alcohol Drinking Patterns and Diet Quality: The 1999-2000 National Health and Nutrition Examination Survey. American Journal of Epidemiology, 163 (4): 359-366.

Brown, J.E. (2008). Nutrition through the life cycle. USA: Thomson Wadsworth. p 83-154

Caballero, B., Popkin, B.M.(2002). The nutrition transition: diet and disease in the developing world. London: Academic Press.

Ceesay, S.M., Prentice, A.M., Cole, T.J., Foord, F, Poskitt, E.M.E., Weaver, L.T. & Whitehead, R.G. (1997). Effects of birth weight and perinatal mortality of maternal dietary supplements in rural Gambia: 5 year randomised control trial. British Medical Journal, 315: 786-790.

Chauoki, M.L., & Benmilloud, M. (1994). Prevention of iodine deficiency disorders by oral administration of lipiodol during pregnancy. European journal of Endocrinology, 130(6):547-551.

Clausen, T., Charlton, K.E., Kesitegile, S.R.D., Gobotswang, S.M. and Holmboe-Ottesen, G. (2004). Predictors of food variety and dietary diversity among older persons in Botswana. Nutrition, 21(1): 86-95.

Costello, A.M., Osrin, D. (2003). Micronutrient status during pregnancy and outcomes for newborn infants in developing countries. Journal of Nutrition, 133: 1757s-1764s.

Coutsoudis, A., Pillay, K., Spooner, E. & Kuhn, L. (1999). Randomised trial testing the effect of vitamin A supplementation on pregnancy outcomes and early mother-to-child- HIV-1 transmission in Durban, South Africa. South African Vitamin A Study Group. AIDS, 13: 1517-1524 (abstract only).

Croxford, J. & Viljoen, D. (1999). Alcohol consumption by pregnant women in the Western Cape. South African Medical Journal, 89: 962-965.

Curtis, M.D. & Rigo, J. (2004). Extra-uterine growth restriction in very low birth weight infants. Acta Paediatrica, 93(12): 1563-1568.

Dallongeville, J., Marécaux, N., Fruchart, J. and Amouyel, P. (1998). Cigarette Smoking Is Associated with Unhealthy Patterns of Nutrient Intake: a Meta-analysis. Journal of Nutrition, 128: 1450-1457.

Day, N.L, Jasperse, D., Richardson, G., Robles, N., Sambamoorthi, U., Taylor, P., Scher, M., Stoffer, D., & Cornelius, M. (1989). Prenatal exposure to alcohol: Effect on infant growth and morphologic characteristics. Pediatrics, 84 (3): 536-541.

De Onis, M., Blossner, M., Villar, J. (1998). Levels and patterns of intrauterine growth retardation in developing countries. European Journal of Clinical Nutrition, 52 (Suppl. 1): S5-S15.

Department of Health. (1998). South African Demographic and Health Survey Report. Preteoria: Department of Health.

Drewnowski, A., Henderson, S.A., Driscoll, A. & Rolls, B.J. (1997). The dietary variety score: Assessing diet quality in healthy young and older adults. Journal of the American Dietetic Association, 97: 266-217

Dowry,C (Speaker). (2007). State of the Province, Debate, 20: Intensifying the fight against poverty. Western Cape Minister for Agriculture
http://www.elsenburg.com/speeches/2007/dowry/070220.doc (19 February 2009)

Doyle, W., Crawford, M.A., Srivastava, A. & Costeloe, K.L. (1999). Interpregnancy nutrition intervention with mothers of low birth weight babies living in an inner city area: a feasibility study. Journal of Human Nutrition and Dietetics, 12: 517- 527.

Dundas, M.L. & Taylor, S. (2002). Perinatal factors, motivation, and attitudes concerning pregnancy affect dietary Topics in Clinical Nutrition, 17 (2):71-79

EuroFIR Consortium: European Food Information Resource Network (EuroFIR Project), Dietary assessment methods used in nutritional epidemiology. (FOOD-CT-2005-513944)

Ewing, J.A. (1984). Detecting alcoholism: the CAGE questionnaire. Journal of American Medicine, 252: 1905-1907.

Fall, C.H, Yajnik, C.S., Rao, S., Davies, A.A., Brown, N. & Farrant, H.J. (2003). Micronutrients and foetal growth. Journal of Nutrition, 133: 1747s-1756s.

Fawzie, W.W., Msamanga, G.I., Spiegelman, D. Urassa, W., McGrath, N. Mwakagile, D.,Antelman, G., Mbise, R., Herrera, G., Kapiga, S., Willett, W. & Hunter, D.J. (1998). Randomized trial of effects of vitamin supplements on pregnancy outcomes and T cell counts in HIV-1-infected women in Tanzania. Lancet, 351 (9114): 1477-1482.

Fawzie, W.W., Msamanga, G.I., Urassa, W., Hertzmark, E., Petrara, P., Willett, W,C. & Spiegelman, D. (2007).Vitamins and perinatal outcomes among HIV-negative women in Tanzania. New England Journal of Medicine, 356:1423-1431.

Fernald, L.C. & Grantham-McGregor, S.M. (2002). Growth retardation is associated with changes in stress response system and behaviour in school aged Jamaican children. Journal of Nutrition, 132: 3674-3679.

Fowles, E.R. (2004). Prenatal Nutrition and Birth Outcomes. Journal of Obstetric, Gynaecological, & Neonatal Nursing, 33: 809-822.

Forsén, T., Eriksson, J.G., Tuomilehto, J., Teramo, K., Osmond, C. & Barker, D.J.P. (1997). Mother's weight in pregnancy and coronary heart disease in a cohort of Finnish men: follow up study. British Medical Journal, 315: 837-840.

Furuno, J.P., Gallicchio, L. & Sexton, M. (2004). Cigarette smoking and low maternal weight gain in medicaid-eligible pregnant women. Journal of Women's Health, 13 (7):770-777.

Gibney. M.J., Margetts, B.M., Kearney, J.M & Arab, L (eds). (2007). Public Health Nutrition. Chapter 3: Assessment of nutritional status in individuals and populations. Blackwell Publishing Company: USA

Gillespie, S & Mason, J. (1991). Some options for improving nutrition in the 1990's. Nutrition-Relevant Actions. UN/ACC SCN. SCN News UN/ACC SCN 1991; 7 (-): 17. IDPAS #506

Godfrey, K. & Barker, D.J.P. (2000). Foetal nutrition and adult disease. American Journal of Clinical Nutrition, 71 (5): 1344S-1352S.

Godfrey, K., Robinson, S., Barker, D, Osmond, C. & Cox, V. (1996).Maternal nutrition in early and late pregnancy in relation to placental and fetal growth. British Medical Journal, 312-410.

Grjibovski, A., Bygren, L.O. & Svartbo, B. (2002). Socio-demographic determinants of poor infant outcome in North West Russia. Paediatric and Perinatal Epidemiology, 16: 255-262.

Groenewald, T.V., Vos, T., Norman, R., Laubscher, R., van Walbeek, C., Saloojee, Y., Sitas, F. & Bradshaw, D. (2007). Estimating the burden of disease attributable to smoking in 2000. South African Medical Journal, 97:674-680.

Gupta, P., Ray, M., Dua, T., radhakrishnan, G., Kumar, R. & Sachdev, H.P.S. (2007). Multimicronutrient supplementation for undernourished women and the birth size of their offspring. Archives of Pediatrics & Adolescent Medicine, 161(1): 58-64.

Guyatt, H.L & Snow, R.W. (2004). Impact of malaria during pregnancy on low birth weight in Sub-Saharan Africa. Clinical Microbiology Reviews, 17 (4): 760-769.

Hales, C.N., Barker, D.J.P. & Clarke, P.M.S et al. (1991). Fetal and infant growth and impaired glucose tolerance at age 64. British Medical Journal, 303:1019-22.

Hatloy, A., Torheim, L.E. & Osshaug, A. (1998). Food variety- a good indicator of nutritional adequacy of the diet? A case study from and urban area in Mali, West Africa. European Journal of Clinical Nutrition, 52: 891- 898.

Hoddinott, J. Measuring dietary diversity. A guide. (2002). Washington, D.C.: Food and Nutrition Technical Assistance, Academy for Educational Development.

Hodddinott, J. & Yohannes, Y. (2002). Dietary diversity as a household food security indicator. Food and Nutrition Technical Assistance Project, Academy for Educational development. Washington DC:IFPRI

Horta, B.L, Victora, C.G., Menezes, A.M., Halpern, R. & Barros, F.C. (1997). Low birth weight, preterm birth, and intrauterine growth retardation in relation to maternal smoking. Paediatric Perinatal Epidemiology, 11 (2): 140-151.

http://www.statssa.gov.za/news_archive/23 August2007_1.asp

Hudson, G.J. (1995): Food intake in a West African village. Estimation of food intake from a shared bowl. British Journal of Nutrition, 73:551-569.

Hulsey, T.C., Neal, D., Bondo, S.C., Hulsey, T. & Newman, R. (2005). Maternal prepregnant body mass index and weight gain related to low birth weight in South Carolina. South Medical Journal, 98 (4):411-415.

Institute of Medicine, Food and Nutrition Board: Dietary reference intakes for energy and the macronutrients, carbohydrate, fiber, fat, and fatty acids, Washington, DC, 2002, National Academic Press (IOM, 2002).

Jackson, D.J., Batiste, E., and Rendall Mkosi, K. (2007). Effect of smoking and alcohol use during pregnancy on the occurrence of low birth weight in a farming region in South Africa. Paediatric and Perinatal Epidemiology, 21 (5): 432-440.

Jackson, D., Lang, J., Dickinson, C. & Fullerton, J. (1994). Use of the Nurse-Midwifery Clinical Dataset for Classification of Subjects in Birth Centre Research. Journal of Nurse-Midwifery, 39:197-213.

Jaddoe, V.W.V., Troe, E.W.M., Hofman, A., Mackenbach, J.P., Moll, H.A., Steegers, E.A.P. & Witteman. J.C.M.(2008). Active and passive maternal smoking during pregnancy and the risk of low birth weight and preterm birth: the Generation R study. Paediatric Perinatal Epidemiology, 22 (2): 162- 171.

James, D.K. & Stephenson, T.J. (1998). Fetal Nutrition and Growth, In: Chamberlain G, Broughton P.F, eds, Clinical Physiology in Obstetrics Oxford: Blackwell Science, 467-497.

Kant, A.S. (1996). Indexes of overall diet quality: A review. Journal of the American Dietetic Association, 96: 785-791.

Kant, A.K., Schatzkin, A., Graubard, B.I. & Schairer, C. (2000). A prospective study of diet quality and mortality in women .Journal of the American Medical Association, 283 (16): 2109-2115.

Kant, A. (2004). Dietary patterns and health outcomes. Journal of the American Dietetic Association, 104:615-635.

Kinabo, J., Kamukama, E & Bukuku, U. (2003).Seasonal variation in physical activity patterns, energy expenditure and nutritional status of women in a rural village in Tanzania. South African Journal of Clinical Nutrition, 16 (3): 96-102.

King, J.C. (2000a). Determinants of maternal; zinc status during pregnancy. American Journal of Clinical Nutrition, 71(supplement), 1334S-1343S.

King, J.C. (2000b). Physiology of pregnancy and nutrient metabolism. American Journal of Clinical Nutrition, 71 (5): 1218S-1228S

King, J.C. (2003). The risk of maternal depletions and poor pregnancy outcomes increases in early or closely spaced pregnancies. Journal of Nutrition, 133:1732S-1736S.

Kramer, S. (2003). The epidemiology of adverse pregnancy outcomes: an overview. Journal of Nutrition, 133: 1592S-1596S.

Kramer, M.S. (1998). Maternal nutrition, pregnancy outcome and public health policy. Canadian Medical Association Journal, 159 (6): 663-665.

Kramer, M.S. Balanced protein/ energy supplementation in pregnancy (Cochrane Review). In Cochrane Library, Issue 3, 2000. Oxford.

Kumwenda, N, Micotti, P.G., Taha, T.E. & Broadhead, R. (2002). Antenatal Vitamin A supplementation increases birth weight and decreases anemai among infants born to HIV-infected women in Malawi. Clinical Infectious Diseases, 35 (5):618-624.

Labadarios, D., Steyn, N.P., Mauder, E., MacIntyre, U., Gericke, G., Swart, R., Huskisson, J., Dannhauser, A., Vorster, H.H., Nesmvuni, A.E. & Nel, J.H. (1999).The National Food Consumption Survey. Public Health Nutrition, 8 (5): 533-543.

Ladipo, O.A. (2000). Nutrition in pregnancy: mineral and vitamin supplements, American Journal of Clinical Medicine, 72 (1): 280S- 290S.

Laor, A., Stevenson, D.K., Shemer, J., Gale, R., & Seidman, D.S. (1997). Size at birth, maternal nutritional status in pregnancy, and blood pressure at age 17: population based analysis. British Medical Journal, 315: 449-453.

Laraia, B., Bodnar, L.M. & Siega-Riz, A.M. (2007). Pregravid body mass index is negatively associated with diet quality during pregnancy. Public Health Nutrition, 10 (9): 920-926.

Levitt, N.S., Steyn, K, De Wet, T & Morell, C. (1999). An inverse relationship between blood pressure and birth weight among 5 year old children from Soweto, South Africa. Journal of Epidemiolgy and Community Health, 53 (5): 264-268.

Li, H., Stein, A.D., Barnhart, H.X., Ramakrishnan, U. & Martorell, R. (2003). Associations between prenatal and postnatal growth and adult body size and composition. American Journal of Clinical Nutrition, 77 (6):1498-1505.

London, L. (1999). The "dop" system, alcohol abuse and social control amongst farm workers in South Africa.: a public health challenge. Social Science and Medicine, 48 (10):1407-1414.

London, L.; Nell, V.; Thompson, M.L. & Myers, J.E. (1998). Health status among farm workers in the Western Cape: Collaterall evidence from a study of Occupational Hazards. South African Medical Journal, 88 (9): 1096-1101.

Love, P. & Sayed, N. (2001). Eat Plenty of Fruits and Vegetables. South African Journal of Clinical Nutrition, 14 (3): S24-S31.

Maart, L.C. (2003). Knowledge, Attitudes and Practices related to lifestyle factors among childbearing women in the Western Cape, West Coast/ Winelands region. Unpublished Master's Thesis. School of Public Health. Univeristy of the Western Cape.

Maddah, M., Karandish, M., Mohammadpour-Ahranjani, B., Neyestani, T.R., Vafa, R. & Rashidi, A. (2005).Social factors and pregnancy weight gain in relation to infant birth weight: a study in public health centres in Rasht, Iran. European Journal of Clinical Nutrition, 59: 1208-1212.

Mahan, L.K. & Escott-Stump, S. (2008). Krause's Food and Nutrition Therapy (12th Edition). Canada: Saunders Elsevier Inc. p.171-173

Makrides, M. & Crowther, C.A. (2002). Magnesium supplementation in pregnancy (Cochrane review) in: the Cochrane Library, Issue 4: CD000937. Update software, Oxford.

Mamabolo, R.L., Alberts, M., Steyn, N.P., Delemarre-van de Waal, H.A. & Levitt, N.S. (2005). Prevalence and determinants of stunting and overweight in 3 year old black South African children residing in the central region of Limpopo province, South Africa. Public Health Nutrition**,** 8 (5): 501-508.

Makola, D., Ash, D.M., Tatala, S.R., Lathmen, M.C., Ndossi, G. & Mehansho, H. (2003). A micronutrient-fortified beverage prevents iron deficiency, reduces anemia, and improves haemoglobin concentration of pregnant Tanzanian women. Journal of Nutrition, 133:1339-1346.

Martorell, R., Stein, A.D. & Schroeder, D.G. (2001). Early nutrition and later adiposity. Journal of Nutrition, 131: 874S-880S.

Maunder, E.M.W., Matji, J. & Hlatshway-Molea, T. (2001). Enjoy a variety of foods. South African Journal of Clinical Nutrition, 14 (3):S7-S11.

May, P.A., Gossage, P., Brooke, L.E., Snell, C.L., Marais, A., Hendricks, L.S., Croxford, J.A. & Viljoen, D.L. (2005). Maternal risk factors for fetal alcohol syndrome in the Western Cape province of South Africa: a population-based study. American Journal of Public Health, 95 (7): 1190-1199.

McCance, D.R., Pettitt, D.J., Hanson, R.L., Jacobsson, L.T.H. Knowler, W.C. & Bennett, P.H. (1994). Birth weight and non-insulin dependant diabetes: thrifty genotype, thrifty phenotype, or surviving small baby genotype? British Medical Journal, 308:942-945.

McDonald, A.D., Armstrong, B.G. & Sloan, M. (1992). Cigarette, alcohol and coffee consumption and prematurity. American Journal of Public Health, 82 (1):87-90.

McKinstry, J. (2005). Using the past to step forward: Foetal alcohol syndrome in the Western Cape Province of South Africa. American Journal of Public Health. 95(7): 1097-1099.

Medical Research Council (2000a). Research Unit for Maternal and Infant Health Care Strategies. Saving Babies Perinatal Care Survey of South Africa. Pretoria: Health Systems.

Merialdi, M., Carroli, G., Villar, J., Abalos, E., Gülmezoglu, A.M., Kulier, R. & de Onis, M. (2003). Nutritional Interventions during pregnancy for the prevention or treatment of impaired foetal growth: an overview of randomized controlled trails. Journal of Nutrition, 133: 1626s-1631s.

Moore, V.M., Davies, M.J., Willson, K.J., Worsley, A. & Robinson, J.S. (2004). Dietary composition of pregnant women is related to size of the baby at birth. Journal of Nutrition, 134: 1820-1826.

Mora, J.O. & Nestel, P.S. (2000). Improving prenatal nutrition in developing countries: strategies, prospects, and challengers. American Journal of Clinical Nutrition, 71 (5): 1353S-1363S.

Neufeld, L.M., Haas, J.D., Grajéda, R. & Martorell, R. (2004). Changes in maternal weight from the first to second trimester of pregnancy are associated with foetal growth and infant length at birth. American Journal of Clinical Nutrition, 79 (4): 646-652.

Ogle, B.M., Hung, P.H. & Tuyet, H.T. (2001). Significance of wild vegetables in micronutrient intakes of women in Vietnam: an analysis of food variety. Asia Pacific Journal of Clinical Nutrition, 10 (1): 21-30.

Olafsdottir, A.S., Skuladottir, G.V., Thodottir, I., Hauksson, A. & Steingrimsdottir, L. (2006). Combined effect of maternal smoking status and dietary intake related to weight gain and birth size parameters. An International Journal of Obstetrics and Gynaecology, 113 (11): 1296-302.

Onyango, A., Koski, K. & Tucker, K. (1998). Food diversity versus breastfeeding choice in determining anthropometric status in rural Kenyan toddlers. International Journal of Epidemiology, 27 (3): 484-489.

Olsen, S.F. (1993). Maine n-fatty acids ingested in pregnancy as a possible determinant of birth weight: A review of current epidemiological evidence. Epidemiological Review, 15: 399-413.

Olsen, S.F., Secher, N.J., Tabor, A., Weber, T., Wlaker, J.J. & Glung, C. (2000). Randomised clinical trial of fish oil supplementation in high risk pregnancies. British Journal of Obstetrics and Gynaecology, 107: 382-395.

Olsen, S.F., Halldorsson, T.I., Willett, W.C., Krudsen, V.K., Gillman, M.W et al. (2007). Milk consumption during pregnancy is associated with increased infant size at birth: prospective cohort study. American Journal of Clinical Nutrition, 86 (4): 1104-10.

Osler, M., Tjonneland, A., Suntum, M., Stripp, C., Gronbaek, M. & Overvad, K. (2002). Does the association between smoking status and selected healthy foods depend on gender? A population-based study of 54 417 middle-aged Danes. European Journal of Clinical Nutrition, 56 (1): 57-63.

Osmond, C. et al. (1993). Early growth and death from cardiovascular disease in women. British Medical Journal, 307:1519-1524.

Perkins, K.A. (1992). Effects of tobacco smoking on caloric intake. British Journal of Addiction, 87: 193.

Phillips, D.I.W. (2006). External influences on the fetus and their long-term consequences. Lupus, 15 (11): 794-800.

Phillips, C. & Johnson, N.E. (1977). The impact of quality of diet and other factors on birth weight of infants. American Journal of Clinical Nutrition, 30: 215-225.

Phillips, D.I.W., Barker, D.J.P., Hales, C.N. et al. (1994). Thinness at birth and insulin resistance in adult life. Diabetologia, 37: 150-154.

Phipps, K et al. (1993). Fetal growth and impaired glucose tolerance in men and women, Diabetologia, 36: 225-228 (abstract only)

Pick, M.E., Edwards, M., Moreau, D. & Ryan, E.A. (2005). Assessment of diet quality in pregnant women using the Healthy Eating Index. Journal of the American Dietetic Association, 105 (2): 240-246.

Pojda, J., Kelly, L. (eds). Low birthweight: Report on a meeting in Dhaka, Bangladesh on 14-17 June 1999. Nutrition Policy Paper 18. Geneva: Administrative Committee on Co-ordination/ Sub-Committee on Nutrition, 1999.

Pollack, H; Lanntz, P.M.; Frohna, J.G. (2000). Maternal smoking and adverse outcomes among singletons and twins. American Journal of Public Health, 90 (3): 395-400.

Popkin, B.M. (2001). The nutrition transition and obesity in the developing world. Journal of Nutrition, 131: 871S-873S.

Popkin, B.M. (2002). The shift in changes of the nutrition transition in the developing world differs from the past experiences! Public Health Nutrition, 5 (1A), 205-214.

Prince, C. (2004). Conditions of farms- A draft paper. Department of Social Servives and Poverty Alleviation. Unit of Social Research, Directorate Research & Population Development.

Purwar, M., Kulkarni, H., Motghare, V, & Dhole, S. (1996). Calcium supplementation and prevention of pregnancy induced hypertension. Journal of Obstetric and Gynecology, 22 (5):425-430.

Ramachandran, P. (2002). Maternal nutrition-effect on foetal growth and outcome of pregnancy. Nutrition Reviews, 60: 26S-34S.

Ramakrishnan, U. (2004). Nutrition and low birth weight: from research to practice. American Journal of Clinical Nutrition, 79 (1): 17-21.

Ramakrishnan, U., Gonzalez-Cossio, T., Neufeld, L.M., Rivera, J. & Martorell, R. (2003). Multiple micronutrient supplementation during pregnancy does not lead to greater infant birth size than does iron-only supplementation: a randomised controlled trial in a semirural community in Mexico. American Journal of Clinical Nutrition, 77 (3): 720-725.

Rantakallio, P. & Hartikainen-Sorri, A. (1981). The relationship between birth weight, smoking during pregnancy, and maternal weight gain. American Journal of Epidemiology, 113: 590-595.

Rao, S. Kanada, A., Margetts, B.M., Yajnik, C.S., Lubree, H., Rege, S., Desai, B., Jackson, A. & Fall, C.H.D. (2003). Maternal activity in relation to birth size in rural India. The Pune Maternal Nutrition Study. European Journal of Clinical Nutrition, 57 (4): 531-542.

Rasmussen, K.M. (2001). Is there a causal relationship between iron deficiency or iron deficiency anaemia and weight at birth, length of gestation and perinatal mortality? Journal of Nutrition, 131: 590S-603S.

Rayco-Solon, P., Fulford, A.J., & Prentice, A.M. (2005). Differential effects of seasonality on preterm birth and intrauterine growth restriction in rural Africans. American Journal of Clinical Nutrition, 81 (1): 134-139.

Rich-Edwards, J.W., Stampfer, M.J. & Manson, J.A.E. (1997). Birth weight and the risk of cardiovascular disease in a cohort of women followed-up since 1976. British Medical Journal, 315:396-400 (abstract only)

Rogers, I., Emmet, P., Baker, D., Golding, J., & ALSPAC study team. (1998). Financial difficulties, smoking habits, composition of the diet and birth weight in a population of pregnant women in the South West of England. European Journal of Clinical Nutrition, 52: 251-260.

Rondo, P.H., Abbott, R., Rodrigues, L.C. & Tomkins, A.M. (1997). The influence of maternal nutritional factors on intrauterine growth retardation in Brazil. Paediatric and Perinatal Epidemiology, 11 (2): 152-166.

Ruel, M.T. (2002).Is dietary diversity an indicator of food security or dietary quality? A review of measurement issues and research needs. FCND Discussion Paper 140. Washington DC: International Food Policy Research Institute.

SADHS (South African Demographic and Health Survey). Medical Research Council and Macro International. Pretoria: Department of Health , 1998.

Saving Babies 2003-2005: Fifth Perinatal Care Survey of South Africa. Pretoria; 2007. http://www.ppip.co.za/

Savy, M. Martin-Prevel, Y., Traissac, P., Eymard-Duvernay, S. & Delpeuch. (2006). Dietary diversity scores and nutritional status of women change during the seasonal shortage in rural Burkina Faso. Journal of Nutrition, 136: 2625-2632.

Savy, M., Martin-Prevel, Y., Sawadogo, P., Kameli, Y. & Delpeuch, F. (2005). Use of variety/ diversity scores for diet quality measurement: relation with nutritional status of women in a rural area in Burkina Faso. European Journal of Clinical Nutrition, 59: 703-716.

Schneider, M., Norman, R., Steyn, N. & Bradshaw. D. (2007). Estimating the burden of disease attributable to low fruit and vegetable intake in South Africa. South African Journal of Clinical Nutrition, 97 (8): 717-723.

Scholl, T.O., Hediger, M.L., Schall. J.I., Khoo, C.S. & Fischer, R.L. (1996). Dietary and serum folate: Their influence on the outcome of pregnancy. American Journal of Clinical Nutrition, 63:520-525.

Scholl, T.O. & Johnson, W.G. (2000). Folic acid: Influence on outcome of pregnancy. American Journal of Clinical Nutrition, 71 (5):1295S-1303S.

Shabodien,F.(2006).http://www.wfp.org.za/pdf/livelihood_struggles_of_sa_women_farm_workers, 2006.pdf (28 March 2008)

Siega-Riz, A.M., Adair, L.S. & Hobel, C.J. (1996). Maternal underweight status and inadequate rate of weight gain during the third trimester of pregnancy increases the risk of preterm delivery. Journal of Nutrition, 126 (1): 146-153.

Simon, D.M., Vyas, S., Prachand, N.G., David, R.J. & Collins, J.W. (2006). Relation of maternal low birth weight to infant growth retardation and prematurity. Maternal and Child Health Journal, 10 (4): 321-327.

Sørensen, H.T., Sabroe, S., Olsen, J., Rothman, K.J., Gillman, M.W. & Fischer, P. (1997). Birth weight and cognitive function in young adult life: historical cohort study. British Medical Journal, 315: 401-403,

Stein, C.E. et al. (1996). Fetal growth and coronary heart disease in South India. Lancet, 348:1269-1273 (abstract only).

Stein, Z., Susser, M., Saenger, G. & Marolla, F. (1975).Famine and Development: The Dutch Hunger Winter of 1944-45. New York: Oxford University Press.

Steyn, N.P. & Nel, J.H. (2006): Dietary intake of adult women in South Africa and Nigeria with focus on the use of spreads. Medical Research Council: Chronic Diseases of Lifestyle Unit.

Steyn, N.P., Nel, J.H., Nantel, G., Kennedy, G. & Labadarios. (2005). Food variety and dietary diversity scores in children: are they good indicators of dietary adequacy. Public Health Nutrition, 9 (5): 644-650.

Steyn, K., de Wet, T., Saloojee, Y. Nel, H & Yach. D. (2006). The influence of maternal cigarette smoking, snuff use and passive smoking on pregnancy outcomes: The Birth-to-Ten study. Paediatric Perinatal Epidemiology, 20 (2): 90-99.

Strauss, R.S. & Dietz, W.H. (1999). Low maternal weight gain in the second or third trimester increases the risk for intrauterine growth retardation. Journal of Nutrition, 129 (5): 988-993.

Torheim, L.E., Ouattara, F., Diarra, M.M., Thiam, F.D., Barikmo, I., Hatloy, A. & Oshaug, A. (2004). Nutrient adequacy and dietary diversity in rural Mali: association and determinants. European Journal of Clinical Nutrition, 58: 594-560.

Torheim, L.E., Barikmo, I., Parr, C.L., Hatloy, A., Ouattara, F., & Oshaug, A. (2003).Validation of food variety as an indicator of diet quality with food frequency questionnaire for Western Mali. European Journal of Clinical Nutrition, 57: 1283-1291.

Victora, C.G:, Barros, F.C., Horta, B.L. & Martorell, R. (2001). Short-term benefits of catch-up growth for small for gestational age infants. International Journal of Epidemiology, 30:1325-1330.

Vandebosche, R.C. & Kirchner, D.O. Intrauterine Growth Retardation- October 15, 1998- American Academy of Family Physicians, 58 (6).

Venter. C.S. & van Eyssen, E. (2001). More legumes for better overall health. South African Journal of Clinical Nutrition, 14 (3):S32-S38

Verbeke, W. & Bourdeaudhuij, I.D. (2007). Dietary behaviour of pregnant versus non pregnant women. Appetite, 48: 78-86.

Vorster, H.H. & Nell, T.A. (2001). Make starchy foods the basis of most meals. South African Journal of Clinical Nutrition, 14 (3): S17-S24

Wardlaw, T., Blanc, A. & Ahman, E. (2004). United Nations Children Fund and World Health Organisation. Low Birth Weight: Country, regional and global estimates, New York

Watts, V., Rockett, H., Baer, H., Leppert, J. & Colditz, G. (2006). Assessing diet quality in a population of low income women: A comparison between Native Americans and Whites. Maternal and Child Health Journal, DOI 10.1007/s10995-006-016-4.

West, K.P.J., Katz, J., Khatry, S.K., LeClerk, S.C., Pradham, E.K. & Shresha, S.R. (2000). Maternal low dose vitamin A or beta-carotene supplementation has no effect on fetal loss and early infant mortality: a randomized cluster trial in Nepal. American Journal of Clinical Nutrition, 71: 1570-1576.

Whitney, E.N., Cataldo, C.B. & Rolfes, S.R. (2002). Understanding Normal and Clinical Nutrition. (6th edition). Toronto: Wadsworth. Thomas Learning, p 33.

WHO/ FAO (World Health Organisation/ Food and Agriculture Organization of the United Nations). 1996. Preparation and use of food based dietary guidelines. Geneva: Nutrition Programme, World Health Organisation

World Health Organisation/ Food and Agriculture organisation. Diet, Nutrition and the Prevention of chronic diseases. Report of a joint WHO/ FAO Expert Consultation Geneva: WHO, 2003

World Health Organization. Coverage of maternity care: a listing of available information. Geneva: World Health Organization, 1997.

Wrieden, W., Peace, H., Armstrong, J & Barton, K. (2003). Briefing paper prepared for: Working group on monitoring Scottish dietary targets workshop. A short review of dietary assessment methods used in National and Scottish Research Studies.

Wu, G., Fuller, W.B., Cudd, T.A. et al. (2004). Maternal Nutrition and Fetal Development. Journal of Nutrition, 134: 2169-2172.

APPENDIX A

HEALTHY CHILDBEARING STUDY

CONFIDENTIAL QUESTIONNAIRE

(To be completed for all participants mother and infant/s)

Office use only

Study Number

Interviewer Code

Date of interview DDMMYY

A. GENERAL CHARACTERISTICS. TO BE COMPLETED BY ALL

1 Age at last birthday (in years)

2 What is the highest standard you passed at school?

3 Do you currently work and earn money? Yes 1 No 2

4a) If "yes" specify type of work……

b) If "no" answer question 7

5 How many months pregnant were you before you stopped working?

no. of months pregnant	

6 What is your approximate monthly household income?

R200 or less	1
R300- R500	2
R600- R700	3
R800-R1000	4
>R1000	5

7 Marital status (Please tick the appropriate box)

Single -Never Married	1
Married- Monogamous relationship	2
Married- polygamous relationship	3
Widowed	4
Divorced/Seperated	5
Co-habiting	6

7 Maternal race (Ethnicity)

a) Black	1
b) Coloured/ Mixed race	2
c) White	3
d) Asian	4
e) Other, specify	5

B HOUSEHOLD INFORMATION

1 Where do you live (specify area)…….

2 What type of area do you live in (choose one which best applies)

On a farm	1
In a city/ town	2
In a township-informal settlement	3
In a township -formal settlement	4
Other,……..	5

3 What type of house do you live in?

Brick house / flat	1
Wendy house	2
A shack in the yard	3
A shack in the squatter area	4
Other, specify……	5

4 How many rooms (including kitchen and toiltet) are there in your house?

no. of rooms				

5 How many people, including yourself, live in this house?

6 Do you currentlly live with the father of your baby?

Yes	1	No 2	

7 Does the father of your baby support you financially?

Yes	1
No	2
Sometimes	3

8. Which of the following financial support do you receive?(Tick all that apply)

a) disability grant	1
b) child support grant	2
c) unemployment benefit	3
d) other, specify:……	4

9 Whom of the following people gave you emotional/social support during your pregnancy? Tick all that apply.

a) Nobody	1

b) Father of your baby	2	
c) Parents	3	
d) Brothers / Sisters	4	
e) Friends	5	
f) Other, specify……	6	

9. Did you make use of any other emotional /social support service?

Yes 1	No 2	

10. If "yes" please, specify

C PREGNANCY INFORMATION

I. Is this your first pregnancy?

Yes 1	No 2	

2 How many months pregnant were you when you first booked at the clinic?

1-3 months	1	
4-6 months	2	
7-9 months	3	

3 Was this a planned pregnancy?

Yes 1	No 2	

4 Were you using any form of contraception / birth control when you became pregnant?

Yes 1	No 2	

5 How many times were you pregnant before this pregnancy?

No of pregnancies				

6a. Did any of your pregnancies end in any miscarriages?

Yes 1	No 2	

6b. If "yes " how many miscarriages did you have?

No of miscarriages				

The following questions (7-10) deal with babies who were stillborn, not miscarriaged

7 Were any of your babies stillborn (Died after 20 weeks / 5 months of pregnancy)?

Yes 1	No 2	

8 Did any of your babies die before one year of birth?

Yes 1	No 2	

10 If "yes" to numbers 7-8 please explain what was wrong with the baby who died.

11 How many living children do you have?

No. of living children				

12 Were any of your babies from your previous pregnancies very small at birth (low birth weight)?

Yes 1	No 2	

D. SMOKING

1. Which best describes your smoking habit

a) Currently smoking, every day. ***Go to section D1***	1
b) Not every day, but at least one cigarette a month. ***Go to section D1***	2
c) No, not at all but I did smoke on a daily basis in the past. ***Go to section D3***	3
d) No I have never smoked. ***Go to section D2***	4

D1. ***To be completed by smokers only***

1. How old were you when you started smoking?

Age in years				

2. How many cigarettes/ beedies do you smoke now?

daily smokers: e.g. 5 cigarettes per day	1
occasional (social) smokers: e.g. 12 per month	2

3. Which one of the following describes you best?

I have been smoking less during my pregnancy	1
I have been smoking more during my pregnancy	2
My smoking has not changed during my pregnancy	3

4. For the following please choose only one option:

I smoke more when I am alone.	1
I smoke more when I am with my husband/boyfriend.	2
I smoke more when I am with friends or others that smoke.	3
I always smoke the same amount of cigarettes.	4

5a. What are your reasons for continuing to smoke? *(Please tick all that apply)*

a) Helps me cope with daily tension / stress.	1	
b) Helps me cope with job situation.	2	
c) Helps me cope with loneliness during my pregnancy.	3	
d) Helps me cope with looking after my children.	4	
e) Helps me cope with crime/violence in my community.	5	
f) Helps me deal with problems with my family	6	
g) Helps me get through the day.	7	
h) I smoke because my friends smoke.	8	
i) None of the above.	9	

b. If you chose "none of the above", explain why you continue to smoke.

……

……

……

6. Have you ever tried to stop smoking?

Yes, I have tried to stop smoking ***(Answer question 7)***	1	
No, I have not tried to stop smoking	2	
I have never tried but want to stop smoking	3	

7. Have you tried any of the following in your attempts to stop smoking?(Tick all that apply)

a) Nicotine patch	1	
b) Nicotine gum	2	
c) Nicotine spray	3	
d) Stop smoking counseling	4	
e) Brochures/ pamphlets	5	
f) Other,specify……	6	
……		

D2: *To be completed by non-smokers*

1. Have you ever smoked a cigarette?

Yes 1		No 2	

2. Which one of the following describes your feelings at present?

I have a strong desire to smoke	1	
I sometimes have the desire to smoke	2	
I don't feel that I should start smoking	3	

3a Do you live with people who smoke?

Yes 1		No 2	

b. If "yes" do they smoke in your presence?

Yes 1		No 2	

4a. Does smoking from others bother you?

Yes	1
No	2
Sometimes	3

b If "yes" please explain why.

……

……

……

……

D3. To be completed by former smoker(quitter)

1. How old were you when you started smoking on a daily basis?

age in years

2. How many years did you smoke daily? *If you stopped smoking and started again,indicate total years smoked*

total smoking years

3. What helped you to stop smoking?

4. What were the positive(good) aspects about quitting?

5. What were the negative (bad) aspects about quitting?

6. How long ago did you stop smoking on a daily basis?

no. of years stopped

7. If you stopped smoking less than a year ago, how long ago in months did you stop?

no. of months stopped

8. How many cigarettes did you smoke before you stopped?

no. of cigarettes				

9. Why did you stop smoking? (Tick all that apply)

a) I stopped because the father of my baby wanted me to	1	
b) I stopped because the midwives advised me to	2	
c) I stopped because the doctor advised me to	3	
d) I stopped because my mother suggested that I should	4	
e) I stopped because it was bad for my health	5	
f) I stopped because I fell pregnant	6	
g) I stopped because cigarettes are too expensive	7	
h) Other, specify……	8	

10. Which one of the following describes you best?

I experienced quitting as very easy	1	
I experienced quitting as easy	2	
I experienced quitting as difficult	3	
I experienced quitting as very difficult	4	

E. DRUG USE TO BE COMPLETED BY ALL

1. Do you use any drugs?

Yes	1	No	2	

2. If "yes" which of the following drugs do you use?

Marijuana (Dagga)	1	
Ecstacy	2	
Mandrax tablets (Pill)	3	
Other, specify……	4	

3. Do you use any snuff?

a) Yes, every day . ***Answer question 4***	1	
b) Yes, not every day but at least once a month. ***Answer question 4***	2	
c) No, not every day but I did use it in the past	3	
d) No, I have never used snuff	4	

4. If " yes" which of the following do you inhale?

a) glue	1	
b) Household solvents(e.g. paraffin,)	2	
c) Other, specify……	3	

5. Do you use chewable tobacco(pruimtabak)?

Yes 1	No 2	

F. ALCOHOL USE: TO BE COMPLETED BY ALL

1. Which best describe your alcohol habit?

a) Yes, I drink alcohol every day. ***Go to section F1***	1
b) Yes , I drink alcohol, but not every day. ***Go to section F1***	2
c) No, but I did drink alcohol in the past. ***Go to section F2***	3
e) No I have never used alcohol. ***Go to section G***	4

F1. Alcohol users

1. How old were you when you first started drinking alcohol?

age in years				

2. How much alcohol do you drink during the week?
(Monday- Thursday)
(I glass = 200ml)

I don't drink during the week	1
1 - 2 glasses per day	2
3-4 glasses per day	3
5 or more glasses per day	4
communal drinker	5

3. ***If communal drinker:***

a) How many bottles do you drink during the week?	no of bottles				
b) What volume alcohol do the bottles contain?	amount of alcohol in…….litres				
c) How many friends share one bottle at a time?	no of friends				

4. How much alcohol do you drink during weekends?
(Friday night-Sunday night)
(I glass = 200 ml)

I don't drink during weekends	1
1 - 2 glasses per day	2
3-4 glasses per day	3
5 or more glasses per day	4
communal drinker	5

5. ***If communal drinker:***

a) How many bottles do you drink weekends?	no of bottles				
b) What volume alcohol do the bottles contain?	amount of alcohol in…….litres				
c) How many friends share one bottle at a time?	no of friends				

6. Have you felt that you ought to drink less?	Yes 1	No 2	
7. Does it annoy you when people criticize your drinking?	Yes 1	No 2	
8. Have you ever felt bad or guilty about your drinking?	Yes 1	No 2	
9. Have you ever had a drink first thing in the morning to calm your nerves or to get rid of a hangover?	Yes 1	No 2	

10. Do you usually smoke more when you are drinking?

Yes	1	
No	2	
Unsure	3	

F2. To be completed by former drinkers

1. How many years ago did you stop drinking alcohol? *If you stopped and started again indicate the number of years since you stopped drinking.*

no of years				

2. If you stopped drinking less than a year ago, how many months ago did you stop drinking?

no. of months				

3. How much alcohol did you drink during the week?

(Monday- Thursday)

(I glass = 200ml)

I don't drink during weekends	1	
1 - 2 glasses per day	2	
3-4 glasses per day	3	
5 or more glasses per day	4	
communal drinker	5	

4. ***If communal drinker:***

a) How many bottles did you drink during the week?	no of bottles				
b) What volume alcohol did the bottles contain?	amount of alcohol in …….litres				
c) How many friends shared one bottle at a time?	no of friends				

4. How much alcohol did you drink during weekends?

(Friday night-Sunday night)

(I glass = 200 ml)

I don't drink during weekends	1	
1 - 2 glasses per day	2	
3-4 glasses per day	3	
5 or more glasses per day	4	
communal drinker	5	

5. ***If communal drinker:***

a) How many bottles did you drink weekends?	no of bottles				
b) What volume alcohol did the bottles contain?	amount of alcohol in …….. Litres				
c) How many friends shared one bottle at a time?	no of friends				

6. What were your reason(s) for stop drinking alcohol?

G. NUTRITION

How often do you eat foods from each of the following categories:
(Choose one option (day, week or month) and indicate number of times)

1. Meat / Poultry	daily		
	weekly		
	monthly		
	never		
2. Fish (Tinned, Fresh)	daily		
	weekly		
	monthly		
	never		
3. Eggs	daily		
	weekly		
	monthly		
	never		
4. Bread (brown, white, whole grain)	daily		
	weekly		
	monthly		
	never		
5. Mealie meal, rice, samp	daily		
	weekly		
	monthly		
	never		
6. Tinned foods eg. baked beans	daily		
	weekly		
	monthly		
	never		
7. Dairy products, milk, cheese, yoghurt	daily		
	weekly		
	monthly		
	never		
8. Legumes, eg lentils, split peas, beans	daily		
	weekly		
	monthly		
	never		

9. Vegetables, leafy green veg.	daily		
	weekly		
	monthly		
	never		
10. Other vegetables eg. potatoes, carrots, etc.	daily		
	weekly		
	monthly		
	never		
11. Fats (oil, butter, margarine, peanut butter) (inlude fat from meat)	daily		
	weekly		
	monthly		
	never		
12. Sugars(sweets, cooldrinks, cakes)	daily		
	weekly		
	monthly		
	never		
13. Fruit	daily		
	weekly		
	monthly		
	never		

14. Do you usually eat less when you are	(a) drinking	Yes 1	No 2	
	(b) smoking	Yes 1	No 2	

Comments

H. STRESS-RELATED FACTORS

During your pregnancy did you:

1. Often feel very anxious.	Yes 1	No 2	
2. Often feel depressed.	Yes 1	No 2	
3. Often feel alone.	Yes 1	No 2	
4. Often feel unable to cope.	Yes 1	No 2	
5. Have you experienced severe conflicts with anyone in your home?	Yes 1	No 2	
6. Have you suffered from any mental or physical abuse?	Yes 1	No 2	
7. Have you experienced any work-related stress e.g. heavy lifting or long periods of standing during pregnancy?	Yes 1	No 2	
8. If you have experienced any of the above, did it cause you to (a) drink more alcohol	Yes 1	No 2	
(b) smoke more	Yes 1	No 2	
(c) eat less	Yes 1	No 2	

Comments

APPENDIX B

HEALTHY CHILDBEARING STUDY
PERINATAL RECORD REVIEW
(To be completed for all participants (mother and infant/s)

Office use only

STUDY NUMBER			
INTERVIEWER CODE			
DATE OF INTERVIEW	DD MM YY		
Maternal history			
Gravida			
Para			
Term			
Preterm			
Abortions			
Miscarriages			
Maternal Gynaecologic History (Tick all that apply)			
Condoloma Accuminata	Yes 1	No 2	
Chlamydia	Yes 1	No 2	
Gonorrhea	Yes 1	No 2	
Herpes	Yes 1	No 2	
Syphilis	Yes 1	No 2	
Infertility	Yes 1	No 2	
Uterine, cervical, ovarian or tubal surgery	Yes 1	No 2	
Other, specify……			
Normal	Yes 1	No 2	
Unknown	Yes 1	No 2	
Past Pregnancy History (Tick all that apply)			
Not applicable (this is her first pregnancy)	Yes 1	No 2	
Gestational Diabetes	Yes 1	No 2	
Gestational Proteinuric Hypertension (GPH)	Yes 1	No 2	
Eclampsia (seizures or fits)	Yes 1	No 2	
LGA (birthweight more than 400 gms)	Yes 1	No 2	
Low birth weight (birthweight less than 2500 gms)	Yes 1	No 2	
Multiple gestation (twins, triplets etc.)	Yes 1	No 2	
Incompetent cervix	Yes 1	No 2	
Preterm delivery (delivered less than 37 weeks)	Yes 1	No 2	
Post term delivery (delivered more than 42 weeks)	Yes 1	No 2	
Stillbirth or intra -uterine (foetal) death (IUD)	Yes 1	No 2	
Neonatal death (infant death within 28 days of birth)	Yes 1	No 2	
Foetal alcohol syndrome (suspected or confirmed)	Yes 1	No 2	
Other Congenital anomalie, specify……..			
Other , Specify…….			
Normal	Yes 1	No 2	
Unknown	Yes 1	No 2	

Maternal Medical / Surgical History (Tick all that apply)

Chronic Hypertension (BP more than 140/90 non pregnant)	Yes 1	No 2	
Chronic Renal Disease (glomerulonephritis, chronic pyelonepritis...)	Yes 1	No 2	
Diabetes	Yes 1	No 2	
Heart Disease, class 1 (no limitation of activity)	Yes 1	No 2	
Heart Disease, class II- IV (any limitation)	Yes 1	No 2	
Haematological Disorder (hemoglobinopathy, severe anaemia Hb...)	Yes 1	No 2	
Hepatitis	Yes 1	No 2	
HIV Positive / AIDS	Yes 1	No 2	
Neurological Disorder (seizures or epilepsy)	Yes 1	No 2	
Psychological Disorder (depression, psychosis, severe stress, etc)	Yes 1	No 2	
Pulmonary Disease (asthma, etc)	Yes 1	No 2	
Tuberculosis	Yes 1	No 2	
Thyroid Disorder	Yes 1	No 2	
Urinary tract infection(urethritis, cystitis, pyelonephritis etc.)	Yes 1	No 2	
Vascular problems (varicose veins, thrombophlebitis, etc.)	Yes 1	No 2	
Other , specify……			
Normal	Yes 1	No 2	
Unknown	Yes 1	No 2	

Antenatal Course

Site of antenatal care, Name of clinic or mobile……

Date of first antenatal visit	DDMM YY	
No antenatal care (unbooked)		1
Unknown		9
Number of weeks gestation at first antenatal visit		
Date of last menstrual period	DDMMYY	
Unknown		9
Estimated date of delivery	DDMMYY	
Unknown		9
Maternal Height……..…in cm		
Unknown		9
Pre- pregnant maternal weight (in kg) ….. ……..kg		
Unknown		9
Weight at first antenatal visit ……kg		
Unknown		9
Haemoglobin at beginning of antenatal care (in gm/dl) ……gm/dl		
Unknown		9
Total number of antenatal visits		
No antenatal care		3
Unknown		9

Maternal Drug and substance use in Pregnancy (Tick all that apply)

Tobacco smoking	Yes 1	No 2	
No of cigarettes per day			
Tobacco other, specify ……			
Alcohol	Yes 1	No 2	
(I glass= 200ml) No of drinks per day			
Marijuana (dagga)	Yes 1	No 2	
Amphetamines	Yes 1	No 2	
Cocaine/ Crack	Yes 1	No 2	
Heroin/Methdone	Yes 1	No 2	
Ecstacy	Yes 1	No 2	
Intravenous drug therapy (any type)	Yes 1	No 2	
Prescription narcotics/ sedative abuse	Yes 1	No 2	
Suspected drug use	Yes 1	No 2	
Unknown	Yes 1	No 2	

Maternal Medication Prescribed in Antenatal Period (Tick all that apply)

Antibiotics	Yes 1	No 2	
Antifungals	Yes 1	No 2	
Antiemetics	Yes 1	No 2	
Antihypertensives	Yes 1	No 2	
Herbal/ traditional Medicines	Yes 1	No 2	
Minerals	Yes 1	No 2	
Vitamines	Yes 1	No 2	
Narcotics/ Sedatives	Yes 1	No 2	
Other, specify ……			
None	Yes 1	No 2	
Unknown	Yes 1	No 2	

Antenatal Problems/ Complications (Tick all that apply)

Bleeding (vagina)	Yes 1	No 2	
Placenta Praevia	Yes 1	No 2	
Placenta Abruption	Yes 1	No 2	
Anaemia (Hb < 11.0)	Yes 1	No 2	
Gestational Diabetes	Yes 1	No 2	
Gestational Proteinuric Hypertension (GPH)	Yes 1	No 2	
Eclampsia (seizures or fits)	Yes 1	No 2	
Syndromic management for STI	Yes 1	No 2	

Confirmed STI (laboratory exam) Specify……

Herpes (genital lesions)	Yes 1	No 2	
Syphilis	Yes 1	No 2	
Asymptomatic Bacteruria	Yes 1	No 2	
Urinary tract infection	Yes 1	No 2	
Pyelonephritis	Yes 1	No 2	
Influenza (URI or GI with Fever)	Yes 1	No 2	
Decreased foetal movement	Yes 1	No 2	
Foetal malpresentation (breech or transverse)	Yes 1	No 2	
Multiple gestation (twins, triplets)	Yes 1	No 2	
LGA/ Macrosomia (suspected or confirmed)	Yes 1	No 2	
SGA/ IUGR (suspected or confirmed)	Yes 1	No 2	
Post- dates (>42 weeks gestation)	Yes 1	No 2	
Intra-uterine (foetal) death (IUD)	Yes 1	No 2	
Poly hydramnios	Yes 1	No 2	
Preterm labour (regular contractions & cervical change between 20-36 weeks gestation)	Yes 1	No 2	
Psychologic distress (depression, psychosis, severe stress)	Yes 1	No 2	
Weight gain more than 5 kg by 20 weeks gestation	Yes 1	No 2	

Other, specify……..

Normal	Yes 1	No 2	
Unknown	Yes 1	No 2	

Comments

Intrapartum and Delivery Data

Delivery Date DDMMYY

Haemoglobin at delivery or third trimester (gm/dl)……

Unknown 9

Maternal weight in labour or at last ANC visit (in kg)……

Unknown 9

Labour induction Yes 1 No 2

Reasons for labour induction(choose one, primary reason)

a) Diabetes	1
b) Gestational Proteinuric Hypertension	2
c) Dysfunctional Labour	3
d) Elective	4
e) Foetal Assessment Result (NST/CST)	5
f) Post-Dates	6
g) Rupture of membranes without labour	7
h) Other, specify	8
l) Unknown	9

Medications given during Labour (tick all that apply)

a) Analgesia	Yes 1	No 2	
b) Anaesthesia: Epidural / General	Yes 1	No 2	
c) Anaesthesia: Paracervical	Yes 1	No 2	
d) Antiemetics	Yes 1	No 2	
e) Magnesium Sulphate	Yes 1	No 2	
f) Tocolytics (agents to suppress labour)	Yes 1	No 2	
g) Tranquilizers / Sedatives	Yes 1	No 2	
h) Medicinal herbs / Traditional medicines	Yes 1	No 2	
I) Other, specify……			
J) None	Yes 1	No 2	
K) Unknown	Yes 1	No 2	

Labour & Delivery Problems/ Complications (Tick all that apply)

Cord Prolapse	Yes 1	No 2	
Foetal heart rate abnormalities	Yes 1	No 2	
Foetal Malpresentation(breech or transverse)	Yes 1	No 2	
Haemorrhage	Yes 1	No 2	
SGA / IUGR (suspected or confirmed)	Yes 1	No 2	
Intrauterine (foetal) death (IUD)	Yes 1	No 2	
Gestational Proteinuric Hypertension (GPH)	Yes 1	No 2	
Eclampsia (seizures or fits)	Yes 1	No 2	
Rupture of membranes> 24hrs	Yes 1	No 2	
Meconium stained liquor	Yes 1	No 2	
Placenta abruption	Yes 1	No 2	
Placenta Preavia	Yes 1	No 2	
Pre-term (labour / delivery < 37 weeks gestation)	Yes 1	No 2	
Post-term (labour / delivery > 42 weeks gestation)	Yes 1	No 2	
Cephalo-pelvic Disproportion	Yes 1	No 2	
Temperature > 38 degree Celsius	Yes 1	No 2	
Other, specify……			
Normal	Yes 1	No 2	
Unknown	Yes 1	No 2	

Type of Delivery (Choose one)

a) NSVD	1	
b) VBAC	2	
c) Forceps	3	
d) Vacuum Extraction	4	
e) Version & Extraction for Breech	5	
f) Ceasarian Section	6	

Comments

Immediate Newborn Data

Number of infants born (if more than one complete additional newborn data sheet/s)

number of infants born			

Infant gender	Male 1	Female 2	

Weight in grams ……gms

Estimated gestational age in weeks ……wks

Immediate Newborn Complications (tick all that apply)

a) Birth Trauma	Yes 1	No 2	
b) Congenital anomalies	Yes 1	No 2	
c) Meconium aspiration	Yes 1	No 2	
d) Metabolic Problem (hypoglycaemia / hypocalcaemia	Yes 1	No 2	
e) Postmaturity Syndrome	Yes 1	No 2	
f) Premature	Yes 1	No 2	
g) Respiratory Distress	Yes 1	No 2	
h) Seizures	Yes 1	No 2	
I) Sepsis / Infection (suspected or confirmed)	Yes 1	No 2	
j) Other, specify……			
k) None	Yes 1	No 2	
l) Unknown	Yes 1	No 2	

Place where majority of immediate newborn transition and recover occurred (tick one)

a) Remained with mother	1	
b) Routine transfer/ admission to hospital nursery	2	
c) Transfer/ admission to nursery for observation	3	
d) Transfer / admission to special care / intensive care nursery	4	
e) Neonatal death	5	

Comments

Immediate newborn data- Multiple birth

Infant Number (of infants born e.g. 2nd ,3rd)

infant number			

Infant gender, choose one	Male 1	Female 2

Weight in grams .....gms

Estimated gestational age in weeks .....wks

Immediate Newborn Complications (tick all that apply)

a) Birth Trauma	Yes 1	No 2	
b) Congenital anomalies	Yes 1	No 2	
c) Meconium aspiration	Yes 1	No 2	
d) Metabolic Problem (hypoglycaemia / hypocalcaemia	Yes 1	No 2	
e) Postmaturity Syndrome	Yes 1	No 2	
f) Premature	Yes 1	No 2	
g) Respiratory Distress	Yes 1	No 2	
h) Seizures	Yes 1	No 2	
I) Sepsis / Infection (suspected or confirmed)	Yes 1	No 2	
j) Other, specify.....			
k) None	Yes 1	No 2	
l) Unknown	Yes 1	No 2	

Place where majority of immediate newborn transition and recover occurred (tick one)

a) Remained with mother	1	
b) Routine transfer/ admission to hospital nursery	2	
c) Transfer/ admission to nursery for observation	3	
d) Transfer / admission to special care / intensive care nursery	4	
e) Neonatal death	5	

Comments

APPENDIX C
WEST COAST/ WINELANDS HEALTHY CHILDBEARING STUDY
INFORMED CONSENT FORM

PURPOSE OF STUDY

The purpose of this study is to look at possible risk factors for babies being born with a low birth weight. We would like to ask you a few questions about your pregnancy, general health, nutrition, your family, work and home.

CONFIDENTIALITY

All information obtained from you, including your medical records will be kept confidential. Any reporting of data will be anonymous.

BENEFITS

There will be no direct benefits to you from this study; however the findings may help us to improve the health of newborn babies in this community. Your care here at the hospital will not be impacted if you do not want to participate in this study.

EXPECTATIONS

- A private interview about your pregnancy, health, family, work and home which will last approximately 30 minutes.
- We will review your clinic and hospital records.

CONSENT

The above study and conditions have been explained to me and my questions have been satisfactorily answered by _____ (name of interviewer).

I understand what has been explained to me and I agree to participate in this study, including an interview, a review of my medical records and to have a small amount of blood drawn from my arm.

_____ (Signature of participant)

_____ (Print name)

_____ (Date)

_____ (Witness/ interviewer signature)