NUTRITIONAL HABITS OF PREGNANT GHANAIAN WOMEN AND EFFECTS ON PREGNANCY OUTCOME.

BY

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A K N O W L E D G E M E N T

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DECLARATION

This project was conducted and presented by me at the Department of Nutrition and Food Science, University of Ghana, Legon, under the supervision of Mrs. Anna Lartey.

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DEDICATION

This work is dedicated to all institutions and organizations concerned with the prevention of maternal and infant mortality.

ABSTRACT

Reduction of infant and maternal mortality is a part of the WHO/UNICEF goals set in 1991 to be achieved by the year 2000. Maternal and infant mortality can be reduced by ensuring favourable outcome of pregnancy.

This study sought to assess the effects of nutrition and health habits of pregnant women on pregnancy outcome. A total of 502 pregnant women attending ante-natal clinics in the Greater Accra region participated in an epidemiological study, which involved a study of food habits, pica practice, alcohol intake, parity, preference for infant size at birth, ante-natal care, oedema and nausea during pregnancy. A sub-sample of 128 pregnant women participated in a longitudinal study which assessed maternal nutrient intake, height, weight gain and nutrient supplementation during pregnancy, infant birth-weight and maternal haemoglobin levels. Results showed that women who experienced nausea during pregnancy had infants of lower birth-weights. Oedema was present in about 40% of the women and this correlated with higher birth-weights.

Mothers who have had three or four previous pregnancies had infants of higher birth-weights than nulliparous

(first-delivery) mothers and those with seven or more previous pregnancies. Pregnant women who received ante-natal care in the first trimester had infants of higher birth weight than those who received it in the second or third trimesters. About 48% of the pregnant women practiced pica. Eating clay was the major form of pica among the pregnant women. It correlated negatively with maternal haemoglobin level but had no effect on infant birth weight and maternal weight-gain. The prevalence of alcohol intake among the pregnant women was 9.36%. A substantial number, 62.35%, of the subjects avoided some kind of food during the pregnancy. Majority of the women, 72.71%, did not increase their dietary intake during pregnancy. Dietary intakes were lower where nausea occurred. To avoid difficult labour, 40.60% of mothers preferred small infants, and about 10% of these mothers reduced their food intake in order to achieve this. Among the 502 pregnant women, the prevalence of low birth-weight delivery was 8.4%. In the longitudinal study, maternal weight-gain and haemoglobin levels were lower for women who experienced nausea. Maternal height was positively associated with infant birth-weight and maternal weight-gain.
The average maternal weight-gain of the 128 mothers was 10.531 ± 1.681kg.

Mothers who have had three or four previous pregnancies had higher maternal weight-gain than nulliparous mothers and those with seven or more previous pregnancies. Oedema had no significant effect on maternal weight-gain. The daily intakes of energy, and iron were lower than the recommended amounts for pregnant women. However mean protein intake met the recommended allowance. Energy and protein intakes had positive effects on infant birth-weight and maternal weight-gain. High dietary iron intake was associated with high maternal weight-gain and haemoglobin level but had no effect on infant birth weight. Mineral and vitamin supplementation during pregnancy had little effect on overall haemoglobin levels of the mothers. It however helped mothers to have infants of higher birth-weight. The mean monthly maternal haemoglobin level was 11.503 ± 0.603g/dl. (WHO standard for pregnant women: 11.0g/dl; Tomkins and Watson, 1991) From the total of 128 pregnant women, about 20% were anaemic throughout pregnancy.

Recommendations include the need for early ante-natal care for pregnant women, education against the practice of pica, intensification of mass education on good nutrition and health practices, during pregnancy and the need for more health posts to encourage ante-natal attendance.

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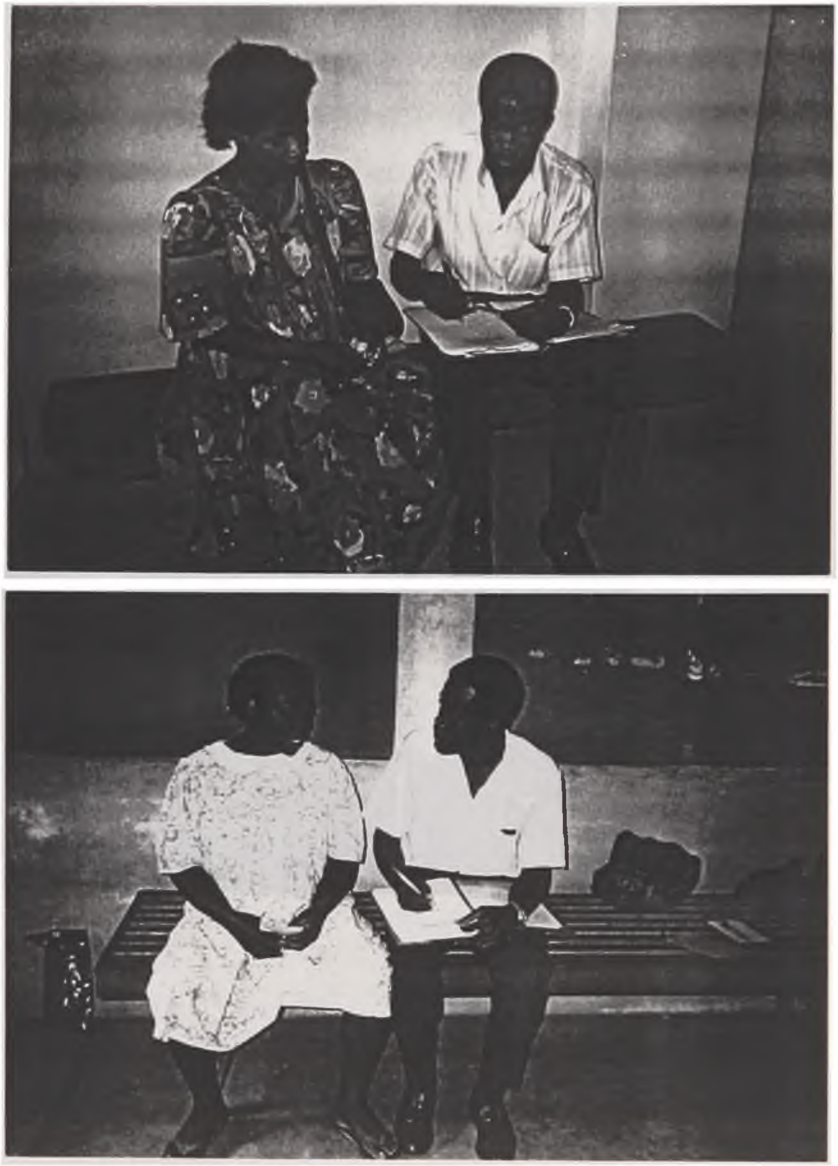


Picture 2: Interviewing pregnant women at the La Polyclinic (top) and University Hospital (down).

Picture 3: Taking the height and weight of a pregnant woman at Kaneshie Polyclinic.

CHAPTER ONE

1.1 INTRODUCTION

Like most developing countries, Ghana has a high maternal and infant mortality rate. The maternal mortality rate for Ghana is as high as 7.9 per 1000 live births (UNICEF, 1990). In a recent meeting on safe motherhood, the director of Health Services in Ghana quoted the maternal mortality rate as between five (5) and fifteen (15) per 1000 deliveries (people's Daily Graphic, January 20th,1993). Infant mortality rate is reported to be 143/1000 life-births (UNICEF,1991).

One of the major contributory factors in the genesis of maternal and infant mortality in developing countries is low nutritional status of infants and women of reproductive age.
The essential role of nutrition in the development of the human organism begins with the conception. The development of the human being begins after fertilization of the egg cell in the mother by the sperm cell from the father. The embryo resulting from fertilization is retained in the womb of the mother who nourishes it with nutrients for its proper development into a baby. The proper development of the baby will thus depend to a large extent on the mother during pregnancy. It is important that the mother be in good nutritional status prior to and during pregnancy so that the foetus is well nourished. As the pregnancy progresses, the amount of nutrients required to maintain the pregnancy progressively increases. However it is rare that pregnant women

alter their diet to suit pregnancy. This behaviour may adversely affect the course and outcome of pregnancy.

Pregnancy is accompanied by physiological changes necessary for the regulation of maternal metabolism and to prepare her for parturition and lactation. These physiological changes accompanying the pregnancy may result in nausea, leading to vomiting, loss of appetite, salivation, aversion to some nutritious foods, and ingestion of alcohol and some non-food items like clay and chalk. Oedema may also develop. If the maternal iron store is inadequate to augment the increased iron requirement in pregnancy iron deficiency anaemia may result presenting general weakness, excessive headache and dizziness. The combined effects of these discomforts can lead to unfavourable alteration in nutritional habits of the pregnant women, and may subsequently interfere with favourable pregnancy outcome. However there are some women who do not experience nausea in pregnancy. For this category of women, nutrition during pregnancy may only be affected adversely by factors other than nausea. Some of these factors include wrongful beliefs and prohibition of certain nutritious foods during pregnancy, family size, alcohol intake, tobacco smoking and low socio-economic status of some women. Of the factors which affect nutrition in pregnancy, it is nausea which is brought about by the direct effect of the pregnancy itself. Unfortunately this has not been widely investigated especially in Ghana.

Nutrition during pregnancy may further be hampered because certain group of pregnant women believe that if they practise good nutrition their infants will be too big and pose labour problems especially obstructed labour or caesarian operation (Garner and Kramer, 1992). The possible existence of this notion in Ghana needs verification.

Mineral and Vitamin supplements are administered to pregnant women to augment the insufficient intakes and increased requirements of these nutrients during pregnancy. In most cases essential mineral elements administered to pregnant women at ante-natal clinics include iron and calcium. The vitamins commonly administered include folic acid, Vitamin B_6, Vitamin B_{12}, retinol, Vitamin D, Vitamin E, ascorbic acid, thiamine, riboflavin and Niacin. Appropriate amounts of these minerals and vitamins are contained in capsules or tablets formulated for this purpose (Appendix 2). Iron tablets mostly administered with vitamin B-complex or multivites were fergon and fersolate. Multivitamin and mineral supplements widely used for supplementation at the ante-natal clinics are vitafol, unicap M, neovita, dynavite, and forceval. Pregnant women are given these supplements on their first attendance at the ante-natal clinic and they continue to take daily doses of these supplements until delivery.Thus pregnant women who seek ante-natal care earlier will be on the nutrient supplement for longer period than those who delay in seeking ante-natal care.

The effect of iron and vitamin supplementation is exhibited as increased levels of haemoglobin in the blood. Therefore haemoglobin levels of pregnant women have been used as good indicator for effectiveness of supplementation. Haemoglobin level of pregnant women is monitored regularly and mostly monthly in most ante-natal clinics to prevent nutritional anaemia in pregnancy. Ensuring optimum levels of nutrition, circulating red blood cells and haemoglobin level will normally contribute to favourable outcome of pregnancy by ensuring good health of the woman and normal foetal development. A study of the characteristics of pregnant women and the factors which contribute to unfavourable outcome of pregnancy will assist in our endeavours to alleviate maternal and infant mortality.

1.2 RATIONALE.

The first world summit for children on September 30th, 1990, set among other goals to be achieved by the year 2000, a 50% reduction of both maternal mortality and child malnutrition (UNICEF, 1991). A UNICEF report in 1991, on the state of the world's children, stated that every year, an estimated half a million women die of causes related to pregnancy and child birth, and their deaths leave one million children motherless. A recent World Bank report indicated that thousand (1000) women over the world die every day from child birth (Ghana Broadcasting Corporation news,May 8th, 1994). These facts and recent frantic efforts being made by the Ministry of Health (MOH) in Ghana to ensure safe motherhood are testimonies of the fact that research is needed in this area (People's Daily Graphic, January 20th, 1993). Encouragement is taken from the idea that some of the causes of maternal deaths in Ghana, notably infections, anaemia, cardiovascular and respiratory disease, tetanus, Meningitis, hepatic failure and haemorrhage are preventable and nutrition related. It is imperative therefore that the nutritional and health habits of women during pregnancy be studied in the attempt to ameliorate the menace of high maternal and child mortality and morbidity. There is little data on nutrition during pregnancy, obstetric behaviour, as well as general information on Ghanaian pregnant women.

1.3 OBJECTIVES OF STUDY

Overall Objectives

The main objective of this study was to investigate the nutritional and health habits of pregnant women and their effects on maternal nutritional status and pregnancy outcome.

Specific Objectives

The specific objectives of this study were as follows:

1. To investigate women's dietary habits in pregnancy and the possible effects of these on pregnancy outcome.
2. To study the effects of geophagia, alcohol intake and other habits on pregnancy outcome, weight-gain and haemoglobin levels during pregnancy.
3. To assess the dietary nutrient intake of pregnant women and its effects on pregnancy outcome, pregnancy weight-gain, and haemoglobin level.
4. To study the effects of nausea and oedema on weight-gain and haemoglobin level during pregnancy and on pregnancy outcome.
5. To assess the effectiveness of mineral and vitamin supplementation during pregnancy.

CHAPTER TWO

LITERATURE REVIEW

2.1 Nutrition and Human Reproduction

The relationship of nutrition with human reproduction has been established mainly from large scale observations and in crisis situations like war and famine (since ethical, moral, and legal limitations of investigating the human subject are compounded by the need to consider the interests of the child, its father as well as the mother (Goodhart and Shils,1989). The general evidence indicates that good nutrition is necessary for efficient human reproduction. Perhaps the most dramatic observations are those made in Great Britain during World War II. Under the food-rationing policy, pregnant women were given special priority, and the quality of diets of pregnant women, especially those in the low-income groups, were significantly enhanced. Between 1939 and 1945, that is the time of war, the stillbirth rate fell from a previously rather stable rate of 38 per 1000 live births to 28, a fall of about 25% during a period when many aspects of the physical environment were deteriorating (Food and Nutrition Board, 1971).

Famine during any part of pregnancy long enough to deplete maternal nutrient reserves has been shown to reduce birth-weight, increase perinatal complications, and mortality of both mother and infant. However, depletion of maternal nutrient stores during the first two-thirds of pregnancy may be compensated for by adequate nutrition during the third trimester (Stein *et al,* 1975). It is generally recognised that in populations where chronic undernutrition is common, low birth-weight deliveries, poor growth and development and even death in infancy are prevalent (Food and Nutrition Bulletin, 1984). Bagchi and Bose (1976) found that infants born to poorly nourished mothers in Calcutta weighed on the average 181g less than those born to well-nourished mothers. In industrialized countries where there is an abundance of high quality food, and adequate health care, the mean birth-weight is about 3,300g as compared to between 2,700g to 3,000g in developing countries where chronic maternal malnutrition is prevalent (Food and Nutrition Board, 1971). In Ghana, the reported mean birth-weight for prosperous groups is 3,188g as compared to 2,879 for the general population (WHO, 1971) (Table 1).

Table 1: Mean Birth-weight According to Socio-economic Status of Women in Various Communities

Place	Subjects	Mean Birth-weights (g)
Madras (India)	Well-to-do	2,985
		2,736
	Wealthy	3,182
South India	Poor	2,810
	Upper class	3,247
Bombay (India)	Upper Middle class	2,945
	Lower middle class	2,796
	Lower class	2,578
	Paying patients	2,851
Calcutta (India)	Poor class	2,656
	Very well nourished	3,026
Congo	Well nourished	2,965
	Badly nourished	2,850
	Prosperous	3,188
Ghana	General population	2,897
	Well-to-do	3,022
Indonesia	Poor	2,816

Source: Food and Nutrition Board, (NRC), U.S.A. 1971.

It is possible that women from prosperous families have better nutritional history and hence adequate nutrient stores prior to pregnancy. This fact in addition to optimum growth of such individuals contributes to efficient reproductive performance. Shah

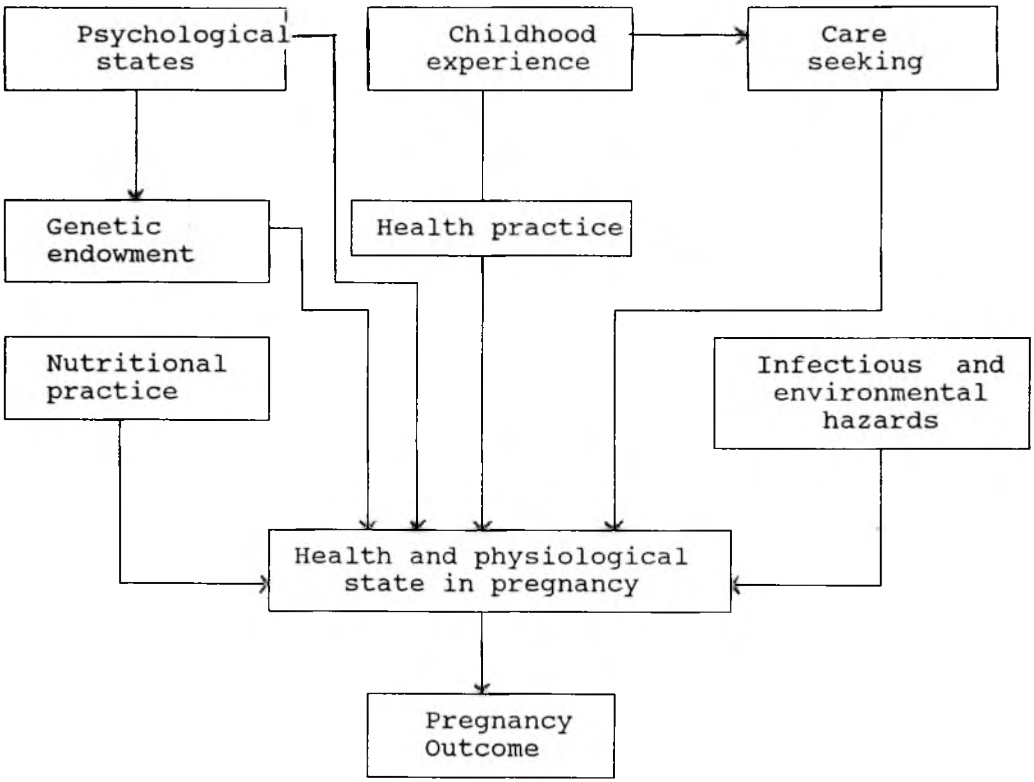
(1981) observed that among the many environmental factors taken into consideration, maternal nutrition had a significant relationship to birth-weight, maternal weight prior to the pregnancy being the determining factor affecting foetal nutrition. In this report, Shah found that the birth-weight of the infants whose mothers weighed 38kg or less before pregnancy were significantly lower than those of new-born infants whose mothers weighed over 41kg (Shah, 1981).

Protein nutritional status has been shown to have a direct effect on the birth-weight of infants. Mothers with low levels of total circulating protein and albumin mass, frequently deliver low-birth-weight babies (Durate, 1974).

Experimental undernutrition in pregnant mammals of some other species resulted in foetal growth retardation and alteration in cell size or number which depended upon the timing of the nutritional deficiency (Wallace, 1948). Rosso (1974) restricted the dietary protein of pregnant rats and observed a reduction in the transfer of the amino acid analogue α-aminoisobutyric acid (AIB) from maternal blood to foetus. It has also been reported that foetuses of fasting pregnant sheep have a 50% reduction in umbilical uptake of glucose, a reduced metabolic rate and a fall in blood glucose level (Boyd and Morris, 1973).

The role of nutrition in human reproduction is enormous. However other factors like genetic endowment, biological, social and psychological state contribute to the outcome of pregnancy (figure 1).

Figure 1: Theoretical Model of Factors Affecting Women's Physiological State and Pregnancy Outcome.



(Source: Food and Nutrition Board, NRC, U.S.A. 1971)

2.2 Nutrient Supplementation in Pregnancy

A number of studies have demonstrated that nutrient supplementation during pregnancy is beneficial to human reproduction. In a study by Viegas et al in 1982, twelve supplemented undernourished women who received protein, energy and vitamin supplements had significantly heavier babies than thirty-one undernourished mothers who received either vitamin and energy supplements or vitamins alone. In this study it appeared that protein had a positive effect on birth-weight. However Rush (1989) has recently reviewed supplementation studies and comments that higher protein content supplements in well nourished women were associated with lower birth-weight among those who were supplemented, whereas lower protein density supplements (under 20% of calories as protein) were uniformly associated with higher mean birth-weight among the supplemented. Atton and Watson (1990) studied 205 Asian women and found that protein and calorie supplementation did not have significant effect on birth-weight of these Asians. In a study in India in which poor women were fed an additional 500 Kcal and 10g of protein, raising their daily intake to 2,500 Kcal and 60g of protein during the last four weeks of pregnancy, an extra weight of 1.5kg was gained as compared to a control group of women (Iyangar, 1974). In this study the birth-weight of babies of the group receiving the extra calories and protein were 300g higher than those of the controls. In another study in five villages in south India, Pregnant women receiving Applied Nutrition Programme (ANP) supplements of 2114 Kcal and 51g of protein on an average gained during pregnancy 1.54kg more than did the women in another group of villages not receiving ANP supplements. Studies in Bogota (Mora et al, 1979) and New York city (Rush et al, 1980) showed that supplements were associated with increased weight-gain.

A study in Guatemala showed that birth-weight increased progressively as dietary intake increased, the risk of low birth-weight was about half that in minimally supplemented mothers (Shah, 1981). In this study it was found that the caloric intake was a more important factor than increased protein intake in improving the infant birth-weight. However investigations in Montreal (Rush et al, 1980) and Taiwan (Blackwell et al, 1973) were not consistent with these results. It seems that in mothers who are either severely malnourished or in a state of acute starvation, supplementation has positive effect on birth-weight and pregnancy weight-gain. In the Gambia, although nutrient supplementation of women in moderately negative energy imbalance had a beneficial effect on birth-weight, when the same women were in positive energy balance, supplementation had no effect (Prentice et al, 1983). Extensive supplementation studies in East Java (Kardjati et al, 1988) concluded that a positive effect of energy supplementation on birth-weight was restricted to the group of pregnant women with the lowest home dietary intake and/or a low pre-pregnant weight. Panth et al (1990), found no effect of vitamin A supplementation on birth-weight, however maternal plasma vitamin A level increased significantly in the third trimester. In this study it was found that vitamin A supplementation enhanced maternal haemoglobin level. Most women in developing countries are undernourished and therefore there is the need for nutrient supplementation during pregnancy.

Most of the minerals and vitamins supplemented are expected to augment haematopoietic need for these nutrients because of the increased erythropoiesis due to expanding plasma volume and obligatory placental transfer of these nutrients (Serge and Galan, 1986),

Extra nutrients are needed during pregnancy. In some cases the level of nutrient required cannot be met by food intake, especially iron and calcium. The WHO Expert committee on Maternal and Child Health has set daily nutrient requirement for adult pregnant and non-pregnant woman to ensure adequate nutrient intake during pregnancy (Appendix 3).

2.3: Energy Need During Pregnancy

For a typical pregnancy weight-gain of about 12.5kg and a median infant birth-weight of 3.3kg, the average extra energy cost of pregnancy has been calculated to be about 335MJ (80.000 kcal) over the nine-month period (FAO/WHO, 1985). This amount of energy is distributed as an extra 630KJ (150Kcal)/day during the first trimester and 1465KJ (350kcal)/day during the second and third trimesters (FAO/WHO, 1985). A cautious policy was adopted so that an amount of energy allowance of 285kcal/day if healthy women reduce their activities during pregnancy (James and Schofield, 1990). However extensive studies on energy metabolism in pregnancy showed that the expected increase in intake of 200 or 285kcal does not occur (James and Schofield, 1990). Measurement of basal metabolic rate (BMR) show modest increase in late pregnancy with a reduction in the metabolic response to food.

Reported studies have indicated that even in women who do not take in commensurate amount of energy, enough fat is deposited to provide reserve needed for subsequent lactation, and the foetal and maternal tissues grow satisfactorily (FAO/WHO, 1985).

The reason is explained by some (Blackburn, 1974, Banejee and Shah, 1971) but not all (Nagy, 1983) studies of well nourished pregnant women that maternal physical activity is reduced to conserve energy during pregnancy. For instance, slowing of self-paced work, example in climbing stairs, is common, so that the energy expended per unit time is maintained at approximately the same level as in the non-pregnant state. On this basis it has been suggested (FAO/WHO/UNU, 1990) that a modest increase in intake of 100kcal per day might have been barely detectable but would have covered the observed increase in BMR (James and Schofield, 1990).

On this basis the FAO/WHO Consultative group agreed on three values as follows:

a) Pregnancy requirement; 100kcal/day.

b) Pregnancy sedentary allowance; 200kcal/day.

c) Pregnancy active allowance; 285kcal/day (James and Schofield, 1990).

The energy intake of pregnant women in different communities is reported to be variable with pregnant women in developing countries having lower energy intake than those in developed countries (Tables 2 and 3).

Table 2: Reported Energy Intakes of Poorly Nourished Childbearing Women.

Country	Energy Intake (Kcal/day)
New Guinea	1,360
India	1,400/1,410
Guatemala	1,500/2,060
Ethiopia	1,540
Colombia	1,620
The Gambia	1,350/1,60/1,700
Tanzania	1,850
Iraq	1,880
Thailand	1,980

Source: Goodhart and Shils, 1989.

Table 3: Energy Intakes of Pregnant Women from Industrialized Countries

Country	Energy Intake (kcal/day
Scotland	2,503
Australia	2,090
Sweden	2,154
United Kingdom	2,152
United Kingdom (Cambridge)	1,980

Source: Goodhart and Shils, 1989.

2.4: Protein Need During Pregnancy

The total protein requirement of a woman gaining 12.5kg of extra weight during pregnancy and delivering 3.3kg infant has been estimated to be 47g per day (FAO/WHO, 1985) throughout pregnancy. The rate of storage is not constant. Estimates provided for the first, second, third and fourth quarters are respectively, 0.64, 1.84, 4.76 and 6.10g of protein per day (FAO/WHO, 1985). Thus it is estimated that the protein requirement should be increased by an average of 6g per day throughout pregnancy. These amounts should be added to the non-pregnancy allowance (41g per day) and the sum corrected for digestibility (FAO/WHO, 1985).

2.5: **Iron Need in Pregnancy**

Iron need during pregnancy cannot be met through dietary iron intake. It is thus recommended that iron supplementation during pregnancy must not be limited to women in whom anaemia has been identified (Tomkins and Watson, 1991). Nonetheless, diets can increase iron status in three main ways;

a) by increasing the intake of haem iron (from animal products)

b) by increasing the intake of Vitamin C, along with foods promoting iron absorption example, acidic and fermented foods.

c) by reducing the intake of iron absorption inhibitors, example; in coffee, tea, some cereals.

Such dietary modifications in addition to allowing cultural constraints especially concerning animal products provide a potential solution to reducing iron deficiency anaemia.

2.5.1 Dosage of Iron

In a well- nourished 55-kg woman, on average haemoglobin, iron status increase by about 500mg and the total iron need during a normal pregnancy is about 1,000mg (FAO/WHO,1988).

For prevention of iron deficiency anaemia in pregnant and lactating women, 60mg elemental iron (200mg ferrous sulphate, often with 250mcg folate) per day (1 tablet) for four months is recommended in areas where iron deficiency anaemia is of low prevalence. In areas of higher prevalence, 2 tablets i.e. 400mg ferrous sulphate per day is recommended (Tomkins and

Watson, 1991).

The iron dose for treatment of anaemia depends on the degree of the anaemia. For severe anaemia, (Hb < 7g/dl) in pregnant and lactating women, 60mg elemental iron (200mg ferrous sulphate) three times daily is recommended; twice daily for mild-moderate anaemia (Tomkins and Watson, 1991).

2.6 Nutrition and Safe Labour

During pregnancy, a number of health intervention measures are taken with the aim of ensuring favourable outcome of pregnancy. Some of the health measures include immunization against tetanus infection (UNICEF, 1991), supplementation of mineral and vitamin intakes and advice on good health and nutritional practices during pregnancy. These measures lead to adequate weight-gain and also increased foetal size and hence increased birth-weight, but their effects on pregnancy outcome and labour need careful examination. If the effect of such interventions operate across the range of birth-weight distribution, one of the effects might be to increase the likelihood of difficult labour resulting from cephalopelvic disproportion. The trend towards slightly larger infants has been accompanied by increased use of caesarian delivery in developed countries (Garner and Kramer, 1990). In places where obstetric services are not available, obstructed labour can be a major cause of maternal death. Due to economic loss, health risks and death associated with cephalopelvic disproportions leading to caesarian deliveries, women in localities where obstetric services are limited, may avoid doing anything that could increase the size of their babies and the consequent risk of difficulties during childbirth (Garner and Kramer, 1990).

In Ghana only 40% of births are attended to by trained personnel (UNICEF, 1991) and such an attitude cannot be ruled out.

2.7 Infant Birth-weight

Birth-weight has been used as a good indicator of pregnancy outcome. Small babies are considered unfavourable outcome of pregnancy because they contribute to early infant mortality and as a group have a high incidence of subsequent physical and behavioural abnormalities (Silverman, 1970). The term "low birth-weight" is applied to all infants who weigh 2.5kg or less at birth (WHO, 1971). Two groups of small babies are commonly found. There are the low birth-weight but full-term group and those whose low birth-weight result from the early onset of labour (Gruewald, 1971). Those in the first group are described as the small-for-date category. These are gestationally mature, but their rate of foetal growth has been retarded. The word pre-term has been suggested for infants born before 37 weeks gestation, while those born before 28 weeks of gestation are described as premature (Yerushalmy and Berge, 1970). There are some babies who weigh far in excess of the normal range. Macrosomia has been used to describe babies weighing over 4.0kg (Garner and Kramer, 1992). Babies of high birth-weight increase the risk of mechanical difficulties during labour.

Birth-weight is affected by various factors. Pre-pregnancy weight and height of the woman as well as nutrition and weight-gained during pregnancy are some of the known factors that affect birth-weight. Within the small-for-date category, there are the intrauterine undernourished infants, some of whom have congenital malformations, foetal rubella infection, and probably other foetal infections. Other causes of small-for-date infants are maternal complications such as toxaemia of pregnancy, multiple pregnancy, and prolonged pregnancy (Silverman, 1970). Acceptable birth-weight is an indication of favourable outcome of pregnancy

2.8: Maternal Physiological Adjustment During Pregnancy.

2.8.1: Pregnancy Weight-gain.

Pregnancy is associated with physiological adjustments and synthesis of maternal tissues including the growth of the foetus itself. These changes lead to increase in weight of the pregnant woman. A strongly positive association exists with the weight of the infant. However the size and importance of its effect differs according to the condition of the woman entering pregnancy and reflects an interaction of weight-gain during pregnancy, pregnancy size and body composition (Food and Nutrition Bulletin, 1984).

An average well nourished Scottish woman is estimated to gain 12.5kg during pregnancy. However, there are extreme variations in ante-natal weight-gain, from a reported average of 11.70kg and 17.0kg in the United Kingdom and the United

States respectively to an observed weight-gain of 5.30kg in primiparae and 6.30kg in multiparae in South India (Shah, 1981) (Appendix 4). In Sri Lanka and Ethiopia, it was similarly observed that a large proportion of the women gained only 6.5kg during pregnancy, whereas in a Gambian village, it was found that the total weight-gained by pregnant women varied from 2.70 to 5.50kg according to the season when the birth took place (Thomson, 1970). Data on pregnancy weight-gain in Ghana is currently very scarce .

Thomson and Billewcz (1970) reported that in the absence of hypertensive complications the total weight-gained during pregnancy was about 12.5kg, with an average rate of gain of slightly less than 0.5kg per week during the second half of pregnancy. This rate of gain is also that which was associated with the lowest overall incidence of pre-eclampsia, prematurity (low birth-weight), and perinatal mortality, and therefore seems suitable for adoption as a physiological norm and the basis for further calculations (Food and Nutrition Board, 1971). On the average most women gain weight progressively in pregnancy (Table 4).

Table 4: Maternal Weight Changes during pregnancy of women from industrialized countries.

Age of pregnancy (weeks)	Additional Weight-gained (kg)
10	0.65
20	4.00
30	8.50
Term (36-40)	12.5

Source: Food and Nutrition Board, 1971.

It has been observed that young women tend to gain slightly more weight than older women, primigravidas slightly more than multigravidas, and thin women slightly more than fat women, but the differences are small (Food and Nutrition Board, 1971).

The extent of weight-gained during pregnancy is affected by a number of factors, especially energy and nutrient intake, pre-pregnancy weight and height of the woman as well as physical activity during pregnancy. Women submitted to heavy workload during pregnancy do not gain much weight and are more likely to deliver small babies (Tafari and Naeye, 1980). Pregnancy weight-gain and pregnancy outcome (birth-weight) improve if a woman maintains energy balance by reducing physical work to counter balance reduced dietary energy intake (Food and Nutrition Bulletin, 1984).

2.8.2 Oedema in Pregnancy

Swelling of the feet, hands and face during pregnancy is common in some women. When the swelling is in other sites in addition to the lower limbs it is said to be a generalized oedema. Not all pregnant women develop oedema, but those who do are reported to deliver larger babies than those who do not develop oedema (Thomson and Billewcz, 1970). Oedema in pregnancy has been studied from epidemiological standpoint by Thomson and Billewcz (1970) who found that the frequency of recorded oedema is remarkably high about 40%, even in patients who showed no other sign of pre-eclampsia. About one-third of such normal patients showed generalized oedema, that is, in sites other than the lower limbs. The incidence was little affected by parity or by maternal age and stature, but increased steeply with maternal weight for height. Women with oedema had slightly larger babies than those with no oedema, and had reduced rates of prematurity. In the absence of pre-eclampsia, oedema is not unphysiological (Thomson and Billewcz, 1970). It has been reported by Hytten and Chamberlain (1980) that women with no oedema gained at term, water surplus of about 1 or 2 litres while women with oedema gained water surplus of about 5 litres. The presence of hand and facial oedema was used as a proxy for adequate blood volume expansion in the Collaborative Perinatal Project in the United States (Hytten and Chamberlain, 1980). In their study, hand and facial oedema positively correlated with blood volume expansion. When pregnancy weight-gains were low, perinatal mortality rates were lower if hand or facial oedema were present than if they were absent (Food and Nutrition Bulletin, 1984). This suggests that at least in thin women, blood volume expansion may reduce perinatal mortality rates (Hytten and Chamberlain, 1980).

Though oedema is a common feature of normal pregnancy, little is known about its nature and origin. Oedema of the lower limbs is probably mainly attributable to mechanical and hydrostatic pressure on the venous loose interstitial water, similar in composition to an ultrafiltrate of plasma (Food and Nutrition Board, 1971).

2.8.3 Anaemia In Pregnancy

Haemoglobin production requires adequate supply of proteins to furnish essential amino acids in addition to folic acid, Vitamin B_6 and Vitamin B_{12}. These vitamins serve as co-factors in the synthesis of haem and globin. Essential minerals like iron, copper and zinc must also be available during blood cell production (DeMaeyer, 1989). Inadequate intakes of these nutrients will ultimately precipitate anaemia.

Anaemia is usually defined as a significant reduction in the concentration of haemoglobin per 100ml of blood, in the volume of packed red cells per 100ml of blood, or in the number of erythrocytes per cubic millimetre of blood (DeMaeyer, 1989). In pregnancy, anaemia is said to exist if the pregnant woman's haemoglobin concentration is less than 11.0g/dl of blood (Tomkins and Watson, 1991). This value is the cut-off point for anaemia diagnosis in pregnant females as compared to 12.og/dl for non-pregnant females (Tables 5 and 6).

Table 5: **Haemoglobin Levels Indicative of Anaemia in Populations Living at sea level.**

Age/Sex group	Haemoglobin level (g/dl)
Children	
6 months - 5 years	< 11
6 - 14 years	< 12
Adult males	< 13
Adult females	
non-pregnant	< 12
pregnant	< 11

Source: Tomkins and Watson, 1991.

Table 6: Interpretative Guide for Anaemia Diagnosis.

Grade	Haemoglobin level (g/dl)
Mild	Above 10
Moderate	7 - 10
Severe	below 7

Source: Tomkins and Watson, 1991.

Pregnancy imposes a substantial burden on the maternal haematopoietic system because of the need for augmented erythropoiesis in the face of an expanding plasma volume and obligatory placental transfer of the two most important micro-nutrients involved, iron and folic acid. This is a major cause of anaemia during pregnancy (Serge and Galan, 1986). Other important causes of anaemia in deprived pregnant mothers are:

a) Increased blood loss due to systemic infection including malaria, bacterial and viral infections, or intestinal parasitism notably, hookworm and round worm infestation;

b) Increased iron requirements for foetal growth;

c) Dietary iron deficiency due either to insufficiency of iron in the diet or low physiological availability;

d) Inability of women with initially depleted iron stores to make up for blood loss during previous child births because pregnancies are too close to each other (Shah, 1981).

In tropical context other causes of anaemia like inflammatory syndrome and sickle cell anaemia are possible (Serge and Galan, 1986).

In Ghana data showed that 69% of women tested at ante-natal clinics in 1987 were anaemic by World Health Organization (WHO) standards, ie. haemoglobin level below 11.0g/dl (UNICEF, 1990). In a study at Korle-Bu Teaching Hospital in 1973, on 1098 pregnant women, 63.7% were found to be anaemic. A 1986 survey found majority of women in Ashanti Region to be anaemic (UNICEF, 1990). Ministry of Health (MOH) Nutritional surveys in 1986 and 1988 also found greater percentages of women in Volta and Northern regions to be anaemic when compared with other regions (UNICEF, 1990). Data from seven regions in 1991 from MOH found the highest incidence of anaemia, among 492 pregnant or lactating women, in the Central region (58.3%), followed by Eastern region (49.3%) and Northern region (44.2%). The number of lactating women who were anaemic was about twice that of pregnant women in this data (Asibey-Berko, 1991).

A WHO report on Maternal Health and Safe motherhood (1992) stated that 56% of women in West Africa have haemoglobin levels below normal, and 64% of Ghanaian women have haemoglobin levels below normal and of this 11% had haemoglobin level below 10g/dl (W.H.O, 1992).

It is estimated that 1.3 billion people suffer from anaemia worldwide of which most is due to iron deficiency (Tomkins and Watson, 1991). The frequency of iron deficiency anaemia is more than 50% among pregnant women and pre-school children in many communities. In developing countries, severe anaemia can be an associated cause of 50% and the main cause in up to 20% of maternal deaths (Tomkins and Watson, 1991).

Investigations in different parts of the developing world have indicated high rates of anaemia among pregnant groups. For instance 21% in Thailand, and 48% in many areas of South America (Ousa and Amatayakul, 1975). In Liberia, Jackson and Jackson found 78% of pregnant women anaemic by WHO standards (Jackson and Jackson, 1987). An exception to this tendency in deprived populations seems to be Ethiopia where studies have demonstrated a rarity not only of true anaemia but also of physiological anaemia of pregnancy, irrespective of the socio-economic groups and parity. This has been attributed to their lifelong exposure to a very high iron intake combined with the hypoxia due to high altitude (Shah, 1981).

Maternal anaemia results in intrauterine growth retardation, low birth-weight and increased perinatal mortality and iron deficiency in infancy and childhood is associated with apathy, inactivity and significant loss of cognitive abilities (Tomkins and Watson, 1991).

2.8.4 Blood-Volume and Composition during Pregnancy

The volume of plasma begins to increase at about the end of the third month of pregnancy, and a maximum increase of about 1250 - 1500ml is reached by about the thirty-fourth week, after which there is slight fall of about 200ml towards term (Food and Nutrition Board, 1971). This rise represents about 50% of the average nonpregnant plasma volume but it is not related to the initial size, so that reference to the increase in terms of percentage rise is not meaningful. In a study where careful attention was paid to the selection of normal subjects, the range of increase was from 630 to 1940ml and was related to foetal size (Hytten and Chamberlain, 1980). The increase is regarded as an adjustment that allows the pregnant woman to expand blood flow to her uterus without reducing blood flow to other vital organs (Rosso, 1981).

During pregnancy, red cell volume increases, probably linearly, from about the end of the first trimester of pregnancy until term. In women who do not take medicinal iron it averages about 250ml. Where iron is given, the average rise is nearer 400ml (Hytten and Thompson, 1970). The normal physiological rise in red cell volume is reported to be about 18% of the average nonpregnant red cell volume (DeMaeyer, 1989).

In pregnancy, there is more rapid red cell production and more young cells are found in the circulation. The amount of haemoglobin in the red cells does not change so that the increase in circulating haemoglobin in pregnancy amounts to about 85g at term (Pritchard et al, 1975).

The increase in total red cell volume during pregnancy is proportionately less than the increase in plasma volume. As a result, the concentration of haemoglobin in the blood falls.

Haemoglobin concentration has shown a fall from an average of about 13.5 - 14.0g/dl in nonpregnant women to between 11.0 and 12.0g/dl in late pregnancy. The fall may be modified slightly, but not prevented, by giving therapeutic iron (Morgan, 1970).

The reduced concentration of red cell and haemoglobin is often referred to as the physiological anaemia of pregnancy and may be evidence of a true iron-deficiency state (DeMaeyer, 1989).

There is a rise in the concentration of leukocytes in pregnancy. In a study, Andrews et al (1972) found a rise from about 700 per cubic millimetre to 10,500 per cubic millimetre of blood. This increase might explain the higher "phagocytic index," a more rapid clearance of particles from the blood, found for pregnant females.

2.8.5 **Plasma Composition in Pregnancy**

Total protein concentration falls dramatically in pregnancy. There is a steep fall in the first trimester from 7g per 100ml of plasma to a level of between 5.5 and 6.0g per 100ml that is maintained for the remaining period of the pregnancy (Food and Nutrition Board, 1971). The fall in total protein is largely by albumin, which falls in early pregnancy from 4g per 100ml to between 2.5 and 3g per 100ml. The other protein fractions behave differently. The concentration of the α-globulin fractions rises slightly while ß-globulin rises conspicuously. The fall in protein concentration would be expected to have a considerable effect on plasma osmotic pressure, the sudden reduction of which may explain the dramatic rise in glomerular filtration rate that occurs in early pregnancy (Food and Nutrition Board, 1971).

Fibrinogen concentration rises considerably throughout pregnancy and is accompanied by a decrease in plasma fibrinolytic activity (Biezenski and Moore, 1973). Taken together with an increase in blood platelet concentration, these changes may indicate a protective mechanism against haemorrhage, but there is little evidence that intravascular clotting becomes more common in pregnancy.

The concentration of most plasma lipids rise during pregnancy. Cholesterol rises progressively from under 200mg per 100ml to between 250 and 300mg per 100ml (De Avarez et al, 1972). Total phospholipid concentration also rises, maintaining the non -pregnancy ratio between phospholipid and cholesterol (Svanborg and Zuckerman, 1976).

The concentration of free, or nonesterified, fatty acids also rises markedly, from around 800μeq/litre before pregnancy to as much as 1300μeq/litre in late pregnancy (Burt, 1970).
There are increased amounts of many enzymes in the blood during pregnancy. Serum alkaline phosphatase may rise to three or four times its usual concentration, and the rise is due to a specific alkaline phosphatase elaborated by the placenta (Sadovsky and Zuckerman, 1975). Large increases have also been described for cysteine and leucine aminopeptidases, glutamic oxaloacetic transaminase, and lactic dehydrogenase. An exception is the

notable fall in serum cholinesterase during pregnancy (Food and Nutrition Board, 1971).

2.8.6 **Cardiovascular Dynamics in Pregnancy**

During pregnancy the cardiac output rises from a nonpregnant mean of 4.5 to 5.0 litres per minute, to a plateau some 1.5 litres per minute higher, probably within the first trimester and certainly within the first half of pregnancy (Walters et al, 1976). This level of between 6.0 and 7.0 litres per minute is maintained until late pregnancy. The increase in cardiac output is brought about by both an increased heart rate and a larger stroke volume. The pulse rate rises progressively throughout pregnancy by at least 15 per minute. A careful study by Schwarz (1974) suggested that the rise might be as high as 20 per minute.

There are blood pressure changes in pregnancy. In general, the systolic pressure in the arteries tends to be a little below the nonpregnant average but rises to the usual level in late pregnancy. Arterial diastolic pressure is conspicuously lower than the nonpregnant level throughout most of pregnancy, so that pulse pressure is consistently raised. Diastolic pressure returns towards nonpregnant levels during the last 2 or 3 months of pregnancy (Burwell and Metcalfe, 1970). Since cardiac output is raised in pregnancy and blood pressure is not, it follows that resistance to flow, the peripheral resistance, is decreased.

In contrast to arterial blood pressure there are clear changes in venous blood pressure. In the upper part of the body pressures are ordinarily unaltered. In the lower limbs, there is a progressive rise in venous pressure during pregnancy and an associated slowing of blood flow. High venous pressure in the legs, possibly helped by the reduced plasma osmotic pressure, probably accounts for the commonness of lower limb oedema in normal pregnancy (Burwell and Metcalfe, 1970).

It is usually observed in pregnancy that the heart of the pregnant mother enlarges and is pushed upward and rotated forward by the diaphragm. These changes produce a characteristic clinical and radiological picture (Burwell and Metcalfe, 1970).

2.8.7 Respiratory Function During Pregnancy

Changes in the anatomy of the chest occur during pregnancy. The subcostal angle increases, the lower ribs flare, and the transverse diameter of the chest increases. At the same time and long before there can be any question of displacement by the uterus, the level of the diaphragm rises by as much as 4cm (Food and Nutrition Board, 1971). In pregnancy, breathing at all stages is more diaphragmatic and less costal than in nonpregnant women (Food and Nutrition Board, 1971).

The rate of ventilation of the lungs rises progressively throughout pregnancy from about 7 litres per minute to about 10 litres per minute, an increase of more than 40%. Vital capacity of the lungs is not affected by the pregnancy but there is a rearrangement of its components. The increase in tidal volume is at the expense of the expiratory reserve volume, the lung is more collapsed than usual at the end of normal expiration.

The residual volume is also reduced, so that the functional residual capacity is considerably smaller. The important consequences are that the increased tidal volume of air is now taken into a smaller residual volume of gas in the lungs, giving much more efficient gas mixing. It is estimated that alveolar ventilation increases by about 65% (Hytten and Thompson, 1970). As a result of this increased ventilation, the partial pressure of carbon dioxide (pCO_2) in the lung falls. The reduced pCO_2 may contribute to the common symptom of dyspnea in pregnancy (Hytten and Thompson, 1970). The sensation of dyspnea, a conscious need to breathe, is experienced at rest but not on moving about during pregnancy.

2.8.8 <u>Total Body Water During Pregnancy</u>

By means of hydrogen isotopes Hytten and Thompson (1970), have estimated with reasonable accuracy the change in volume of total body water during pregnancy. In their series of studies Hytten and Thompson (1970) estimated the overall mean gain of body water during pregnancy to be 8.5 litres. In this study women showing no evidence of clinical oedema gained, on average 6.84 litres; those with oedema of the legs, 7.19 litres; and those with generalized oedema, 9.80 litres. In all three categories, the range was wide, and the difference between women without oedema and those with leg oedema could not be regarded as significant. There was little or no difference between primigravidas and multigravidas. Except for generalized oedema, all the water gained up to about 30 weeks of pregnancy could be accounted for in the product of conception and the enlargement of the maternal blood volume and reproductive organs. But there was a surplus at term, about 1 - 2 litres. In women with generalized oedema a water surplus was present throughout pregnancy that amounted at term to about 5 litres. Most of the water gained had been lost 6 - 8 weeks post partum, even in women with generalized oedema (Food and Nutrition Board, 1971).

2.9 Geophagia in Pregnancy

Geophagia refers to the ingestion of earth materials like clay, chalk and other soils (Food and Nutrition Board, 1971).

During pregnancy, a number of non-food items are ingested by pregnant women, especially clinic patients. Some of the materials ingested can have deleterious effect on the health of both the mother and the infant. For instance, McGanity et al (1970) determined that 28% of 861 pregnant adolescent girls ingested starch, clay, other soils or refrigerator frost.

The role of pica (ingestion of non-food items), however, in the genesis of iron-deficiency anaemia is however not clear. It is speculated that some of the components of the soils ingested can form chelates with minerals like iron, and prevent their absorption. Minnich reported that ingestion of Turkish clay markedly decreased absorption of (Minnich et al, 1970). Talkington et al, (1971) studied two clays from East Texas that are popular with pregnant women and found a minimal impairment of iron absorption when the clays were ingested just prior to the iron intake. The studies of Talkington et al (1971) indicated that the ingestion of starch, may contribute to the development of iron deficiency during pregnancy not because iron absorption is impaired, but because the starch provides calories without iron. In addition to clay and starch, some women may ingest items like coal and chalk (Food and Nutrition Board, 1971).

A black woman (31 years) who ate quantities of clay estimated to be 200-300g daily during pregnancy ,and during preceding pregnancies, had severe anaemia and complete obstruction of the colon, with perforation and sepsis which led to her death (Key et al,1982).

2.10 Alcoholism in Pregnancy.

Alcohol has been reported to be a foetal toxic agent which produces foetal abnormalities including foetal-alcohol syndrome (Abel, 1982). Apart from the direct toxic effect of alcohol, it also causes malnutrition (Burton and Foster, 1988). Hence a woman's habitual alcohol intake during pregnancy should be seen as an unhealthy habit which can adversely affect pregnancy outcome. Various researches have indicated that alcohol intake has a direct effect on the infant. The incidence of low birth-weight increased 2.7 times in the group of new born infants whose mothers consumed excessive quantities of alcohol during pregnancy whereas it was 3.9 times as great in mothers who smoked and consumed alcohol (Sokol et al, 1980). In addition to the promotion of malnutrition, severe doses of alcohol can cause alcoholic liver disease (Burton and Foster, 1988).

Malnutrition caused by alcohol is exhibited as:

a). Protein malnutrition

b). Multiple vitamin deficiencies, especially in folic acid, thiamin, pyridoxine, ascorbic acid and vitamin D.

c). Mineral depletion including potassium, magnesium and Zinc.

Furthermore, adverse effects of alcohol use on nutrition are seen as:

1. Deficient intakes of nutrients, since alcohol is a source of calories devoid of nutrients.
2. Excess calorie intake since alcohol is a source of calories.
3. Loss of appetite due to gut and liver injury.
4. Inefficient use of available nutrients due to poor digestion or malabsorption from gut injury or from deficiency disease caused by alcoholism.
5. Extra financial drain on those of limited financial resources (Burton and Foster, 1988).

2.11: Effects of Physical Activity on Pregnancy Outcome

Heavy manual labour has been associated with less favourable outcome of pregnancy, primarily the delivery of low birth-weight babies or the premature onset of labour (Briend, 1980). The degree of physical work during pregnancy may also affect the health of the mother. It has been demonstrated (Tafari and Naeye, 1980) that pregnancy outcome (birth-weight) improves if a woman maintains energy balance by reducing physical work to counterbalance reduced dietary energy intake.

Briend (1980), observed that a heavy workload during pregnancy contributed to the incidence of low birth-weight in Dacca. In Addis Ababa, Tafari and Naeye reported that with the same diet over 1600 kcal per day, those women submitted to heavy workload did not gain much weight during pregnancy and had smaller children.

2.12: Food Taboos and Beliefs in Pregnancy

Some kinds of foods are avoided by women during pregnancy. The foods may be avoided due to nausea (aversion), taboos and beliefs, during pregnancy. Majority of the foods avoided however tend to be rich sources of vitamins, minerals and energy, which are needed for proper foetal growth and favourable pregnancy outcome (Jackson and Jackson, 1987). In Ghana, for instance, pregnant women often avoid sugary and nutritious foods such as mangoes and ripe plantain for fear that these foods might cause miscarriages, particular in the early months of pregnancy (UNICEF, 1990).

Jackson and Jackson (1987) observed that food taboos associated with pregnancy tend to restrict the intake of local animal-derived foods (eg; monkey, bush cow, red deer, blackdeer, fowl, eggs, opposum, freshwater crab and porcupine) in Liberia. Additionally, numerous taboos limit the intake of vitamin C containing foods like fruits such as pawpaw, pineapple, mango, and monkey nut which if eaten together with haem-iron rich foods, could enhance iron absorption (Jackson and Jackson, 1987).

2.13: Birth-spacing, Breastfeeding and Pregnancy Outcome

It is known that exclusive breastfeeding tend to delay the onset of the succeeding pregnancy (ie. lactational amenorrhoea). However, some women may become pregnant during the period of lactation. This condition referred to as overlap, is clearly likely to increase the stress on woman's health and nutrition (Tomkins and Watson 1991). The phenomenon has been reported to be common among women in a number of poor areas. Ramachandram, (1991) observed 30% overlap prevalence in Guatemala and Senegal, 40% in Indonesia, and as high as 70% in India. In his study, Ramachandram (1991) concluded that irrespective of the duration of lactation and period of gestation, women who continued lactation during their pregnancy had lower body weights than their non-lactating pregnant counterparts. Similar observations were made by Martorell and Merchant in 1991.

Adequate birth-spacing can mean the proper recuperation of the mother after a pregnancy. It can also mean adequate care of the preceding child, including its continued breastfeeding. Rapidly-succeeding pregnancies are associated with low maternal and infant nutritional status due to inadequate maternal nutrient repletion before the succeeding pregnancy. This condition has been referred to as the maternal depletion syndrome (Tomkins and Watson, 1991). The effect of repeated pregnancies and lactation on the health of mothers is however variable. Venkatachalan et al (1970) observed a fall in body weight with rising parity among the poorly fed Chimbu women in New Guinea, which he attributed to the greater energy demand made by frequent lactation, whereas Thomson and Billewcz (1970) found no such decrease with increasing parity in a South African village. Rajlakshmi (1971) in India also found no decrease in body weight, and in fact reported a slight trend towards an increase in birth-weight with parity. Increase in birth-weight up to the fourth, fifth and sixth pregnancies have been reported (Shah, 1981).

CHAPTER THREE

MATERIALS AND METHODS

3.1: The Study Areas

Data for the study were collected from four health centres. They are: Legon University Hospital, La Polyclinic, Kaneshie Polyclinic and Nerzit Maternity at Madina. These centres provide ante-natal services to pregnant women.

3.2: The Subjects

Subjects for this study were pregnant women who were attending ante-natal clinics on out patient basis. Subjects were within the age group of 20 - 35 years. A total of 502 pregnant women were selected for the study. Pregnant women who were present at the ante-natal clinics at the time of the study were those who participated in the study.

Subjects who had sickle cell disease, pre-eclampsia, as well as complicated pregnancy were not selected for this study.

3.3: Data Collection

A questionnaire (Appendix 11) was used to collect data from the pregnant women. Responses to the questionnaire were provided by a total of 502 pregnant women.

Data were collected on food and health habits during pregnancy,socio-economic status and other determinants of pregnancy outcome. A sub-sample of 128 pregnant women were selected for detailed study in a longitudinal study.

3.4: Epidemiological Data

This comprised data collection on biomedical, and psychological determinants of pregnancy outcome. Specifically, data on food habits, nutrient supplementation, geophagia, nausea, oedema, alcohol intake, ante-natal clinics attendance, preference of infant size in pregnancy and women's perception of good nutrition during pregnancy and safe labour, were obtained by means of a questionnaire designed for the purpose.

3.5: The Longitudinal Study

The longitudinal study was in three main parts. Collection of anthropometric and biochemical data and dietary intake assessment.

3.5.1: The Anthropometric Measurements

This included measurements of the heights and weights of the pregnant women and birth-weight of their infants on delivery. Height and weight measurements were in centimetres and kilograms respectively (Jelliffe and Jellife, 1989).

Weight Measurements

Weights of the pregnant women were monitored from the third to the ninth month of pregnancy. Monthly weight measurements were made over a period of six months using the adult weighing scale with a least count of 0.1kg (Seca, M215). The weight measurements enabled the computation of the rate of pregnancy weight-gain over the six month period. Pregnancy weight-gain was determined from the difference in weight first seen in the third month of gestation and that of the ninth month of pregnancy (Hytten and Thompson, 1970).

Height Measurements

The heights of the pregnant women were taken in the first trimester to eliminate drooping effect of the pregnancy weight. The height measurements were done using the stadiometer (adult height scale) with least count of 1mm (Holtain type).

Weight and height measurements were made in a manner conducive with laid down regulations (Jelliffe and Jellife, 1989). Subjects were wearing very light clothing, bare-footed, standing upright and in attentive position with hands relaxed on their sides, looking straight ahead at eye level before measurements were recorded.

3.6: <u>The Biochemical Study</u>

The biochemical study was a longitudinal study of the haemoglobin levels of the pregnant women.

Haemoglobin levels of the pregnant women were determined monthly for a period of six months, from the third to the ninth month of gestation. Haemoglobin determination was by means of the cyanmethaemoglobin method using Drabkin's reagent (Wooton, 1974). The haemoglobin levels were determined to evaluate the effectiveness of the mineral and vitamin supplementation programmes for pregnant women at these ante-natal clinics. The evaluation was done by comparing their mean haemoglobin levels to that of the WHO standard (11.0g/dl) to assess anaemia prevalence in the pregnant women (Tomkins and Watson, 1991).

3.7: <u>The Dietary Study</u>

The dietary study was aimed at assessing average energy, protein, and iron intakes of the pregnant women. This was done by means of the dietary recall method. Twenty-four-hour dietary recall was performed on the 128 pregnant women on three different occasions in the first, second and third trimesters to give the true picture of the dietary intake of these nutrients by the pregnant women. Average values of energy, protein and iron were computed using food composition tables (Eyeson and Ankrah, 1975). Mean values of these nutrients were then compared to the recommended dietary allowances (FAO/WHO, 1985) for pregnant women.

3.8: **Analysis of The Data**

1. Data analysis was computer-based, using the Statistical Package for Social Scientists (SPSS) programme. Data storage was in Dbase 3 Plus.
2. Computed values were expressed as mean ± standard deviation.
3. Analysis of variance (ANOVA) was used where a test for significant effects of the variables was required.
4. Walker-Duncan Adaptive Procedure was used to compare the means of variables where ANOVA showed significant effects.
5. Correlation analysis was done to ascertain relationships between variables.
6. The student's t-test was used where comparison between two means was required.
7. Dietary nutrient intakes were analyzed by the use of FAO food composition tables for Africa (1972) together with food composition tables formulated by Watson (1971), Eyeson and Ankrah (1975).
8. The net protein utilization (NPU) for protein in a mixed diet was taken as 70% (FAO/WHO,1973).

3.9 Characteristics of the Subjects

The general characteristics of the subjects are listed in table 7.

Most of the subjects (55.18%) were originally from the Greater Accra region while the rest were from other regions but were now based in Accra. The mean age of the subjects was 27.5 years. Most of the subjects attained middle (53.98%) and secondary school (33.27%) educational levels. A substantial number of them were traders (57.77%) and vocational workers (27.69%).

Majority of the subjects were married (99.40%). Of the total number of 502 women, 27.49% of them were nulliparous, and 35.46% had had one or two previous pregnancies while 29.88% had experienced three or four previous pregnancies. About 7% had experienced more than four previous pregnancies.

Pre-eclampsia, antepartum haemorrhage, and other sicknesses were absent in the subjects, and most of them (93.0%) had been immunized against tetanus. The subjects had normal mean Body Mass Index (BMI) of 23.09 and were of acceptable (Table 39) mean height (162.17cm) and weight (60.77kg) at the beginning of the pregnancy.

Table 7: Characteristics of subjects involved in the study, (n = 502)

Characteristics	Number of Mothers	Percentage of mothers
Age groups		
20 - 25	245	48.80
26 - 30	161	32.07
31 - 35	96	19.13
Educational level		
None	10	8.56
Primary	46	9.16
Middle	271	53.37
Secondary/Technical/Vocational	167	33.27
University	8	1.59
Region of birth		
Ashanti region	43	8.56
Brong Ahafo region	2	0.40
Central region	64	12.75
Eastern region	51	10.16
Greater Accra region	277	55.18
Northern region[1]	9	1.79
Volta region	40	7.97
Western region	16	3.19

1: Northern region including Upper East and Upper West regions.

Table 7 (continued): Characteristics of subjects involved in the study (n = 502)

Characteristics	Number of mothers	Percentage (%)
Occupation		
Trader	293	58.37
Vocational[1]	141	28.09
Office worker[2]	14	2.79
Professional[3]	33	6.57
Housewife	21	4.18
Marital status		
Married	499	99.49
Single	3	0.60
Number of previous pregnancies (parity)		
Nulliparous	138	27.49
1 - 2	178	35.46
3 - 4	150	29.88
5 - 6	29	5.77
7 - 9	7	1.39

1. Vocational worker: hairdresser, seamstress, driver, caterer, farmer, etc.
2. Officer worker: typist, secretary, receptionist, telephonist, etc.
3. Professional: teacher, lecturer, nurse, police personnel, actress, lawyer etc.

Table 7 (continued): Characteristics of subjects involved in the study (n = 502)

Characteristics	Number of mothers	Percentage (%)
Prevalence of spontaneous abortion		
None	366	72.91
1	112	22.31
2	22	4.38
3	2	0.40
Prevalence of stillbirths		
None	483	96.22
1	19	3.78
Tetanus immunization		
Mothers immunized	468	93.0
Mothers not immunized	34	7.0
Anthropometric values in first trimester	Mean	Standard deviation
Weight (kg)	60.766	10.118
Height (cm)	162.167	5.263
Body Mass Index (BMI)	23.094	3.582

CHAPTER FOUR

4.0: RESULTS

4.1: Conduct of the Ante-natal clinics

The health centres where the study was done operated on an out-patient basis. The patients (Pregnant women) visited the health centres on days scheduled for ante-natal services. The daily schedules varied between the health centres.

The frequency of attendance of the pregnant women at the ante-natal clinics depended on the gestational age of the pregnancy (Table 8).

Table 8: Clinic attendance schedule for the pregnant women

Gestational age (Months)	Attendance schedule
Conception to 7th month	Monthly
7th to 8th month	Fortnightly
8th month to term (delivery)	weekly

However those with special risk problems like low haemoglobin level, high blood pressure (B.P), sickling, poor medical history, including bleeding in previous pregnancy, attended more frequently. The type of nutrient supplements given to the pregnant women are listed in appendix 2. Commonly, the iron supplement given was fersolate (B.P 200mg equivalent to 60mg elemental iron per tablet). Multivitamin tablets given were multivites, folic acid tablets (5mg/tablet), and vitafol (Appendix 2). Calcium tablet administered separately to the pregnant women was dumocalcin (500mg Ca/tablet/day). Three (3) fersolate and multivites were to be taken per day (one each after meals in the morning, afternoon and evening). Folic acid and calcium supplements were administered at a dosage of one tablet per day. Normally fersolate (iron) was administered with multivites, folic acid, vitamin B-complex and calcium while the multivitamin and mineral tablets (eg. vitafol) were administered with only calcium.

On the average the pregnant women paid four thousand, five hundred Cedis (¢4,500.00) on their first attendance to the ante-natal clinics but on subsequent visits amounts between thousand eight hundred (¢1,800.00) to two thousand Cedis (¢2,000.00) were paid. These monies do not cover the cost of drugs, should additional drugs be required, in addition to what is given routinely. The hospital charges for delivery were on the average about twenty-five thousand Cedis (¢25,000.00) but increased to about sixty thousand Cedis (¢60,000.00) if caesarian section was involved. Haemoglobin level, blood pressure and weight of the pregnant women were determined on every attendance to the health centres. Immunization of the pregnant women against tetanus was also done in the fifth month of pregnancy. Malarial chemoprophylaxis was also given. In addition nurses at the ante-natal centres advised the pregnant women on good nutrition and health practices.

4.2 EPIDEMIOLOGICAL STUDY

4.2.1: Infant Birth-weight

The range of birth-weights observed in the study was 1.80 - 4.2kg, with a mean of 2.999 ± 0.511kg. Out of the total of 502 mothers, 42 (8.37%) delivered infants who weighed between 2.50 and 4.00kg, while 5 (1.00%) mothers delivered infants who weighed more than 4.00kg (Figure 2) (Appendix 5).

Infants delivered by the mothers were of about equal sex ratio. There were 265 (52.79%) male and 237 (47.21%) female infants.

There was not much variation in infant birth-weight at the ante-natal clinics of study. Figure 2, (Appendix 6).

4.2.2: Educational Level of the Mother and Infant Birth-weight.

Table 9 shows the birth-weight of infants in relation to the mothers' education level.

No significant ($p < 0.05$) differences were observed in their infants' birth-weights. However mothers who have had tertiary education had slightly larger infants as compared to the other mothers with lower educational levels.

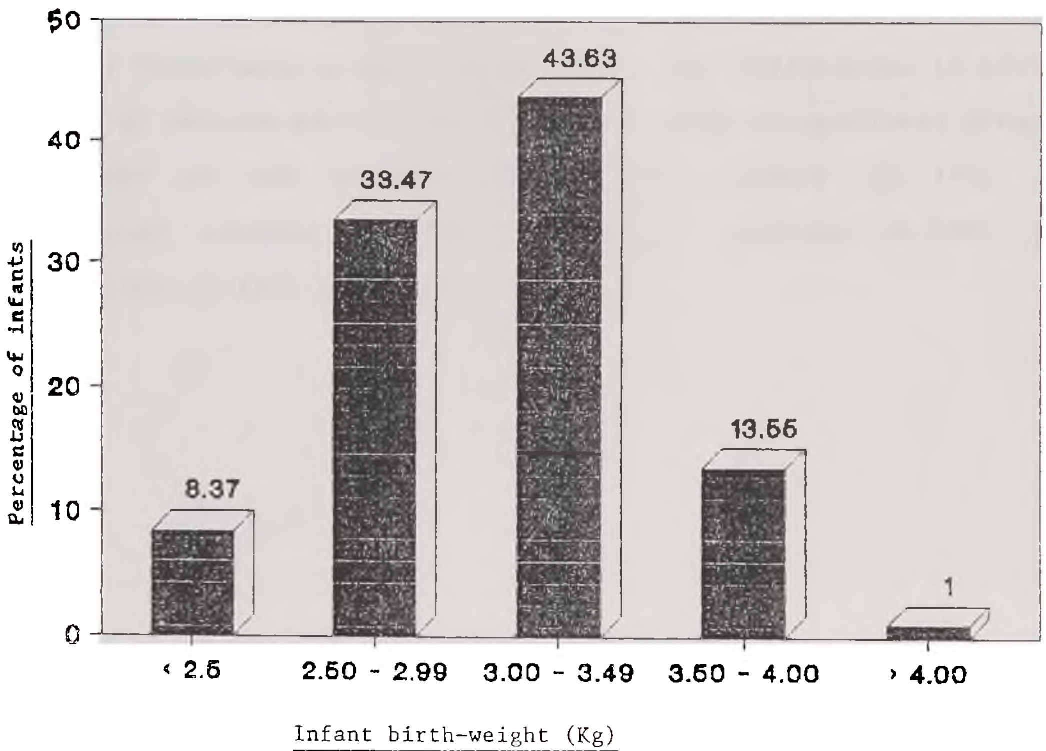
Majority of the mothers had middle (53.98%) and secondary (33.26%) educational levels. Only few had tertiary level education, while ten mothers have had no education at all.

Table 9: Birth-weight of infants in relation to mothers' educational level.

Educational level of mothers	Number of mothers (%)	Birth-weight of infants[1] (kg) (mean ± S.D)
None	10 (2.00%)	3.045 ± 0.319
Primary School	46 (9.16%)	3.072 ± 0.489
Middle School	271(53.98%)	2.998 ± 0.536
Secondary/Vocational	167(33.26%)	2.970 ± 0.488
Tertiary	8 (1.59%)	3.144 ± 0.453
Total	502	2.999 ± 0.511

1: No significant differences were observed, $P < 0.05$: Duncan's multiple range test

Figure 2: Distribution of infants according to birth-weight (n = 502).


50
40
30
20
10
0
Percentage of infants
43.63
33.47
13.56
8.37
1
‹ 2.5
2.50 - 2.99
3.00 - 3.49
3.50 - 4.00
› 4.00
Infant birth-weight (Kg)

4.2.3: Mothers Occupation and Infant Birth-weight

The birth-weight of infants was found to be related to the type of occupation of the mother (Table 10, Duncan's multiple range test showed significant ($p < 0.05$) differences between the infant birth-weights. Women who were housewives had significantly larger infants (3.312 ± 0.352kg) than women who were traders (2.976 ± 0.534kg) and vocational workers (2.985 ± 0.478kg). However there were no significant ($P < 0.05$) differences in birth-weight of infants born to mothers in the other occupational groups.

Most of the pregnant women were traders (57.77%) and vocational workers (27.69%). Office workers (2.79%) and housewives (4.18%) were few.

Table 10: Effect of Mothers Occupation on Birth-weight of Infants (n = 502)

Mothers' Occupation	Number of mothers (%)	Infant Birth Weight (kg)[4]
Trader	293 (58.37)	$2.976^a \pm 0.534$
Vocational[1]	141 (28.09)	$2.985^a \pm 0.478$
Office worker[2]	14 (2.79)	3.079 ± 0.507
Professional[3]	33 (6.57)	3.057 ± 0.653
Housewife	21 (4.18)	$3.312^b \pm 0.352$

1: Vocational worker; hairdresser, seamstress, driver, caterer, farmer, etc.

2: Officer worker; typist, secretary, receptionist, telephonist, etc.

3: Professional; teacher, lecturer, nurse, lawyer, police personal, actress, etc.

4: Mean values different superscripts are significantly different; Duncan's Multiple range test, $P < 0.05$.

4.2.4: Gestational Age at which Mothers seek Ante-natal care and Effect on Infant Birth-weight

Most of the pregnant women 210 (41.83%) in the study visited ante-natal clinic for the first time during the third month (12th week) of pregnancy (Table 11). Only 152 (30.28%) of the pregnant women visited ante-natal clinic in the first two months of pregnancy. Some of the pregnant women visited ante-natal clinic for the first time in the sixth and seventh months of pregnancy.

Pregnant women who received ante-natal care before the end of the first trimester (12th week) had infants of significantly ($P < 0.05$) higher birth-weight than those who received ante-natal care during the second and third trimesters.

The reasons why women visited the ante-natal clinics at the observed gestational ages of first visit are shown in table 12.

Table 11: Age of pregnancy at which mother first seeks ante-natal care in relation to birth-weight of infants (n = 502)

Gestational age on first Visit (weeks)	Number of subjects	Percentage of subjects	Birth-weight of infants (kg)[1]
4	29	5.78	$3.158^a \pm 0.435$
8	123	24.50	$3.078^a \pm 0.437$
12	210	41.83	$3.072^a \pm 0.455$
16	82	16.33	$2.794^b \pm 0.503$
20	36	7.17	$2.709^b \pm 0.658$
24	14	2.79	$2.800^b \pm 0.967$
28	8	1.59	$2.850^b \pm 0.618$

1: Mean values with different superscripts are significantly different from each other; $P < 0.05$ Duncan's multiple range test.

Table 12: Reasons given by mothers for visiting ante-natal clinics at the observed gestational ages of first visit.

Mothers' reasons	Number of mothers	Percentage
It was not time to visit clinic	166	33.07
Because of sickness or vomiting	114	22.71
To save money or not prepared to visit clinic	71	14.14
For care of the pregnancy.	151	30.08
Total	502	100.00

4.2.5: Nausea During Pregnancy and Effect on Infant Birth-weight

Various degrees of nausea were exhibited by the pregnant women in the study. Of the total of 502 pregnant women, 134 (26.69%) did not experience nausea during the pregnancy. Fifty-eight (11.55%) lost appetite but did not vomit, whereas 310 (61.75%) frequently vomited and lost appetite during the pregnancy (Table 13).

Mothers who neither vomited nor lost appetite had infants of significantly ($P < 0.05$) higher birth-weight (3.214 ± 0.566kg) than mothers who lost appetite with vomiting (2.867 ± 0.0391kg). Mothers who lost appetite but did not vomit had infants of slightly lower birth-weights than those who did not lose appetite and did not vomit (Table 13).

Table 13: Effect of Nausea during Pregnancy on Infant Birth Weight (n = 502).

Degree of nausea	Number of mothers (%)	Infant birth-weight (kg) (mean ± S.D)[1]
No loss of appetite and no vomiting	134 (26.69)	$3.214^{a} \pm 0.566$
Loss of appetite but no vomiting	58 (11.55)	$2.912^{a,b} \pm 0.638$
Lose appetite with vomiting	310 (61.75)	$2.867^{b} \pm 0.391$

1: Mean values with different superscripts are significantly different: $P < 0.05$, Duncan's test.

4.2.6: Vomiting During Pregnancy and Effect on Infant Birth weight

Table 14 indicates the effect of vomiting on infant birth-weight. In the study, different durations of vomiting were observed among the subjects. Some of the women 124 (24.70%) vomited frequently for less than three months while others 186 (37.05%) vomited for more than three months but less than five months. However 192 (38.25%) of the pregnant women did not vomit during pregnancy.

Vomiting had a significant adverse effect on birth-weight. Women who did not vomit during the pregnancy had significantly higher birth-weight ($P < 0.05$) infants (3.214 ± 0.566kg) than those who vomited for more than three months (2.738 ± 0.424kg).

In addition, subjects who vomited for more than three months had infants of significantly ($P < 0.05$) lower birth-weight than those who vomited for less than three months.

Table 14: Effect of duration of vomiting during pregnancy on infant birth-weight (n = 502)

Duration of vomiting months)	Number of Mothers	Percentage of Mothers	Birth-weight of infants (kg)[1]
No vomiting	192	38.25	$3.214^a \pm 0.566$
Less than three months	124	24.70	$3.060^b \pm 0.342$
More than three months	186	37.05	$2.738^c \pm 0.424$

1: Means with different superscripts are significantly different: $P < 0.05$, Duncan's test.

4.2.7: Alcoholism During Pregnancy

In the study, it was found that some pregnant women took alcohol during pregnancy. Of the total of 502 pregnant women, 47 (9.36%) took alcohol during pregnancy. Alcoholic drinks taken included local gin (Akpeteshie), Schnapps, beer, and guinness. Of those who took alcohol during pregnancy, 25 (5.18%) took local gin, 12 (2.39%) took beer while 10 (1.99%) took guinness (Table 15).

The quantities of alcohol taken by the subjects were not excessive. Those who took local gin during pregnancy took less than 100ml per week, and those who took either beer or guiness took on the average, one or two bottles per week.

The reasons given by the women who took alcohol during pregnancy are various (Table 16). While some of the women claim they took alcohol to increase appetite 21 (4.18%), others claim they took the alcohol to prevent vomiting 11 (2.19%). However there were some of the women 15 (2.99%) who developed the taste for alcohol during the pregnancy.

Although the number of women who took alcohol is small for any meaningful comparison, it is worth mentioning that there were no significant ($P < 0.05$) differences in birth-weights of infants born to women who took alcohol (3.079 ± 0.384kg) and those who did not (2.992 ± 0.0521kg).

Table 15: Types of Alcoholic drinks and Quantities taken by mothers during pregnancy (n = 502)

Number of Mothers	Type of Alcohol	Quantities taken
25 (5.18%)	Local gin/Schnapps	Less than 100ml per week.
12 (2.39%)	Beer	1 - 2 bottles per week.
10 (1.99%)	Guinness	1 - 2 bottles per week.
455 (90.64%)	Do not take Alcohol	-

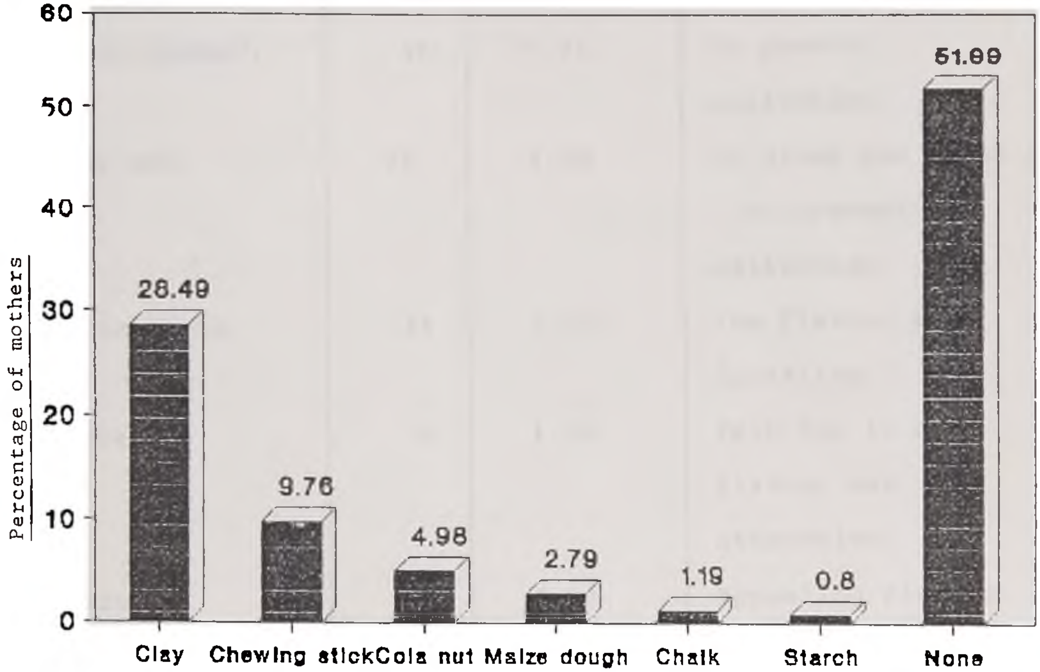
Table 16: Mothers' reasons for taking alcohol during pregnancy

Mothers reasons	Number of Mothers	Percentage of Mothers
For appetite	21	4.18
Developed taste for it in pregnancy	15	2.99
To prevent vomiting and excessive salivation	11	2.19
Do not take alcohol	455	90.64
Total	502	100.00

4.2.8: Pica Practice of the Pregnant Women and their Reasons

It was observed in the study that a substantial number of the pregnant women ingested clay 143 (28.49%) during the pregnancy. Some of them also chewed stick or sponge 49 (9.76%) more frequently. However few of the pregnant women chewed cola nut 25 (4.98%), fresh maize dough 14 (2.79%), chalk 6 (1.20%) and raw starch 4 (0.80%). About half of the pregnant women did not practise pica 261 (51.99%) during the pregnancy. On the whole, 241 (48.01%) of the pregnant women practised pica during the pregnancy (Figure 3, Table 17).

Figure 3: Types of materials ingested by the mothers during pregnancy (n =502)



Type of material

Table 17: Types of material ingested by women during pregnancy and their reasons.

Type of material.	No. of women.	Percentage of mothers	Mothers' reasons.
Clay.	143	28.49	To alleviate salivation, vomiting or flavour was appealing.
Chewing stick/sponge[1].	49	9.76	To prevent salivation.
Cola nut.	25	4.98	To clear the mouth or to prevent salivation.
Maize dough.	14	2.79	The flavour was appealing.
Chalk.	6	1.19	Felt for it or flavour was attractive.
Starch.	4	0.80	Appealing flavour.
None.	261	51.99	-
Total	502	100.00	

1: Chewed more frequently than used to.

Two main groups of pregnant women were found in relation their reasons for eating clay (Table18). One group ate clay to prevent spitting (salivation) or vomiting 81 (16.14%) while the remaining group ate clay because either they liked the flavour or it was appealing to them 62 (12.35%) (Table 18)

Table 18: Mothers' reasons for eating clay during pregnancy, (n = 502).

Mother's reasons.	Number of Mothers.	Percentage of mothers.
To prevent spitting or vomiting.	81	16.14
I like the flavour of clay or it is appealing.	62	12.35
Do not eat clay.	359	71.51

Two categories of women were found in relation to clay intake. There were pregnant women who ate clay everyday 14 (2.79%) and those who sometimes ate clay 129 (25.70%). Majority of the pregnant women did not eat clay 359 (71.51%) during the pregnancy.

Clay intake did not have any effect on the birth-weight of the infants. There were no significant ($P < 0.05$) differences in the birth-weight of infants born to women who ate clay everyday (3.025 ± 0.287kg), who sometimes ate clay (2.994 ± 0.396kg) and those who did not eat clay (3.001 ± 0.552kg) during the pregnancy (Table 19).

Table 19: Effect of clay ingestion on infant birth-weight (n = 502)

Degree of clay ingestion	Number of mothers	Birth-weight of infants (kg)[1]
Eat clay everyday	14 (2.79%)	3.025 ± 0.287
Sometimes eat clay	129 (25.70%)	2.994 ± 0.396
Do not eat clay	359 (71.51%)	3.001 ± 0.552

1: No significant differences were observed, P<0 05: Duncan's test.

4.2.9: Foods Avoided by Ghanaian Women during Pregnancy

In the study, it was found that more than half of the pregnant women avoided some kind of food during pregnancy (Table 20). High protein foods like fresh fish and fresh meat were avoided by some of the pregnant women because of the strong scent of these foods. Slimy sauces and highly scented fermented foods as well as too fatty foods were also avoided by some of the pregnant women. Fufu was also avoided by some of the women during pregnancy because it causes excessive fulness after eating.

Table 20: Foods avoided by Ghanaian women during pregnancy and reasons (values in parenthesis are percentages, (n = 502)

Kinds of food avoided	Number of women	Reasons
Fresh fish or fresh meat	167 (33.27%)	The scent is prohibitive.
Okro or slimy sauce	54 (10.76%)	The slime is not attractive.
Fermented fish and maize foods (Kenkey, porridges, etc)	49 (9.76%)	The scent is too strong.
Fatty food	23 (4.58%)	Too oily.
Fufu	20 (3.98%)	Gives excessive fullness.
None	189 (37.65%)	I like all foods during pregnancy.

4.2.10: Diet Modification During Pregnancy and Effect on Birth Weight

More than half of the pregnant women studied did not alter their diet to suit the pregnancy (Table 21). Only 33 (6.57%) women claimed to have eaten more food during pregnancy. Due to nausea, 104 (20.72%) reported a decrease in food intake.

The diet modifications reported by the mother did not significantly affect the birth-weight of their infants. Women who claim they ate more food than before the pregnancy had slightly higher infant birth-weights (3.124 ± 0.470kg) than women who reported to have eaten lesser amount of food (2.947 ± 0.568kg). This was not significant though.

Table 21: Women who Modified their Diet During the Pregnancy, their Reasons and Effect on Birth-weight

Diet Modification Type of change in diet.	Mother's reasons	Number of mothers (%)	Birth-weight (kg)
Ate more food than before.	For proper development of baby	33 (6.57)	3.124 ± 0.470
Eat less food than before the pregnancy.	Loss of appetite and vomiting or heart burn.	104 (20.72	2.947 ± 0.568
Did not modify diet .	Eat enough food everyday.	365 (72.71)	3.003 ± 497

4.2.11: <u>Oedema During Pregnancy and Effect on Infant Birth Weight.</u>

No generalized oedema was observed in any of the pregnant women. However oedema of the limbs (feet) was present in 205 (40,84%) of the pregnant women.

Significant difference between the mean infant birth-weight for those who developed oedema and those who did not develop oedema was observed, with the former having significantly higher birth-weights ($P<0.05$) than the latter (table 22).

Mothers reported that oedema of the feet was associated with slight pains and dumbness of the feet.

Table 22: Effect of oedema during pregnancy on birth-weight of infants.

Oedema	Number of Mothers	Birth-weight (kg)[1] (mean ± S.D)
Did not develop oedema	297 (59.16%)	2.848[a] ± 0.501)
Developed oedema	205 (40.84%)	3.22[b] ± 0.441
Total	502 (100%)	2,999[a,b] ± 0.511

1: Means with different superscripts are significantly different: P < 0.05, Student's t-test.

4.2.12: Effect of Parity on Infant Birth-weight

Table 23 shows the effect of parity on infant birth-weight.

Mothers who have had three or four previous pregnancies had significantly ($P < 0.05$) larger infants (3.207 ± 0.503kg) than nulliparous (2.910 ± 0.504) and mothers with seven or more previous pregnancies.

Of the 186 pregnant women who had three or more children, 81 (43.55%) were of the opinion that higher number of children was security against child mortality, while 73 (39.25%) had greater number of children due to children from a previous marriage. The desire to have a child of a different sex among the children was the main reason for 32 (17.20%) mothers having more children. Mothers who had less than three children attributed it to economic hardship (Table 24).

Table 23: Number of Previous Pregnancies in Relation to Birth Weight of Infants (n = 502)

Number of Previous Pregnancies	Number of Mothers (n = 502)	Birth-weight (kg)[1] (mean ± S.D)
None (first pregnancy)	138	$2.910^{a} \pm 0.504$
1 - 2	178	$2.975^{a,b} \pm 0.520$
3 - 4	150	$3.207^{b} \pm 0.503$
5 - 6	29	$3.039^{a,b} \pm 0.437$
7 - 9	7	$2.943^{a} \pm 0.468$

1: Means with different superscripts are significantly different, P<0.05: Duncan,s test.

Table 24: Mothers' Reasons for having three or more children

Reasons for three or more children	Number of mothers (n = 186)	Percentage in the group (%).
Some of the children may die	81	43.55
Multiple marriages	73	39.25
Desire for a different sex among the children	32	17.20

4.2.13: <u>Mothers' Preference of Infant size and Reasons.</u>

Table 25 shows mother's preference for infant size at birth and the reasons for their preferences.

A substantial number 204 (40.60%) of the subjects preferred small infants for easy labour. Only 55 (10.90%) wanted big infants on delivery with the reason that big infants look bouncy or tough. However most of the subjects 242 (48.50%) had no particular preference of infant size at labour. They were of the opinion that infant was an act of God which cannot be controlled by humans.

Table 25: Mothers' Preference of Infant size and Reasons

Mothers' reasons for preferred infant size	Number of mothers	Percentage of mothers
Small infants present easy labour	204	40.60
Big infants look tough or bouncy	55	10.90
No Preference, God's decision	243	48.50
Total	502	100

4.2.14: **Measures Taken by Mothers to Achieve Preferred Infant size.**

Although a substantial number of mothers had particular preferences for infant size, majority 145 (71.04%) of them did not take any measures aimed at achieving the preferred infant size (Table 26). Of the 204 women who preferred small babies, only 21 (10.29%) reported to have eaten less food than their non-pregnancy food intakes to achieve the small infant size. One mother in this group actually used herbs in order to deliver small infants. Thirty-six (65.46%) of the women who preferred big infants at birth claimed they ate more food to achieve their aim.

Table 26: What Mothers Do to Achieve Preferred Infant size.

	Number of Mothers	Percentage (%)
Do nothing	201	40.04
Eat less	21	4.20
Eat more/right food	36	7.20
Use herbs	1	0.20
No preference for infant size.	243	59.56
Total	502	100.00

4.2.15: Mothers' Preference of Infant size at Birth in Relation to Birth-weight of their Infants

Table 27 shows that even though mothers had particular preferences for infant size, actual birth-weight of infants did not always tally with mothers' preference. There were no significant ($P < 0.05$) differences between the birth-weight of infants born to mothers of the various preference levels. However women who wanted small infants delivered infants of slightly higher birth-weight (3.042 ± 0.554kg) than those who wanted big infants (2.989 ± 0.548kg).

Twelve (2.4%) women, out of the total of 502 pregnant women, did not have spontaneous labour. These women delivered significantly ($P < 0.05$) bigger infants (3.480 ± 0.295kg) as compared to those who had spontaneous delivery who had mean infant birth-weight of 2.987 ± 433kg. Though the number of women who experienced difficult labour was small, the impression had was that high infant birth-weight may pose labour problems.

Table 27: Mothers' Preferences of Infant size at Birth in Relation to Birth-weight of their Infants (n = 502).

Mothers' Preference	Number of Mothers	Percentage of Mothers	Birth-weight of infants (kg) (Mean ± S.D)
Small infants	83	16.50	3.042 ± 0.554
Medium size infants	124	24.60	3.003 ± 0.405
Big infants	55	10.90	2.989 ± 0.548
No preference	243	48.00	2.986 ± 0.538
Total	502	100.00	2.999 ± 0.511

1: No significant differences between birth-weights were observed; ($P < 0.05$, Duncan's test).

4.2.16: <u>Duration of Mineral and vitamin Supplementation During Pregnancy and Infant birth-weight</u>

The results of the effects of mineral and vitamin supplementation on infant birth-weight are shown in table 28, and figure 4.

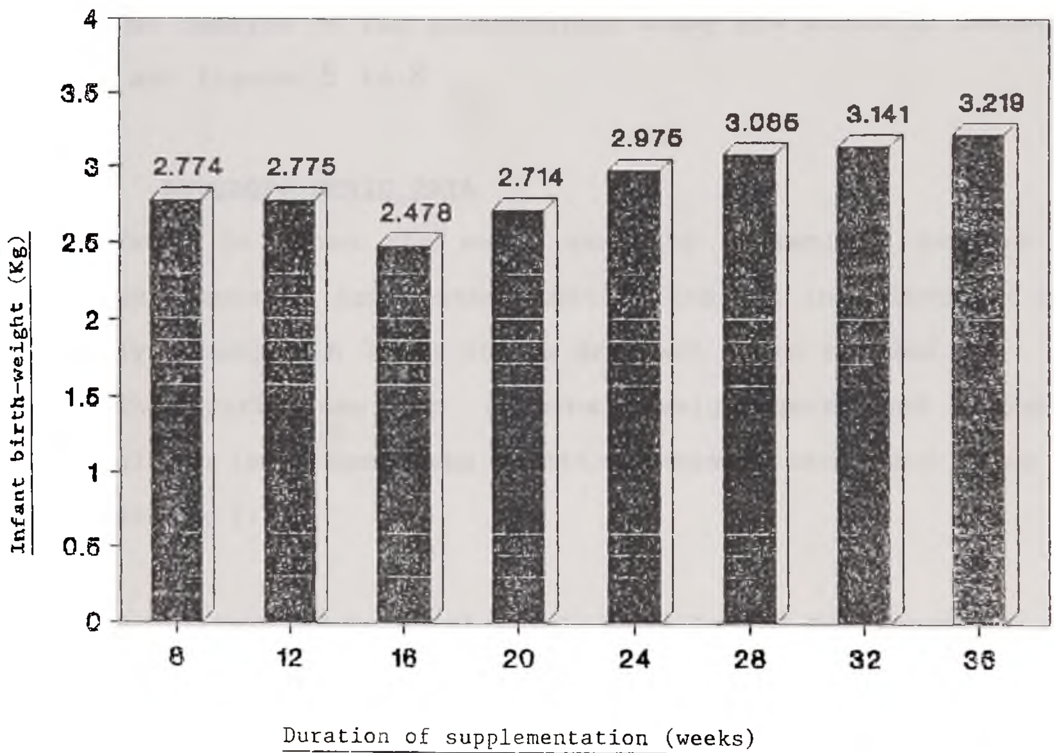
Pregnant women who had supplementation for more than 20 weeks had infants of significantly ($P < 0.05$) higher birth-weight than those who received supplementation for less than 20 weeks.

Table 28: Duration of mineral and vitamin supplementation during pregnancy in relation to birth-weight (n = 502).

Duration of supplementation (weeks)	Number of Mothers	Birth-weight (kg)[1] (mean ± S.D)
8	11	$2.774^{a} \pm 0.542$
12	12	$2.775^{a,b} \pm 0.248$
16	21	$2.478^{a} \pm 0.703$
20	54	$2.714^{a,b} \pm 0.579$
24	123	$2.975^{b} \pm 0.472$
28	171	$3.085^{b} \pm 0.473$
32	85	$3.141^{b} \pm 0.379$
36	25	$3.219^{b} \pm 0.492$

1: Means with different superscripts are significantly different, P<0.05; Duncan's test.

Figure 4: Effect of duration of mineral and vitamin supplementation of the mother on infant birth-weight (n = 502).



4
3.5
3
2.5
2
1.5
1
0.5
0
2.774
2.775
2.478
2.714
2.976
3.086
3.141
3.219
8
12
16
20
24
28
32
36
Infant birth-weight (Kg)
Duration of supplementation (weeks)

4.3: THE LONGITUDINAL DATA

From the total of 502 pregnant women, a sub-sample of 128 participated in the longitudinal study. Their energy, protein and iron intakes were assessed through a 3-day 24-hour dietary recall. Monthly maternal weight-gains and maternal haemoglobin levels were also studied. In addition, some of the effects of mineral and vitamin supplementation on pregnancy was studied to ascertain the effectiveness of the supplementation programme.

The results of the longitudinal study are shown in tables 29 to 45 and figures 5 to 8 .

4.3.1: ANTHROPOMETRIC DATA

Table 29 shows the mean, standard deviation, maximum and minimum values of some anthropometric indices including the mean monthly haemoglobin level of the pregnant women studied.

The variations in maternal weight-gain and maternal haemoglobin level among the health centres of study are shown in appendix 7.

4.3.2: Pattern of Maternal Weight-gain During Pregnancy.

The pattern of maternal weight-gain is shown in figure 5. Maternal weight-gains at the various gestational ages was significantly ($P < 0.05$) lower than that of women from developed countries throughout pregnancy (Figure 5, Appendix 8).

Table 29: Mean Values of some measured indices on the Pregnant women (n = 128), (mean, standard deviation, Maximum and minimum values)

	Height (cm).	Weight in first trimester (kg).	Pregnancy weight at term (kg).	Maternal weight-gain at term (kg).	Weight-gain per week (kg).	Body Mass Index in first trimester.	Mean Monthly haemoglobin level (g/dl).
Mean value (n = 128).	162.167	60.766	71.276	10.531	0.440	23.094	11.503
Standard Deviation.	5.263	10.118	15.164	1.681	0.068	3.582	0.603
Maximum value.	179.00	98.00	114	17.00	0.710	34.310	13.06
Minimum value.	148.00	46.00	55	6.00	0.250	17.570	10.01

Figure 5: Mean monthly weight gain during pregnancy (n = 128).

Legend

Reference weight gain: —x—x—x—

Observed weight gain: —■—■—■—■—

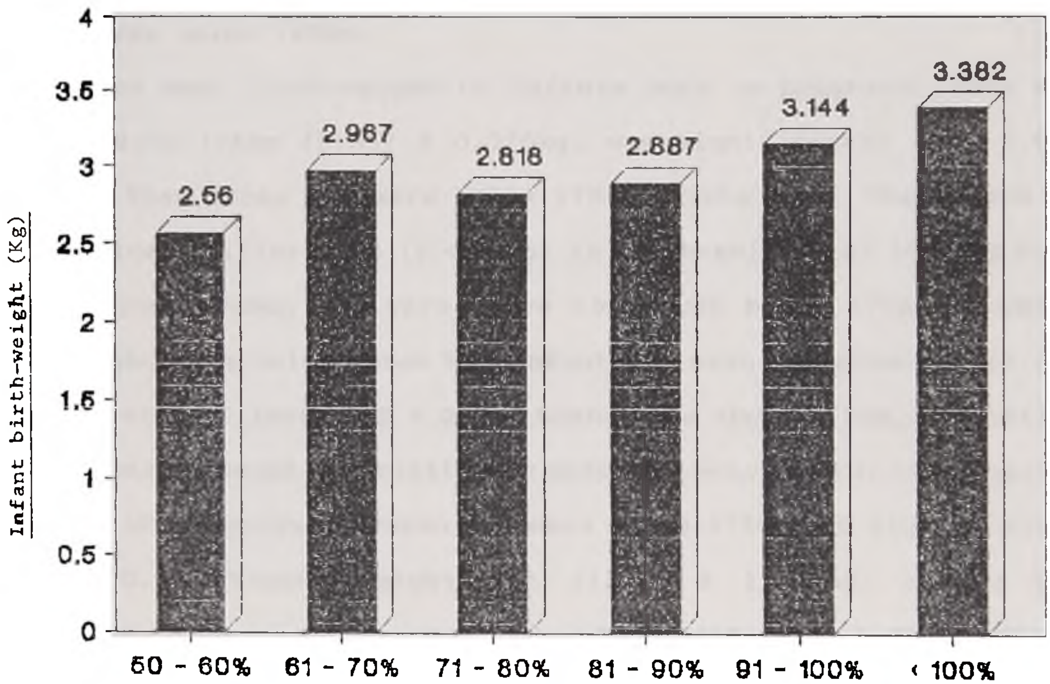
12
10
8
6
4
2
0
0
5
10
15
20
25
30
35
Maternal weight-gain (Kg)
Gestational age (weeks)

4.3.3: Maternal Weight-gain and Effect on Infant Birth-weight.

The mean maternal weight at the beginning of the pregnancy (first trimester) was 60.766 ± 10.118kg with a range of 46 - 98kg. In the third trimester, the mean weight of the pregnant women was found to be 71.276 ± 15.164kg with a range of 55 - 114kg. The mean maternal weight-gain during the pregnancy as calculated from the individual weight-gain of the pregnant women, was 10.531 ± 1.681kg. The range of weight-gain was observed to be 6 - 17kg during the pregnancy (Table 29).

Infants born to women who gained above 90% of the reference weight-gain (12.5kg; FAO/WHO, 1985) had infants of significantly ($P < 0.05$) higher birth-weight than pregnant women who gained below 90% of the reference standard. Generally, birth-weight was observed to increase as the weight-gained by the mother increased (Figure 6, Appendix 9).

Figure 6 : Effect of maternal weight gain on birth-weight (n = 128).



Weight gain as percentage of recommended

4.3.4: <u>**Effect of maternal Height on infant birth-weight and maternal weight-gain.**</u>

In the study, the mean height of the pregnant women in the first trimester was found to be 162.167 ± 5.263cm, with a range of 148 - 179 cm (Table 29). Thirteen (10.16%) of the mothers were below 156cm. Majority of them (60.94%) were within 156 - 165cm height group, while 24 (18.75%) were above 165cm but below 175cm. Those above 175cm were few 13 (10.16%). None of the women was below 148cm.

The mean birth-weight of infants born to pregnant women who were above 175cm (3.467 ± 0.375kg) was significantly ($P < 0.05$) higher than those who were below 175cm (Table 30). There were no significant differences ($P < 0.05$) in birth-weights of infants born to pregnant women who were above 155cm but below 175cm. However women who were below 156cm had infants of mean birth-weight (2.840 ± 0.475kg) far lower (($P < 0.05$) than those above 175cm. A similar trend was observed in relation to maternal weight-gain and maternal height where pregnant women who were above 175cm had significantly ($P < 0.05$) higher weight-gain (12.00 ± 1.732kg) during the pregnancy than those who were below 156cm (10.231 ± 1.409). There was a gradual increase in weight-gain as the height of the mother increased (Table 30).

Table 30: Birth-weight of infants and maternal Weight-gain in Relation to the Height of the Mother in the first trimester (n = 128)

Height groups (cm)	Number of mothers	Birth-weight (kg)	Maternal weight-gain (kg) 1
145 - 155	13	$2.840^{a} \pm 0.475$	$10.231^{a} \pm 1.409$
156 - 165	78	$3.054^{a} \pm 0.445$	$10.438^{a,b} \pm 1.606$
166 - 175	24	$3.085^{a} \pm 0.466$	$10.854^{a,b} \pm 1.502$
> 175	13	$3.467^{b} \pm 0.375$	$12.000^{b} \pm 1.432$

1: Means with different superscripts are significantly different, $P < 0.05$; Duncan's multiple range test.

4.3.5: Maternal Body Mass Index (BMI) at the Beginning of Pregnancy, Effect on Infant Birth-weight and Maternal Weight-gain.

The mean body mass index (BMI) of 23.094 ± 3.582, suggests that the pregnant women were of acceptable body size (Table 39) at the beginning of the pregnancy. The range for the BMI was 17.57 - 34.31. Of the 128 pregnant women who participated in the longitudinal study, 3 (2.34%) had BMI below 18 and were therefore underweight at the beginning of the pregnancy. Majority of the subjects 113 (88.28%) had acceptable BMI values. Few were either overweight, 5 (3.91%), or obese, 7 (5.47).

There were no statistically significant ($P < 0.05$) effects of BMI during the first trimester on either infant birth-weight or maternal weight-gain at term (Table 31).

Table 31: Infant Birth-weight and Maternal Weight-gain in Relation to Body Mass Index (BMI) of Mother During the First Trimester (n = 128)

Body Mass Index[2] (BMI)	Number of Subjects (%)	Birth-weight of infants (kg)	Maternal Weight-gain at term[1] (kg)
< 18 (Underweight)	3 (2.34)	3.300 ± 0.200	10.667 ± 2.307
18 - 28 (Acceptable weight)	113 (88.28)	3.038 ± 0.467	10.518 ± 1.568
29 - 30 (Overweight)	5 (3.91)	2.910 ± 0.292	10.500 ± 0.866
> 30 (Obese)	7 (5.47)	3.187 ± 0.426	11.571 ± 2.936

1: No significant differences were found for the various BMI groups, $P < 0.05$; Duncan's test.

2: Source; Jelliffe and Jelliffe, 1989.

4.3.6: Occupation of Women and Maternal Weight-gain

It was observed that the maternal weight-gain of the women during pregnancy was affected by their occupation (Table 32). Analysis of variance (ANOVA) in combination with Duncan's multiple range test showed that women who were housewives gained significantly ($P < 0.05$) more weight (11.392 ± 2.055kg) than women who were traders (10.238 ± 1.395kg) and those in professional occupations (10.400 ± 2.065kg).

Office workers had appreciably high weight-gain (11.250 ± 1.708kg) but it was not significantly ($P < 0.05$) different from that of women in the other occupational disciplines.

Table 32: Effect of Mothers Occupation on Maternal Weight-gain (n = 128)

Mothers' Occupation	Number of Mothers	Maternal Weight-gain (kg)1 (mean ± S.D)
Trader	48	$10.24^{a} \pm 1.39$
Vocational	40	$10.61^{a,b} \pm 1.88$
Office worker	14	$11.25^{a,b} \pm 1.71$
Professional	10	$10.40^{a} \pm 1.621$
Housewife	16	$11.39^{b} \pm 2.06$

1: Means with different superscripts are significantly different, $P < 0.05$; Duncan's test.

4.3.7: Effect of Parity on Maternal Weight-gain

Parity affected weight-gain in women (Table 33). Though insignificant ($P < 0.05$), women with seven or more previous pregnancies had appreciably lower maternal weight-gain (10.021 ± 1.256kg) than women with three or four previous pregnancies (10.984 ± 2.072kg). With the exception of nulliparous women who had slightly lower weight-gain (10.236 ± 1.417kg), women in the other parity groups had similar weight-gains during the pregnancy.

Table 33: Number of Previous Pregnancies in Relation to Maternal Weight-gain (n = 128).

Number of previous pregnancies	Number of Mothers	Maternal Weight-gain (kg)[1] (mean ± S.D)
None (Nulliparous)	35	10.236 ± 1.417
1 - 2	50	10.471 ± 1.640
3 - 4	32	10.984 ± 2.072
5 - 6	6	10.583 ± 0.992
7 - 9	5	10.021 ± 1.256
Total	128	10.531 ± 1.681

1: No significant differences were observed between the mean weight-gains of the various parity groups, $P < 0.05$; Duncan's multiple range test.

4.3.8: Effect of Clay intake During Pregnancy on Maternal Weight-gain.

The effect of clay intake during pregnancy on maternal weight-gain is shown in table 34.

There was no significant effect of clay intake on maternal weight-gain. Pregnant women who ate clay everyday had similar weight gain (10.375 ± 1.377kg) to those who sometimes ate clay (10.345 ± 1.440kg) and women who did not eat clay (10.595 ± 1.768) during the pregnancy.

Table 34: Effect of clay ingestion on maternal weight-gain (n = 128).

Degree of clay ingestion	Number of mothers	Maternal weight-gain[1]
Eat clay everyday	12	10.375 ± 1.377
Sometimes eat clay	21	10.345 ± 1.440
Do not eat clay	95	10.595 ± 1.768

1: No significant differences between the maternal weight-gains were observed: $P < 0.05$, Duncan's test.

4.3.9: Effect of Oedema during pregnancy on Maternal Weight-gain

The variation of maternal weight-gain with oedema is shown in table 35. There was no significant effect of oedema on maternal weight-gain. However women who developed oedema had slightly higher maternal weight-gain.

Table 35: Effect of Oedema During Pregnancy on maternal weight gain (n = 128).

Oedema category	Number of mothers	Maternal Weight-gain[1] (kg)
Women who developed oedema	52	10.827 ± 1.920
Women who did not develop oedema	76	10.329 ± 1.476
Total	128	10.531 ± 1.1681

1: No significant differences between the maternal weight-gains were observed: $P < 0.05$, Student's t-test

4.3.10: Nausea and Maternal Weight-gain

The relationship of nausea and maternal weight-gain is depicted in table 36.

Analysis of variance (ANOVA) combined with Duncan's multiple range test showed a significant ($P < 0.05$) effect of nausea on maternal weight-gain.

Pregnant women who lost appetite with vomiting gained significantly ($P < 0.05$) lower weight (10.160 ± 1.705kg) during pregnancy than those who lost appetite but did not vomit (10.761 ± 1.364kg). These weight-gains were also significantly lower than that of pregnant women who neither lost appetite nor vomited (11.057 ± 1.489kg).

Table 36: Effect of Nausea during pregnancy on Maternal Weight-gain

Degree of nausea	Number of mothers	Maternal weight-gain[1] (kg)
No loss of appetite and no vomiting	53	$11.057^{a} \pm 1.489$
Lose appetite but no vomiting	23	$10.761^{b} \pm 1.364$
Lose appetite with vomiting	72	$10.160^{c} \pm 1.705$
Total	128	10.531 ± 1.681

1: Means with different superscripts are significantly different, $P < 0.05$: Duncan's test.

4.3.11. Effect of Vomiting on Maternal Weight-gain during Pregnancy

Women who vomited during the pregnancy had significantly lower maternal weight-gain ($P < 0.05$) than those who did not vomit during the pregnancy (Table 37). The mean maternal weight-gain at term for women who vomited for less than three months (10.372 ± 1.771kg) and that of those who vomited for more than three months (9.804 ± 1.595kg) were significantly lower than the mean maternal weight-gain of women who did not vomit (11.057 ± 1.489kg) during pregnancy.

Table 37: Effect of degree of vomiting on Maternal weight-gain (n = 128)

Degree of vomiting (months)	Number of Mothers	Maternal weight gain (kg)[1]
No vomiting	53	$11.057^{a} \pm 1.489$
Vomit for less than three months	47	$10.372^{b} \pm 1.771$
Vomit for more than three months	28	$9.804^{b} \pm 1.595$

1: Means with different superscripts are significantly different, $P < 0.05$; Duncan's test.

Effect of Duration of vomiting on Rate of weight-gain was apparent throughout the pregnancy (Table 38). Those who experienced nausea with vomiting had significantly ($P < 0.05$) lower maternal weight-gain throughout pregnancy than women who did not vomit(Figure 7).

Table 38: Mean monthly Maternal Weight-gain (kg) in Relation to Duration of vomiting (n = 128)

Gestational age (weeks).	Duration of Vomiting		
	Less than three months. (n = 47)	Greater than three months. (n = 28)	No vomiting (n = 53)
16	1.096 ± 0.518	0.982 ± 0.726	1.434 ± 0.567
20	2.776 ± 1.042	2.554 ± 1.383	3.368 ± 1.001
24	4.638 ± 1.245	4.500 ± 1.564	5.538 ± 1.319
28	6.660 ± 1.504	6.357 ± 1.627	7.566 ± 1.566
32	8.830 ± 1.822	8.375 ± 1.642	9.584 ± 1.667
36	10.372 ± 1.771	9.804 ± 1.595	11.057 ± 1.490

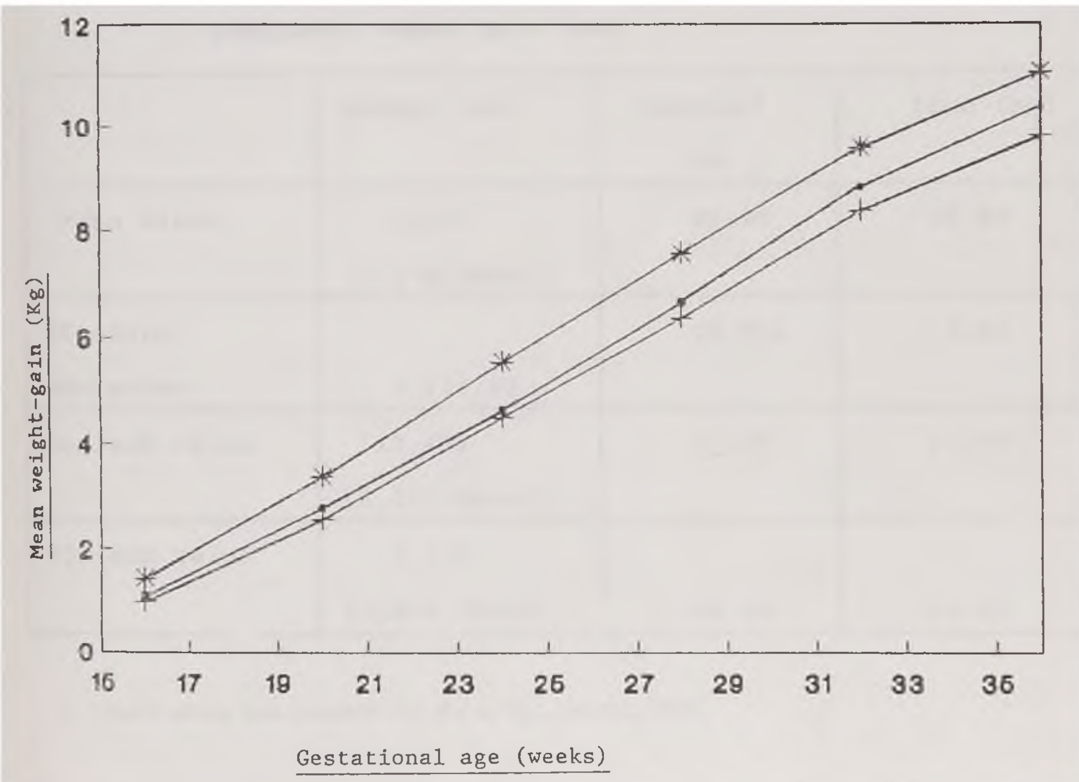
Figure 7: Effect of vomiting on maternal weight gain during pregnancy (n=128).

Legend

Do not vomit during pregnancy: —*—*—*—

vomit for less than 3 month: —■—■—■—

vomit for more than 3 month: —×—×—×—


Mean weight-gain (Kg)
0
2
4
6
8
10
12
16
17
19
21
23
25
27
29
31
33
35
Gestational age (weeks)

4.4: DIETARY INTAKE DATA

The dietary assessment was done through a 24-hour dietary recall on three different occasions on the 128 pregnant women who participated in the longitudinal study. The food intake data was analyzed for energy, protein and iron intakes. Table 39 shows the average energy, protein and iron intakes of the pregnant women.

Table 39: Average Energy Protein and Iron intakes of the pregnant women (n = 128)

	Energy (kJ)	Protein[1] (g)	Iron (mg)
Mean value	9,109 (2,175.5kcal)	48.99	25.54
Standard deviation	1,171.83	10.042	6.82
Maximum value	13,431 (3,207.0kcal)	74.79	47.96
Minimum value	6,315 (1,508.7kcal)	28.98	14.43

1: Protein values were corrected with NPU of 70% ,(WHO/FAO, 1973).

4.4.1. Effect of Energy Intake of the Pregnant Women on Infant Birth-weight and Maternal Weight-gain.

The mean daily energy intake of 9,109.00 ± 1171.83KJ (2,175.5kcal) was found to be similar to the daily energy requirement for the non-pregnant woman (9,569.61kJ; 2,278.48kcal) Among the subjects, daily energy intake ranged from 6,315.00 - 13,431.00KJ (1508.70 - 3207.00kcal) (Table 39).

The mean energy intake met about 87.8% of the recommended energy requirement for pregnant women; 10,409.62kJ (2478.48kcal). Protein provided 9.0% of the mean energy intake. The energy intakes of 51 (40%) of the subjects were within 80 - 90% of the recommended intake (Table 40). Those taking 90 - 100% of the requirement were few, 19 (15%). However about 30% of the women met more than 100% of their daily energy requirement.

Table 40 shows infant birth-weight and maternal weight-gain in relation to mothers energy intake.

Women who met more than 100% of their daily energy requirement had infants whose birth-weights were significantly ($P < 0.05$) higher than those taking energy below 80% of their daily requirement.

Mothers who met more than 100% of their energy requirement had maternal weight-gains statistically higher ($P < 0.05$) than those who met less than 90% of the requirement. However no statistical differences were observed among mothers who met

91 - 100% and those who met above 100% of the requirement. This indicates that maintaining energy intakes above 90% of requirement would improve maternal weight-gain.

Table 40: Effect of Energy Intake of Pregnant Women on Maternal Weight-gain, and Infant Birth-weight, (n = 128)

	(%) energy requirement met (Reference: 10,360.1kJ/day (2,478.48kcal/day)[1]			
	70 - 80%	81 - 90%	91 - 100%	> 100%
Number of subjects Percentage (%)	27 (21.1)	53 (41.4)	35 (27.3)	13 (10.2)
Birth-weight (kg)	$2.947^{a} \pm 0.462$	$3.021^{a,b} \pm 0.462$	$3.153^{a,b} \pm 0.470$	$3.183^{b} \pm 0.383$
Maternal Weight gain (kg)	$10.074^{a} \pm 1.172$	$10.076^{a} \pm 1.449$	$11.371^{b} \pm 1.864$	$11.077^{b} \pm 0.976$

a: means with different superscripts are significantly different: $P < 0.05$, Duncan's test.

1: Non-pregnancy energy requirement plus pregnancy allowance (2,278.48 + 200)kcal/day, based on mean weight of 60.8kg woman, who is moderately active; BMR x 1.64 = (14.7 x 60.8 + 496) x 1.64. (FAO/WHO,1985).

4.4.2: Effect of Maternal Protein Intake on Infant Birth-weight, Maternal Weight-gain and Haemoglobin Level

From table 41, protein intake by the pregnant women ranged from 28.98 - 74.49g/day, with a mean intake of 48.987 ± 10.04g/day. This mean intake met about 104% of the estimated pregnancy protein requirement (47g/day) (FAO/WHO, 1985).

Of the 128 pregnant women, 61 (47.66%) met more than 100% of their protein requirement while 35(27.34%) women met between 90% and 100% of their requirement. None of the women met below 70% of their protein requirement.

Pregnant women who met more than 80% of their protein requirement had significantly ($P < 0.05$) higher infant birth-weights than those who met less than 80% of their requirement (Table 41).

In the case of maternal weight-gain, pregnant women meeting more than 100% of their protein requirement had significantly ($P < 0.05$) higher weight-gain than those taking 80% of their requirement.

Haemoglobin levels in relation to protein intakes were not significantly different in all groups (Table 41).

Table 41: Maternal Weight-gain, Haemoglobin Levels and Infant Birth-weight in Relation to Protein Intake (n = 128)[1]

	Percentage of Protein Requirement Met. (Reference; 47g Protein/day)[2]			
	< 80%	81 -90%	91-100%	> 100%
Number of subjects	11	21	35	61
Percentage (%)	8.63	16.41	27.34	47.66
Infant Birth-weight (kg)	2.755^{a} ± 0.439	2.983^{b} ± 0.428	3.027^{b} ± 0.438	3.134^{b} ± 0.461
Maternal weight-gain (kg)	9.864^{a} ± 1.080	$10.500^{a,b}$ ± 1.809	$10.243^{a,b}$ ± 1.714	10.828^{b} ± 1.601
Maternal Haemoglobin Level (g/dl)	11.309^{a} ± 0.487	11.531^{a} ± 0.568	11.502^{a} ± 0.622	11.529^{a} ± 0.633

1: Meansu in the same row with different superscripts are significantly different: $P < 0.05$, Duncan's test.

2: Non-pregnant protein requirement plus pregnancy allowance; (41g + 6g) Protein/day (FAO/WHO, 1985).

4.4.3: Dietary iron intake and effect on birth weight, maternal weight-gain and haemoglobin level

The dietary iron intake of the pregnant women ranged from 14.43 - 47.96mg/day, with a mean intake of 25.539 ± 6.819mg/day (Table 39).

In view of the difficulty in meeting iron requirement during pregnancy through dietary intake only, comparison with pregnancy absorbed iron requirement of 24.3mg/day (FAO/WHO, 1988) was not done. Instead, levels of dietary iron intake in relation to birth-weight was assessed.

The effects of dietary iron intake on birth-weight, maternal weight-gain and maternal haemoglobin level are shown in table 42.

Sixteen (12.50%) of the women took below 18mg, while 33 (25.78%) women took above 30mg of dietary iron per day.

Infant birth-weight was not sensitive to iron intake by the pregnant women studied. Pregnant women who took below 18mg had significantly ($P < 0.05$) lower maternal weight-gain than those who took above 30mg of dietary iron per day.

Haemoglobin levels of the pregnant women were significantly ($P < 0.05$) higher for those who took above 28mg of dietary iron per day. However, there were no statistical differences ($P < 0.05$) in haemoglobin levels of women in the other levels of iron intake.

Table 42: Dietary Iron Intake and Effects on Infant Birth-weight, Maternal Weight-gain and Haemoglobin level[1]

	Level of dietary Iron intake (mg/day)					
	< 18	18 -21	22 - 24	25 - 27	28 - 30	> 30
No. of mothers	16	24	21	19	15	33
Percentage (%)	12.50	18.75	16.41	14.84	11.72	25.78
Infant Birth-weight (kg)	$2.966^{a} \pm 0.393$	$3.087^{a} \pm 0.548$	$3.087^{a} \pm 0.409$	$3.113^{a} \pm 0.460$	$2.967^{a} \pm 0.363$	$3.042^{a} \pm 0.494$
Maternal Weight-gain (kg)	$10.031^{a} \pm 2.053$	$10.392^{a,b} \pm 2.162$	$10.643^{a,b} \pm 1.296$	$10.263^{a,b} \pm 1.316$	$10.267^{a,b} \pm 1.033$	$10.788^{b} \pm 1.750$
Maternal haemoglobin level (g/dl)	$11.562^{a} \pm 0.428$	$11.585^{a} \pm 0.733$	$11.274^{a} \pm 0.511$	$11.462^{a} \pm 0.589$	$11.797^{b} \pm 0.670$	$11.752^{b} \pm 0.575$

1: Mean values in the same row with different superscripts are significantly different: $P < 0.05$, Duncan's test.

4.5: HAEMOGLOBIN DATA

4.5.1: Maternal Haemoglobin Levels During Pregnancy and Effect on Infant Birth-weight

The mean haemoglobin level of the pregnant women throughout pregnancy was found to be 11. 503 ± 0.603g/dl, with a range of 10.01 - 13. 06g/dl (Table 39). The mean haemoglobin level was within acceptable level (11.0g/dl; Tomkins, 1991) for pregnant women but below 12g/dl, the acceptable limit for non-pregnant women.

Table 43 shows maternal haemoglobin levels during the pregnancy. From the total of 128 pregnant women, 26 (20.31%) had mean haemoglobin level below 11.0g/dl from the third to the ninth month of pregnancy, and were therefore anaemic by WHO standard (Tomkins, 1991). Seventy-eight (60.93%) of the pregnant women had haemoglobin level above 11g/dl but below 12g/dl, while 24 (18.79%) had haemoglobin levels above 12g/dl.

The maternal haemoglobin level did not have significant ($P < 0.05$) effect on infant birth-weight. However pregnant women with mean haemoglobin level above 12g/dl had infants of slightly higher birth-weight than those who had haemoglobin level below 11g/dl (Table 43).

Table 43: Effect of maternal Haemoglobin level on Infant Birth Weight (n = 128)

Maternal haemoglobin level (g/dl)	No. of mothers (%)	Infant Birth-weight[1] (kg) (mean ± S.D)
Below 11.00	26 (20.31)	3.066 ± 0.581
11.00 - 11.99	78 (60.93)	3.011 ± 0.426
12.00 - 13.00	22 (17.19)	3.157 ± 0.403
Above - 13.00	2 (1.60)	3.187 ± 0.438

1: No significant differences between infant birth-weights were observed, $P < 0.05$; Duncan's test.

4.5.2: Evaluation of Iron and Vitamin Supplementation During Pregnancy

Haemoglobin level and infant birth-weight were used as the response for the evaluation of effectiveness of iron and vitamin supplementation during the pregnancy.

From figure 8 and Appendix 10 it is seen that there was a gradual decrease in mean maternal haemoglobin level from the third month (11.705 ± 1.010g/dl) to the seventh month (11.182 ± 0.746g/dl) and then a sharp decrease in the eighth month (10.856 ± 0.719g/dl), and could not recover much in the ninth month (11.065 ± 0.524g/dl).

The observation that maternal haemoglobin level was below 12g/dl throughout pregnancy indicates that the level of iron and Vitamin supplementation could not maintain high maternal haemoglobin level during the pregnancy. It did, however, maintain an adequate haemoglobin level ($\geq$ 11.0g/dl) by WHO standard for pregnant women.

4.5.3: **Nausea and Maternal Haemoglobin level.**

Loss of appetite for less than three months did not significantly ($P < 0.05$) affect the haemoglobin level of those pregnant women (Table 44). However pregnant women who lost appetite with vomiting had significantly lower haemoglobin level (11.368 ± 0.571g/dl) than pregnant women who neither lost appetite nor vomited (11.695 ± 0.604g/dl).

Figure 8: Mean maternal haemoglobin level at various gestational ages (n = 128).

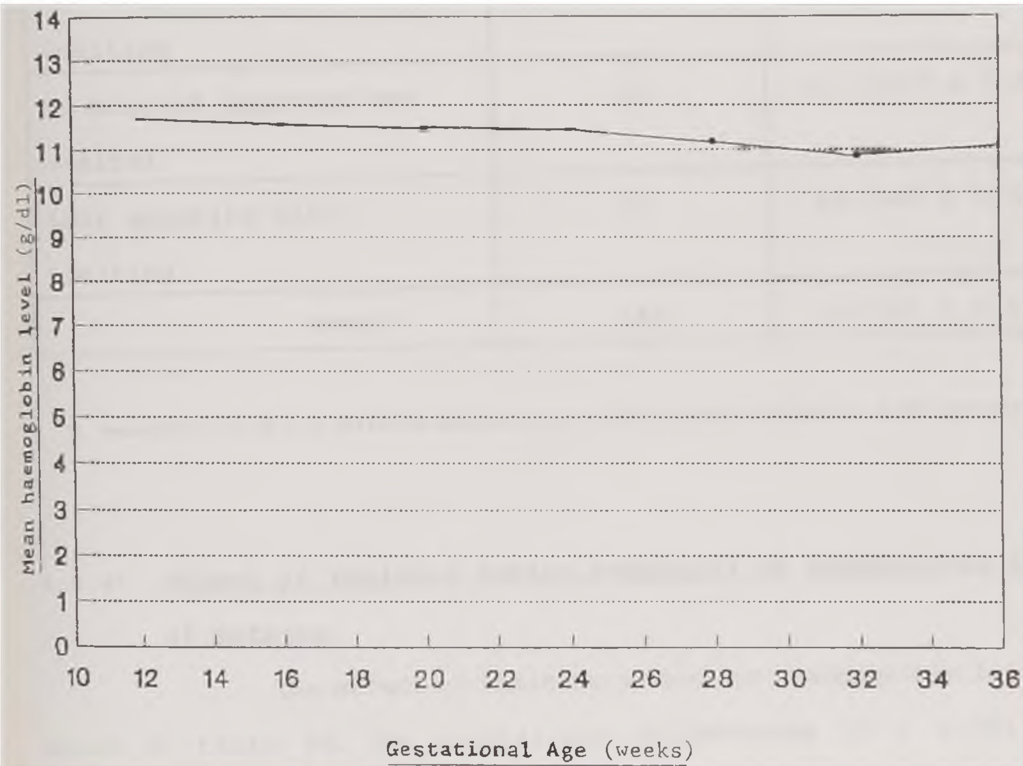

Mean haemoglobin level (g/dl)
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
10
12
14
16
18
20
22
24
26
28
30
32
34
36
Gestational Age (weeks)

Table 44: Effect of Nausea during Pregnancy on Maternal Haemoglobin level.

Degree of nausea	Number of mothers	Maternal haemoglobin level[1] (g/dl)
No loss of appetite and no vomiting	53	$11.695^{a} \pm 0.604$
No Loss of appetite but vomited	23	$11.714^{a,b} \pm 0.655$
Lost appetite with vomiting	72	$11.368^{b} \pm 0.571$
Total	128	11.503 ± 0.603

1: Haemoglobin values with different superscripts are significantly different, $P < 0.05$; Duncan's test.

4.5.4: Effect of Vomiting during Pregnancy on Haemoglobin level of mothers.

The effect of vomiting on mothers' haemoglobin levels is shown in table 45. No significant differences ($P < 0.05$) were observed between the haemoglobin level of mothers who vomited for less than three months (11.354 ± 0.552g/dl) and those who vomited for more than three months (11.391 ± 0.603g/dl). However women who did not vomit during pregnancy had significantly ($P < 0.05$) higher haemoglobin level (11.895 ± 0.604g/dl) than those who vomited irrespective of the duration of vomiting.

Table 45: Effect of Duration of Vomiting on Mothers' Haemoglobin Level During Pregnancy

Duration of vomiting (months)	Number of mothers	Maternal haemoglobin level[1] (g/dl) (mean ± S.D)
No vomiting	53	11.895[a] ± 0.604
Less than three months	47	11.354[b] ± 0.552
More than three months	28	11.391[b] ± 0.603
Total	128	11.503 ± 0.603

1: Means with different superscripts are significantly different, $P < 0.05$; Duncan's test.

4.5.5: Effect of Clay Intake During Pregnancy on Maternal haemoglobin level

The effect of clay intake during pregnancy on maternal haemoglobin level is shown in table 46.

Pregnant women who ingested clay during the pregnancy had significantly ($P < 0.05$) lower haemoglobin levels than those who did not eat clay. Pregnant women who ate clay everyday had mean haemoglobin level (10.863 ± 0.412g/dl) significantly ($P < 0.05$) lower than that of those who ate clay less frequently (11.238 ± 0.596g/dl). These mean haemoglobin levels were significantly lower than that of pregnant women who did not ingest clay during the pregnant (11.611 ± 0.574g/dl).

Table 46: Effect of clay ingestion on mean monthly maternal haemoglobin level (n = 128)

Degree of Clay ingestion	Number of mothers	Maternal haemoglobin level[1] (g/dl) (mean ± S.D)
Eat clay everyday	12	10.863^{a} ± 0.412
Sometimes eat clay	21	11.238^{b} ± 0.596
Do not eat clay	95	11.611^{c} ± 0.574

1: Mean with different superscripts are significantly different, $P < 0.05$; Duncan's test.

4.6: Correlation analvses of Factors Affecting Pregnancy Outcome

The extent to which the factors studied affect pregnancy outcome were assessed through correlation analysis (Tables 47 - 49)

Table 47: Correlation Values of Factors which showed Relationship with Birth-weight (Results from epidemiological study, n = 502)

Factors	Birth-weight		Remarks[b].
	Correlation Coefficient (r)	R^2 (%)[a]	
Nausea.	- 0.180	3.2	Significant (r)
Mothers' educational level	+ 0.093	0.9	- do -
Vomiting level	- 0.089	0.9	- do-
Oedema	+ 0.088	0.6	- do -

a:R2 is an index of the extent of association between thevariables(R2100r2)

b:Significant level of r for a sample size of 502 (df , 500) 0.088 (Steel, 1980)

Table 48: Correlation Values of Factors which showed Relationship with Birth-weight (Results from longitudinal study, n = 128)

Factors	Birth-weight		Remarks[b]
	Correlation Coefficient (r)	R^2 (%)[a]	
Maternal weight-gain.	+ 0.484	23.4	Significant (r)
Maternal height	+ 0.204	4.2	- do -
Protein intake	+ 0.230	5.3	- do -
Energy intake	+ 0.180	1.7	Insignificant (r)
Duration of supplementation	+ 0.130	1.7	- do-
Haemoglobin level	+ 0.047	0.8	- do -
BMI[c]	+ 0.082	0.7	- do -
Dietary Iron intake	+ 0.018	0.03	- do -

a: R^2 is an index to the extent of association between the variables $R^2 = 100r^2$).

b: Significant level of r for a sample size of 128 (df; 126) = 0.174 (Steel, 1980)

c: BMI [weight (kg)/height^2 (m)] is the body mass index in the first trimester.

Table 49: Correlation Values of Factors which showed Relationship with Maternal Weight-gain (results from longitudinal study, n = 128)

Factors	Maternal Weight-gain		Remarks[b]
	Correlation Coefficient (r)	R^2 (%)[a]	
Energy intake	+ 0.295	8.7	Significant (r)
Maternal height	+ 0.227	5.1	- do -
Protein intake	+ 0.225	5.1	- do -
Duration of supplementation	+ 0.200	4.0	- do -
Oedema	+ 0.146	2.1	Insignificant (r)
BMI[c]	+ 0.143	2.0	- do-
Parity	- 0.093	0.3	- do -
Iron intake	+ 0.050	0.3	- do -
Malaria	- 0.038	0.1	- do -
Diarrhoea	- 0.011	0.1	- do -

a: R^2 is an index to the extent of association between the variables ($R^2 = 100r^2$).

b: Significant level of r for a sample size of 128 (df; 126) = 0.174 (Steel, 1980)

c: BMI is the body mass index in the first trimester.

CHAPTER FIVE

5. DISCUSSIONS AND CONCLUSION

5.1: EPIDEMIOLOGICAL DATA

5.1.1: Infant Birth-weight

Infant birth-weight is a good proxy for the assessment of pregnancy outcome. Favourable pregnancy outcome is usually associated with acceptably high birth-weight. It is also a strong indicator of the survival of infants and health status of women (Food and Nutrition Bulletin, 1984). However, high infant birth-weight can pose mechanical difficulties during labour.

It was observed, after studying 502 pregnant women, that majority (90.64%) of them had infants of acceptable birth-weight (Birth-weight; 2.5 - 4.0kg). The prevalence of low birth-weight (birth-weight below 2.5kg; WHO, 1971) observed in the study was 8.4%, which is lower than the national figure of 17% reported by UNICEF in 1991 for Ghanaians (Figure 2, Appendix 5).

The observed mean birth-weight of infants of 2.999 ± 0.511kg, is in close agreement with the infant birth-weight of 2.879kg reported for the Ghanaian population, but below the value of 3.188kg for prosperous Ghanaian groups (WHO, 1971).

The prevalence of macrosomia (infant birth-weight above 4.0kg) found in the study was low (1.0%) (Appendix 5).

The mean birth-weight observed was below the value of 3.30kg reported for developed countries (FAO/WHO, 1985).

Infant birth-weight can be adversely affected by many factors. Inadequate energy intake, high physical activity, low haemoglobin level and poor physiological state of some women during pregnancy contribute to the lower birth-weight of infants in less technically developed countries. Apart from these, high infant birth-weight delivery is reported to be associated with a change in attitude of pregnant women due to fear for obstructed labour. These women may not engage in any activity that could lead to an increase in the size of the foetus especially those in communities where obstetric services are limited (Garner and Kramer, 1991). These changes in behaviour in addition to other maternal habits like pica and alcohol intake, delayed ante-natal care, and nausea during pregnancy, can contribute to the delivery of infants of lower birth-weight in less developed than developed countries, as observed in the study.

The lower prevalence of low birth-weight, observed in this study, is because the subjects live in Accra the national capital, and therefore have to ante-natal care and other services, which may not be available to majority of rural women.

5.1.2: <u>Effect of Mothers' Educational Level on Infant Birth-weight</u>

The results obtained in the study (Table 9) suggest that the educational level of the mother does not have a significant influence on infant birth-weight. However pregnant women who have had tertiary education had infants of slightly higher birth-weight, than the women with lower educational levels. The positive correlation obtained (r = + 0.093) which was significant, (Table 47) further suggests that education of the mother is associated with an increase in the birth-weight of her infant and hence a more favourable outcome of pregnancy.

The slightly higher infant birth-weight for women in the tertiary educational level may be attributed to the usually higher socio-economic status of women in this category (Table 1). Women of high educational level usually have better access to health care, and good nutrition during pregnancy (Kaur and Sagar, 1982). In addition, they have better social services like that of servants and cars including household appliances, which reduce physical activities associated with their daily chores. They also have small family size (Kaur and Sagar, 1982) and better ability of self initiative and care seeking as well as good health practices during pregnancy (Food and Nutrition Board, 1971). All these are contributory factors which are favourable for adequate foetal growth. The relatively higher infant birth-weight for women with tertiary education can thus be partly due to their relative superiority, in this respect, over women of lower educational levels.

5.1.3: Effect of Mothers' Occupation on Pregnancy.

Data from Table 10 indicates that pregnant women who were housewives had infants of significantly ($P < 0.05$) higher birth-weight than women who were engaged in some form of occupation. Traders (mostly hawkers) who tended to be more mobile and therefore expended much energy had relatively lower birth-weight infants likewise lower pregnancy weight-gain.

It was observed in the study that husbands of women who were housewives were of better socio-economic status and possibly better nutritional status prior to and during pregnancy than the trader or vocational workers who may work until late pregnancy (personal observation). The increased maternal weight-gain observed in subjects who were office workers may be partly explained by their type of occupation which is associated with less mobility and therefore less energy expenditure (FAO/WHO,1988).

These observations suggest that women of low physical activity are more likely to deliver infants of higher birth-weight and gain more weight during pregnancy.

Various researchers have observed similar trends in occupation and pregnancy outcome. Briend in 1980 observed that high physical activity was associated with the delivery of low birth-weight infants (Briend, 1980). Similar observations was also made by Tafari and Naeye (1980) in Addis Ababa, that pregnancy outcome (birth-weight) and pregnancy weight-gain improved when women reduced their physical activity to counterbalance reduced dietary energy intake. Also increased fat deposition following decreased physical activity during pregnancy is associated with satisfactory infant birth-weight (FAO/WHO, 1985). In this study the energy intake of the subjects was low compared to their pregnancy requirement, and women whose occupation were less exacting energywise tended to have higher infant birth-weights.

5.1.4: Effects of Parity on Pregnancy

The number of previous pregnancies women have had affected infant birth-weight in a dual manner (Table 23). Women who have had three or four previous pregnancies had infants of significantly ($P < 0.05$) higher birth-weight than women who were in their first pregnancy (nulliparous) and women with seven or more previous pregnancies (Figure 6).

The effect of parity on maternal weight-gain was similar to that on infant birth-weight (Table 32). Women who have had three or four previous pregnancies had significantly higher maternal weight-gain than those with seven or more previous pregnancies (Figure 11). In this case, although nulliparous women had lower maternal weight-gain, the difference was not significant.

These observations suggest that the pregnant women seemed to adapt to the pregnancy up to the fourth one after which dwindling maternal nutrient stores could not adequately support further pregnancies (Tomkins and Watson, 1991), and hence the lower infant birth-weight and maternal weight-gain observed for higher parity.

The effect of parity on pregnancy outcome is not clear. While Venkatachalan and Shankar (1970) observed a fall in maternal weight-gain with rising parity among the poorly fed Chimbu women in

New Guinea, Thomson and Billewcz (1970) found no such decrease with increasing parity in a South African village. Similarly, Rajlakshmi (1971) in India found no decrease in maternal weight-gain with rising parity. The result of the present study is consistent with that of Venkatachalan and Shankar (1970).

The increase in infant birth-weight up to the fourth pregnancy is in agreement with earlier reports by Grover (1982), Shah (1981) and Rajlakshmi (1971) who observed an increase in birth-weight with rising parity up to the fourth, fifth and sixth pregnancies.

In the study, the fear for death of a child was a strong factor in determining the number of children mothers had (Table 24). Since large family size in developing communities adversely affects adequate nutrition of women (Dhalival, 1980), it implies that high rate of child mortality can adversely affect maternal nutrition, because women may have more children as a security against child mortality.

5.1.5: Nausea During Pregnancy and Effect on Pregnancy outcome

Physiological changes associated with the pregnancy included uncomfortable conditions in some of the pregnant women. Some of these discomforts in pregnancy are also clinical signs for anaemia (ie. headache, dizziness, heart pounding, joint pains, lack of sleep (insomnia), excessive tiredness and general weakness).

From this study, it was observed that not only the presence of nausea but also the severity and duration were equally important in affecting infant birth-weight and maternal weight-gain (Table 13, Figure 4). The major effects of nausea on pregnancy were loss of appetite, vomiting, salivation and strong aversion to some nutritious foods. Hence the observation in the study that pregnant women who did not experience nausea during the pregnancy had higher weight-gain and infant birth-weights can be due to the adverse effects these discomforts on food intake of the affected women during the pregnancy. Nausea correlated negatively with birth-weight ($r = - 0.180$) (Table 47). This significantly negative correlation indicates that the experience of nausea by pregnant women is associated with a decrease in infant birth-weight.

The adverse effect of nausea on maternal haemoglobin level was probably partially obliterated by the beneficial effects of iron and vitamin supplementation during the pregnancy. However the fact that the pregnant women who lost appetite with vomiting had significantly ($P < 0.05$) lower haemoglobin level is an indication that the level of nutrient supplementation, especially iron and vitamins involved in maternal haematopoiesis, could not sustain maternal haemoglobin levels in pregnant women who experienced nausea (Table 44).

Singularly, vomiting during pregnancy had significant ($P < 0.05$) adverse effects on pregnancy (Table 14). The drastically lower ($P < 0.05$) birth-weight of infants born to women who vomited for more than three months, as compared to those who did not vomit, can be the consequence of decreased nutrient intake for a longer period due to vomiting during pregnancy. A significantly negative relationship ($r = -0.089$) was observed for birth-weight and vomiting during pregnancy.

Although the pregnant women were on iron and vitamin supplements, the level of supplementation could not obviate the adverse effect of vomiting on maternal haemoglobin level. The consequence of this effect culminated in lower maternal haemoglobin level of women who vomited for more than three months during the pregnancy.

When the rate of maternal weight-gain was assessed at the various gestational ages, it was observed that the difference in weight-gain between pregnant women who vomited for less than and those vomiting for more than three months became significant after the seventh month of pregnancy, a period when those who vomited for less than three months might have replenished their nutrient stores and had gained much weight (Table 38).

The maternal weight-gain at the ninth month, a period when appreciable number of the subjects (24.90%) delivered, was significantly ($P < 0.05$) lower in women who vomited for three months or more. This suggests that the adverse effects of vomiting was throughout pregnancy. Though it is reported (Food and Nutrition Board, 1971) that women who experience nausea in pregnancy become voracious in late pregnancy, this habit could not obviate the detrimental effect of vomiting on maternal weight-gain in late pregnancy.

Apart from the induced reduced food intake, other effects of nausea can adversely affect the dietary habits of pregnant women.

Pelchat and Rozin in 1982, reported that when nausea follows ingestion of food, people tend to develop dislike for the taste of the food (Pelchat and Rozin, 1982). Nausea also motivates avoidance of associated foods through events such as diarrhoea, respiratory distress or rashes (Pelchat and Rozin, 1982). In this study, therefore, the presence of nausea in the pregnant women might have caused drastic adverse changes in maternal food habits, resulting in its observed adverse effects on pregnancy. For instance, Baylis and Leeds (1982) observed that women with pregnancy sickness had a high preference for dairy products. Also the intake of vitamin B_6-rich foods and sucrose were reported to be reduced in women who experience nausea (Pickard, 1983).

5.1.6: Prevalence of Oedema During Pregnancy and Effect on Infant Birth-weight

A substantial number of the pregnant women, 205 (41%) developed oedema during the pregnancy (Table 22). Oedema of the limbs was the commonest type of oedema observed in the pregnant women. Generalized oedema (that is, presence of oedema in other sites of the body in addition to the limbs) was absent in the pregnant women.

Pregnant women who developed oedema had infants of significantly ($P < 0.05$) higher birth-weight than those who did not develop oedema. In addition, there was a significantly positive correlation ($r = + 0.088$) between oedema and infant birth-weight.

Subjects who developed oedema complained of pains and dampness at the feet, and described it as uncomfortable.

The oedema prevalence (40.8%) observed in the study is similar to that (40%) reported by Thomson and Billewcz in (1970) among pregnant women in the Gambia. In the Collaborative Perinatal Project in the United States of America, Hytten and Chamberlain (1980) observed that the development of oedema was associated with adequate maternal blood volume expansion. The observation in the present study, that women who developed oedema had infants of higher birth-weight might be due to adequate nutrient supply to the foetus, following the higher maternal blood volume expansion.

The development of oedema during pregnancy was associated with an increase, though not significant in maternal weight-gain during pregnancy (Table 35). The significant difference may be attributed to the reported view that the water accumulated during pregnancy by women who develop oedema is not significantly different from that accumulated by women who do not develop oedema (Hytten and Thompson, 1970).

5.1.7: <u>Alcohol Intake During Pregnancy</u>

There are undesirable effects of alcohol on the human body, particularly on nutritional status, on the foetus as well as on essential organs like the liver and the brain (Seymour and Halpern, 1979). This makes the observation that the prevalence of alcohol consumption of 9.36% among the pregnant women observed in the study must be looked at with all seriousness (Table 15). Fortunately further observation indicated that the quantities of alcoholic drinks taken by the subjects were not excessive. Those who took local gin during the pregnancy drank less than 100ml per week, while on the average one or two bottles (600 - 1200ml) per week were taken by those who preferred beer or guiness.

Of the 47 (9.36%) women who took alcohol during the pregnancy, 21 (45%) were of the view that the alcohol will help them regain appetite, while others, 11 (23%), took alcohol to prevent vomiting (Table 16). A substantial number, 15 (32%) of those who took alcohol developed the taste for alcohol during the pregnancy. Clearly, there are other ways of gaining appetite or preventing vomiting and alcohol use to achieve these aims is an indication of the ignorance, on the part of the pregnant women of the deleterious effects of alcohol on the human body. Mass education through the media, at ante-natal clinics and at adult literacy classes can help reduce alcohol consumption by women, especially during pregnancy.

The rate of alcohol intake was found to be variable among the pregnant women. Among those who ingested alcohol during the pregnancy, 6 (13%) took alcohol everyday. While in 41 (87%) women, alcohol intake was infrequent. Further observation suggests that the frequency of alcohol intake by the pregnant women was related to the type of alcoholic drink taken. Those who took local gin had more frequent intake than those who had preference for beer or guiness. The reasons were that the local gin was cheaper and could be dispensed in smaller quantities than beer or guiness.

The number of women (47) who ingested alcohol is small as compared to the total number (502) of women in the study. Hence the various levels of alcohol intake and effects on pregnancy could not fully be discussed based on observations from this study. However women who took alcohol had similar infant birth-weights (3.077 ± 0.346) to those who did not take alcohol (2.992 ± 0.521) during the pregnancy.

Some researchers (Burton and Foster, 1988; Abel, 1982; and Sokol et al, 1980) have observed a decrease in infant birth-weight upon excessive intakes of alcohol during pregnancy. In the present study, small doses of alcohol were taken as compared to excessive amounts reported (Sokol et al, 1980). This difference may be the reason why infant birth-weight was not affected by alcohol intake in the present study.

5.1.8: Pica During Pregnancy

The pregnancy is associated with some alterations of maternal habits. Notable among these is the practice of pica (the ingestion of non-food items). This study showed that about half 241 (48.0%) of the 502 pregnant women studied ingested some types of non-food materials (Table 17). Clay intake, by 143 (28.5%) women, was the most common form of pica practised. Some of the pregnant women chewed stick or sponge; 49(9.8%), and cola; 25 (5.0%), more frequently than when not pregnant, while few ingested fresh maize dough; 14 (2.8%), chalk; 6 (1.2%) and raw starch; 4 (0.8%).

These findings imply that in addition to aversion to some nutritious foods due to nausea, some pregnant women develop taste for some non-food items. The combined effects of these on the dietary intake during pregnancy can be profound. The non-food materials might replace a substantial part of the diet possibly preventing adequate nutrition during pregnancy. Some of these non-food items like chalk and clay can form chelates with essential mineral elements like iron and calcium and reduce their availability in the gut, and can also cause obstruction of the colon (Key et al, 1982). The reduced availability of iron and other mineral elements can aggravate the already high anaemia prevalence among pregnant women in developing countries. The high microbial contents of items like raw maize dough and fresh starch can also induce diarrhoea in women who ingest them.

Pica practice by pregnant women has been reported by Talkington et al, 1971. In his report, they observed that the ingestion of starch promoted iron deficiency anaemia, not because raw starch prevented iron absorption but the raw starch supplied energy without iron. The ingestion of coal and chalk is also reported to be a common form of pica among some pregnant women (Food and Nutrition Board, 1971).

The high prevalence of pica among the Ghanaian pregnant women studied is undesirable and can be reduced through efficient public education especially at maternal and child health (MCH) clinics and also in the mass media.

Clay eating was observed among some of the pregnant women (Tables 18 and 19). While 14 (2.8%) women ate clay everyday, 129 (25.7%) ingested clay less frequently. In this case clay consumed by the subjects is White clay popularly known as " Ayilao " in Ga, and as " Shirew " in Akan. Traditionally this white clay is used on the body during rituals like Dipo and in some cases on the body of the mother during the first few days following parturition.

Two main groups of pregnant women were discovered in relation to their motives for eating clay. The first group 81 (16.1%) ate clay to allegedly prevent spitting (salivation) or vomiting, while the second category, 62 (12.4%) ate clay because they liked the flavour of it (Table 18).

Nevertheless, clay intake did not have any effect on the birth-weight of infants (Table 19). There were no significant ($P < 0.05$) differences in the birth-weights of infants born to women who ate clay everyday, those who ate clay less frequently and those who did not eat clay at all during pregnancy.

Maternal weight-gain was not affected by clay intake (Table 34). Pregnant women who ate clay everyday had similar maternal weight-gain to those who ate clay less frequently, and those who did not eat clay during the pregnancy.

Data from table 46 indicate that clay intake markedly reduced maternal haemoglobin level. Subjects who ingested clay during the pregnancy had significantly ($P < 0.05$) lower maternal haemoglobin level than those who did not eat clay. Pregnant women who ate clay everyday had a mean haemoglobin level (10.863 ± 0.412g/dl) which was significantly lower than that of women who ate clay less frequently (11.238 ± 0.596g/dl). Irrespective of the degree of clay intake, maternal haemoglobin level was higher for those who did not eat clay (11.811 ± 0.574g/dl) than those who did. The mean haemoglobin level of women who ate clay everyday indicates that they were anaemic by WHO standard (Haemoglobin concentration < 11.0g/dl) for pregnant women (Tomkins and Watson, 1991).

The significantly negative correlation (r = -0.322) between clay intake and haemoglobin level suggests an association between clay intake and anaemia.

Various reasons can be assigned to the ability of clay to reduce maternal haemoglobin level. The clay can form chelates with essential mineral elements needed for haemoglobin synthesis, such as iron and copper, and prevent their absorption. The reduced availability of mineral elements needed for haemotopoiesis can lead to iron-deficiency anaemia, worsening the already high anaemia prevalence among pregnant women. In addition, the absorption of mineral elements like calcium and magnesium could be reduced for the same reason. Some of the components of clay and other earth materials can promote toxaemia and respiratory tract infection, including worm infestation in the pregnant women.

A high rate of death was observed among pregnant women who ate clay during pregnancy (Key et al, 1982). Women who ingested clay frequently suffered from severe anaemia, complete obstruction of the colon with perforations and sepsis (Key et al, 1982).

The role of clay intake in the genesis of iron-deficiency anaemia is however not clear. For instance, while Minnich et al (1970) reported that Turkish clay markedly decreased absorption of iron, Takington (1971) found only a minimal impairment of iron absorption caused by the type of clay that is popularly eaten by pregnant women in East Texas. It is therefore probable that different clay types have different effects on maternal haemoglobin level, since the composition of the clay may be different at different places. As observed in the study, clay eaten by Ghanaian pregnant women adversely affected maternal haemoglobin level.

5.1.9: Food Avoidance During Pregnancy

Data obtained show that food avoidance was common among the pregnant women (Table 20). More than half (62.4%), of the pregnant women avoided some kind of food during the pregnancy. Unfortunately, high protein foods like fresh fish and fresh meat were the types of food mostly avoided by some, (33.3%) of the pregnant women, because of the strong scent associated with these foods. The strong scent of fermented foods discouraged some pregnant women (9.8%) from taking such foods. Slimy sauces, (1.8%), and foods of high fat or oil content (4.6%) were also avoided by some of the women during the pregnancy. In addition, physical stress like excess fullness discouraged some of the pregnant women (4.0%) from taking heavy foods such as fufu.

The highly selective behaviour of the subjects towards foods during pregnancy was mostly prompted by the nausea associated with the pregnancy. The significant role of nausea in the selective attitude towards food types was reported earlier by Pelchat and Rozin in 1982. In the present study, the contribution of taboos and beliefs to food avoidance were not noticed.

5.1.10: Modification of Diet During Pregnancy and Effect on Infant Birth-weight

During pregnancy, it is expected that women increase their dietary nutrient intake above the non-pregnancy intake to ensure adequate supply of nutrients to the developing foetus. An investigation into this aspect in the study showed that only 6.6% of the pregnant women reported to have eaten more food during pregnancy (Table 21). About 21% of the women reported a reduction in food intake during pregnancy because of loss of appetite and vomiting. Most of the pregnant women (72.7%) did not modify their diet at all. The observation in the study that most of the women did not increase their dietary intake during pregnancy is in agreement with an earlier report by James and Schofield in 1990. This observation implies that women who do not have enough nutrient stores prior to pregnancy are not likely to meet the increased nutrient requirement through dietary intake during pregnancy.

Although there was an increase in mean birth-weight of infants born to pregnant women who claimed to have eaten more food during pregnancy, the mean infant birth-weight was not significantly (P <

0.05) higher than those who either ate less food or ate the same amount of food as in their non-pregnant state. The insignificant differences in birth-weights suggest that the nutrient intake of women who ate more food, was not considerably higher than those who either ate less food or did not modify their diet during the pregnancy. When women have adequate nutrient intake, which is not so in this study, extra nutrient intake does not have significant effect on infant birth-weight (Atton and Watney, 1990).

5.1.11: Gestational Age at which Women Attended Ante-natal Clinics and Effects on Infant Birth-weight

Earlier attendance at ante-natal clinic can mean earlier intake of vitamin and mineral supplements given at the ante-natal centres in addition to earlier benefits from medical examination and advice on good nutrition and health practices during pregnancy. However it was observed that only 30% of the pregnant women visited ante-natal clinics in the first two months of pregnancy (Table 1). A substantial number (41.8%) attended ante-natal clinic in the third month (12th week) of pregnancy. Astonishingly, some of the women attended ante-natal clinic for the first time in the sixth (2.8%) and seventh (1.6%) months of pregnancy.

Data from table 11 indicate that pregnant women who received ante-natal care before the end of the first trimester (12th week) had infants of significantly ($P < 0.05$) higher birth-weight than those who received ante-natal care during the second and third trimesters.

This observation is expected since earlier attendance to ante-natal clinic could lead to longer duration of nutrient supplementation including other health benefits from the ante-natal clinic which might result in increase infant birth-weight.

The main reason for visiting ante-natal clinic is of course for ante-natal care. However only few (30.1%) of the mothers were of this opinion (Table 12). Some of the pregnant women (22.7%) attended ante-natal clinic because they were vomiting while others (14.1%) deliberately delayed the attendance to reduce the cost of the ante-natal care. This behaviour can be attributed to ignorance of some women of the benefits of ante-natal care, especially, when some of them (33%) were of the opinion that it was too early or it was not time to visit the ante-natal clinic (Table 12).

The delayed attendance to ante-natal clinics, observed in the study, is attributable to various reasons. Firstly, most of the women may not be sure of the initiation of the pregnancy until after the third month (12th week) because of irregularities in their menstrual cycle (Personal observation in the study). Secondly, some women deliberately delay, as observed in the study to reduce cost of the ante-natal care. The cumulative cost of ante-natal care, as shown earlier (Section 4.1) can be enormous and pregnant women who were of low financial status were deterred from attending clinic earlier to reduce the cost. With increasing cost of living, the financial cost of ante-natal care can be a strong deterrent to clinic attendance by pregnant women of low socio-economic background. There is thus the need to subsidize ante-natal cost by governments to encourage attendance to ante-natal clinic by women. In addition, there is the need to educate women on prompt pregnancy test when it is suspected, so that ante-natal care can be initiated earlier.

5.1.12: Mothers' Preference of Infant Size in relation to maternal Nutrition and labour outcome.

In pregnancy, various prenatal intervention measure aimed at ensuring proper outcome of pregnancy are taken. The effects of such interventions might be to increase foetal size and hence the likelihood of difficult labour. This effect can discourage women, especially those in communities where obstetric services are limited, from engaging in activities that could lead to an increase in infant size.

It was found, after studying the 502 pregnant women, that although most (48.5%) of the pregnant women had no particular preference for infant size, about 41% of them preferred small infants for comfortable labour (Table 25). Only few (10.9%) pregnant women wanted big infants at birth. Women in the latter category were of the opinion that big infants look bouncy or tough.

Data from table 26 indicate that although a substantial number of the pregnant women had particular preferences for infant size at birth, majority of them (71.0%) did not take measures aimed at achieving the preferred infant size. Nevertheless, 10.3% of those in the group actually reduced their food intake, while one pregnant woman used herbs to achieve the small infant size. Most (65.5%) of those who preferred big infants at birth claimed to have increased their food intake during the pregnancy.

Assessment of the birth-weights of infants born to the pregnant women revealed that infant birth-weight did not relate to the mothers' choice of infant size (Table 27). In fact, pregnant women who preferred small infants had infants of slightly higher birth-weights. It was difficult to put in quantitative terms what women meant by small, medium and big infants.

The high percentage of pregnant women who preferred small infants at labour is an attestation of the fact that labour problems can hinder women's compliance to intervention measures aimed at ensuring acceptable pregnancy outcome (Garner Kramer, 1990). The high rate of maternal death associated with child birth in Ghana (7.9 per 1000 deliveries; UNICEF, 1991), in addition to scarce obstetric facilities in some Ghanaian communities might have contributed to the high percentage of women wanting small infants for easy labour.

An assessment of the type of labour experienced by the subjects indicated that the prevalence of normal or spontaneous delivery was high (97.6%), but some of the mothers, 12 (2.4%), experienced difficult labour and thus needed extra assistance during labour. It was observed that the pregnant women who needed extra assistance during labour had infants of significantly ($P < 0.05$) higher birth-weight (3.48 ± 0.295kg) than those who had spontaneous delivery (2.987 ± 0.433kg). This observation indicates that high infant birth-weight poses labour difficulties. The labour difficulties may arise due to mechanical difficulties, including cephalopelvic disproportion.

Such difficulties can lead to physical deformities in the woman. Higher cost of labour services are incurred when such mechanical difficulties lead to caesarian section.

Some of the solutions to this problem may be to provide skilled assistance during child birth and to provide adequate obstetric services in communities where such services are limited.

5.1.13: Effect of Duration of Mineral and Vitamin Supplementation During Pregnancy on Infant Birth Weigh

The gestational age of the pregnancy on the first visit to the ante-natal clinics determines the duration of mineral and vitamin supplementation in pregnancy.

The duration of supplementation had significant ($P < 0.05$) effect on infant birth-weight (Table 28). Infants born to pregnant women who had mineral and vitamin supplements for more than 20 weeks had significantly higher birth-weights than those who had the supplements for less than 20 weeks. This observation suggests that women who seek ante-natal care earlier in pregnancy are more likely to have favourable outcome of pregnancy.

Advice on good nutritional and health practices are given in addition to regular medical examination at the ante-natal centres. Pregnant women who sought ante-natal care earlier benefitted to a great extent from these services including earlier supplementation of nutrients which are essential during pregnancy. The beneficial effect of this is the higher infant birth-weight observed for pregnant women who attended ante-natal clinics earlier.

5.2: ANTHROPOMETRIC DATA

5.2.1: Effect of Maternal Height on Birth-weight and Maternal Weight-gain

Data from table 29 show that the mean height of the pregnant women was 162.17 ± 10.12cm with a range of 148 - 175cm. None was below 145cm, the height below which women are reported to be nutritionally at risk and stunted (Shah, 1981).

Influence of maternal height on infant birth-weight was significant ($P < 0.05$). Pregnant women who were below 156 cm of height had infants of significantly lower ($P < 0.05$) birth-weight than those whose heights were above 175cm (Table 30). Nevertheless, women who were below 175cm but above 156cm had infants of slightly lower birth-weight, than those who were above 175cm of height.

There was a significantly positive correlation ($r = + 0.204$) between maternal height and infant birth weight (Table 48).

In the case of maternal weight-gain, there were no significant ($P < 0.05$) effect of maternal height on maternal weight-gain of pregnant women whose heights were below 175cm (Table 30). Subjects whose heights were above 175cm had significantly ($P < 0.05$) higher weight-gain during the pregnancy than those in the other height groups. Furthermore, there was a significantly positive correlation ($r = + 0.227$) between maternal height and maternal weight-gain.

There was a gradual increase in maternal weight-gain as the height of the women increased. This observation is consistent with the general view that maternal nutritional history prior to pregnancy has a strong influence on efficiency of reproduction (Tomkins and Watson, 1991). Women in high height category possibly have better nutritional history than seemingly stunted women (Shah, 1981). The better nutritional history of women in this category can mean adequate nutrient stores prior to pregnancy which will lead to favourable pregnancy outcome.

5.2.2: Maternal Weight-gain and Effects on Infant Birth-weight.

The mean maternal weight-gain (10.53 ± 1.68kg) (Table 29), determined in the study is lower than the observed maternal weight-gain for developed countries (12.50kg) (FAO/WHO, 1985). The observed mean maternal weight-gain for the subjects of this study is about 17% of the mean body weight of 60.8kg in first trimester.

The level of maternal weight-gain observed in the study (10.53kg) is similar to the 10.00kg observed by Jansen and Lakhani (1983) in Nairobi, who also reported an 18% increase in body weight during pregnancy. However Devadas and Chandy (1980) have observed a lower increase in maternal weight-gain of 5.9 to 6.7kg in India. Furthermore, the observed mean maternal weight-gain is higher than that for some developing countries.
(Appendix 4).

There was a significant effect of maternal weight-gain on infant birth-weight (Appendix 9). Women who gained above 90% of the reference weight-gain (12.5kg; FAO/WHO, 1985), had infants of significantly ($P < 0.05$) higher birth-weight than pregnant women who gained below 90% of the reference standard (Figure 9).

It was also observed that infant birth-weight increased as maternal weight-gain increased. Further analyses revealed that there was a significant correlation ($r = + 0.484$) of infant birth-weight with maternal weight-gain (Table 47). This finding is consistent with observations by other researchers (Calandra and Abel, 1981; Devadas and Chandy, 1980). Adequate energy intake leads to adequate fat deposition and hence increased maternal weight-gain during pregnancy. Fat deposition during pregnancy is a strong determinant of infant birth-weight (FAO/WHO, 1985).

From figure 7 it could be observed that the rate of maternal weight-gain at all stages of pregnancy was lower than that for pregnant women of developed countries (Food and Nutrition Board, 1971). The relatively higher rate of weight-gain for developed countries can be attributed to the relatively better nutrition and health care during pregnancy.

5.2.3: Women's Body Mass Index (BMI) in First Trimester and Effect on Infant Birth-weight and Maternal Weight-gain

Maternal BMI did not influence significantly ($P < 0.05$) infant birth-weight and maternal weight-gain, though obese women had slightly higher weight-gain (Table 31). The insignificant differences in maternal weight-gain could mean that the lean women had relatively higher maternal weight-gain during pregnancy than the fat women.

It was further observed that BMI correlated significantly with oedema prevalence ($r = + 0.306$).

The observation that maternal BMI did not correlate significantly with infant birth-weight is in agreement with an earlier observation by Atton (1990) in European and Asian women. However, the observation is not consistent with an earlier one by Arteaga (1978) among women in Chile.

The BMI indicates the degree of fatness of the mothers. If there is no wide variation between the BMI values of the pregnant women, as is the case in the present study, then BMI is not likely to affect differences in pregnancy outcome.

5.3: DIETARY INTAKE DATA

5.3.1: Energy Intake, Infant Birth-weight and Maternal Weight-gain.

Commensurate energy intake during pregnancy is essential for proper outcome of pregnancy. In this study, the mean daily energy intake of the 128 pregnant women (9,109KJ; 2175.5kcal) was not significantly different from the recommended energy intake for non-pregnant women, and this was within 89% of the recommended level of energy intake for pregnant women. Protein provided 9.0% of the total energy intake by the pregnant women. This level of energy intake suggests that most of the pregnant women did not increase their energy intake during pregnancy.

Eaton (1982) had earlier observed an energy intake of between 3,800 and 14,300KJ in Asian pregnant women, where protein supplied 12.3% of total energy intake. Grover (1982) and Benerjee,and Shah (1981) have also observed energy intakes below the recommended dietary allowance for pregnant women.

The lower level of energy intake by the pregnant women agrees with studies from other developing countries where energy intakes of pregnant women were lower than that for developed countries (Table 3).

Although there were no significant ($P < 0.05$) difference in the birth-weight of infants born to pregnant women meeting energy levels between 80% and the recommended daily dietary allowance

(RDA), pregnant women whose energy intake met over 100% of the RDA had infants of significantly ($P < 0.05$) higher birth-weight than those whose intakes were below 80% of the RDA (Table 40). Correlation analyses showed a positive but insignificant relationship ($r = + 0.130$) between infant birth-weight and maternal energy intake, which is in agreement with observations from other researchers (James and Schofield, 1990; Prentice et al ,1983; Shah,1981).

Unlike infant birth-weight, maternal weight-gain was more sensitive to energy intake (Table 40). Pregnant women meeting more than 90% of the RDA for energy had significantly ($P < 0.05$) higher weight-gains.

The significantly positive correlation ($r = + 0.295$) of maternal weight-gain with energy intake indicates that undernourished pregnant women could increase their weight-gain during pregnancy if they increase their energy intake.

The effects of energy intake on pregnancy most often depends on the nutritional status of the women. In well nourished women who are in positive energy balance, supplementary energy intake does not have effect on infant birth-weight and pregnancy weight-gain. Conversely in women who are in negative energy balance, supplementary energy intake has a positive effect on infant birth-weight (Kardjati et al, 1988). The observation in this study that infant birth-weight was higher for pregnant women whose energy intake was above their RDA is consistent with observations made by some researchers (Prentice et al, 1983; Shah, 1981, Iyangar, 1974) that in marginally nourished women high energy intake is associated with an increase in infant birth-weight.

Furthermore, the finding that high energy intake was associated with high maternal weight-gain, in this study, is in agreement with some research findings (Shah, 1981; Rush et al, 1980; Mora et al, 1979) that commensurate energy intake during pregnancy is associated with an increase in maternal weight-gain in marginally nourished women.

The effect of the energy intake on maternal weight-gain observed in the study is attributable to the accepted fact that high energy intake leads to excessive fat deposition and hence high maternal weight-gain during pregnancy (FAO/WHO, 1985).

5.3.2: Protein Intake of the Pregnant Women

The effects of maternal protein intake on infant birth-weight and maternal weight-gain were similar (Table 41). The birth-weight of infants and maternal weight-gain were significantly ($P < 0.05$) higher for pregnant women taking above 80% of the RDA for protein. In addition, subjects whose levels of protein intake were above the RDA had significantly higher ($P < 0.05$) maternal weight-gain than those whose protein intake was below 100% of the RDA.

The positive relationship between protein intake and infant birth-weight observed in the study is in agreement with that observed in other developing countries for instance (Iyangar, 1974, Shah, 1981, and Mora et al, 1979). However, Atton and Watney

(1990) did not observe a correlation between protein intake and infant birth-weight in Canadian and Asian women respectively.

The effect of protein intake during pregnancy on infant birth-weight depends on the protein nutritional status of the women. Rush (1989) reported that in well nourished women, a high protein intake (above 20% of calories as protein) had no effect on infant birth-weight but in some cases it was associated with delivery of low birth-weight infants. The positive relationship of infant birth-weight and maternal protein intake observed in this study may be due to the low protein nutritional status of some of the women involved in the study.

Assessment of haemoglobin level indicated that protein intake did not affect the haemoglobin level of the pregnant women (Table 41). This observation is at variance with that of Kaur and Sagar (1982) who observed a significantly positively relationship between protein intake and haemoglobin level in anaemic women. The difference can be attributed to the fact that women in the present study were on vitamin and mineral supplements, some of which directly affect haemoglobin level.

5.3.3: Effects of Dietary Iron Intake of the Pregnant Women on Infant Birth-weight, Maternal Weight-gain and Maternal Haemoglobin Level

Although iron need during pregnancy cannot be met through dietary iron intake alone (Tomkins and Watson, 1991), assessment of dietary iron intake could help to ascertain the level of iron supplementation during pregnancy.

In the study, it was observed that the mean dietary iron intake of the pregnant women was undoubtedly lower than the reference requirement for pregnant women (Table 39).

The pregnant women were on iron supplement, 180mg/day, hence differences in dietary iron intake could be obliterated by the supplementary iron intake, making the influence of dietary iron intake on pregnancy less vivid. Nevertheless, with the exception of infant birth-weight, maternal weight-gain and maternal haemoglobin level increased as the level of dietary iron intake increased (Table 42).

Pregnant women whose dietary iron intake was below 18mg/day had significantly lower maternal weight-gain than those whose dietary iron intake was above 27mg/day. The observation that iron intake improved maternal weight-gain is in agreement with an earlier report by Vijayalakshmi and Usha (1981). This observation could partly be due to the reported fact that increased iron intake leads to increased appetite in animals (Yartey, 1989).

In the presence of supplementary iron, maternal haemoglobin level was significantly influenced by dietary iron intake during the pregnancy (Table 42). Maternal haemoglobin level was significantly ($P < 0.05$) higher in pregnant women whose level of dietary iron intake was above 27mg/day but there were no significant differences ($P < 0.05$) in haemoglobin concentration of those whose dietary iron intake was less than 27mg/day.

The marked influence of dietary iron intake on maternal haemoglobin level observed in the study is expected since iron is necessary for haematopoiesis (DeMaeyer, 1989).

5.4: HAEMOGLOBIN DATA

5.4.1: Maternal Haemoglobin Level and Effects on Infant Birth-weight

The mean monthly haemoglobin levels of the subjects were within values acceptable for pregnant women (Table 29). However even though the pregnant women were on iron and vitamin supplements, about 20% of them were anaemic by WHO haemoglobin standard (haemoglobin level below 11.0g/dl; Tomkins and Watson, 1991). This observed prevalence of anaemia should be viewed as the prevalence of anaemia among pregnant women who are on iron and vitamin supplements (Appendix 2). This level of anaemia prevalence indicates that the level of mineral and vitamin supplementation could not prevent anaemia in pregnancy. Only 18.85% of the pregnant women had haemoglobin level above 12g/dl (Table 43).

The effect of haemoglobin concentration on infant birth-weight was not significant ($P < 0.05$). However pregnant women with mean haemoglobin level above 12g/dl had infants of slightly higher birth-weight than pregnant women who had haemoglobin level below 11g/dl. Prema Neelakumari (1981) observed a rather stronger relationship of maternal haemoglobin level with infant birth-weight. He observed, after studying 3,461 urban Hyderabad women, that when haemoglobin level was below 8g/dl, mean birth-weight also decreased. A Similar finding was reported by Yusufji (1973) among anaemic women in India.

need in pregnancy. In addition, other factors like the presence of parasites in the gut (eg. hookworm), as well as low adherence (compliance) due to side effects from ferrous sulphate can affect iron availability to the subjects (Tomkins and Watson, 1991).

5.5: CONCLUSION

Based on the results of this study, the following conclusions can be made:

(a) The main determinants of infant birth-weight are; maternal weight-gain, height, protein intake, energy intake, level of formal education, occupation, oedema, duration of mineral and vitamin supplementation and ante-natal care of the mother.

(b) The experience of nausea during pregnancy was associated with a reduction in infant birth-weight, maternal weight-gain and maternal haemoglobin level.

(c) The mean maternal weight-gained during pregnancy by pregnant Ghanaians was 10.531 ± 1.681kg

(d) Factors such as maternal energy intake, occupation, height, protein intake and duration of nutrient supplementation were strong determinants of maternal weight-gain.

(e) Women did not increase their nutrient intake during the pregnancy, and in the case of iron and protein had intakes lower than the level recommended for pregnant women.

(f) The mineral and vitamin supplementation during pregnancy could not maintain maternal haemoglobin level. The mean maternal haemoglobin level was 11.503 ± 0.603g/dl.

(g) Maternal habits such as clay ingestion, alcohol intake, and delayed attendance to ante-natal clinics lead to a reduction in maternal haemoglobin level.

(h) The prevalences of alcohol intake, pica and clay among pregnant Ghanaian women were 9.36%, 48.01%, and (28.49%) respectively.

(i) The fear for difficult labour had adversely effected some women's desire for high birth-weight infants at birth.

(j) Women who seek ante-natal care early are likely to have better outcome of pregnancy.

(k) The high cost of ante-natal care discouraged 14.14% of pregnant women from early attendance to ante-natal clinic.

5.4.2: Effects of Iron and Vitamin Supplementation on Maternal Haemoglobin Level During Pregnancy

Normally some of the effects of iron and vitamin supplementation during pregnancy are exhibited as increase in maternal haemoglobin level. In this study, mothers haemoglobin levels were assessed monthly from the third to the ninth month of pregnancy to ascertain the effectiveness of the supplementation programmes.

The results showed a gradual decrease in mean maternal haemoglobin level up to the seventh month, after which a sharp decrease was observed in the eighth month (Figure 8) (Appendix 10). The continuous decrease in mean monthly maternal haemoglobin level during the pregnancy could be because the amount of iron absorbed from the supplements was not enough to sustain the increased requirements of the pregnancy state. Normally it is during the third trimester that iron need during pregnancy is greatest (FAO/WHO, 1988), thus for women of marginal iron status as the subjects of this study, it is not surprising that haemoglobin levels were lowest after the seventh month of gestation. Shukla and Verma (1982) have also observed a decrease in maternal haemoglobin level with increasing gestational age, while Ross and Read (1981) have reported that prophylactic iron supplements do not increase maternal haemoglobin level.

The observation in the present study could mean that the level of bioavailability of the form of iron (ferrous sulphate) used in the supplementation programme may not be high enough to meet iron

5.6: RECOMMENDATIONS

There is need to intensify mass education at ante-natal clinics, in the media and at adult literacy classes on good nutrition and health practices, as well as on the adverse effects of clay and alcohol ingestion during pregnancy.

Pica should be avoided since it pre-disposes to low haemoglobin levels and anaemia.

Emphasis should be placed on the importance of early ante-natal care and good nutritional habits during pregnancy.

Mothers should begin getting Ante-natal care in their first trimester to improve chances of giving birth to high-birth-weight infants. This is critical to teenage pregnant mothers since they reproduce most low-birth-weight infants in Ghana.

Women who experienced nausea during pregnancy should be given extra medical and nutritional attention especailly to improve their dietary intake.

Since adequate Energy, Protein and iron intake positively affect both maternal weight gain and infant birth-weight, these do affect pregnancy outcome positively and should be adequately provided.

Obstetric problems could be alleviated by the provision of more health posts especially in rural communities. This could allay women's fear of labour problems through the availability of skilled health personnel and indirectly encourage adequate nutrition during pregnancy.

If Ghana had adequate resources, a program of low-priced or free food supplementation for pregnant women would be commendable.

The cost of ante-natal care could be subsidized by Government to encourage women to seek ante-natal care early.

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APPENDICES

Appendix 1: Basic Indicators of Nations Categorized as Having Very High Under-five-mortality Rate (U5MR) (ie. Over 140/1000)

Nation[1]	Total Population (Millions) (1989)	U5MR 1960	U5MR 1989[1]	Infant Mortality rate (Under 1 year) 1960	Infant Mortality rate (Under 1 year) 1989	Annual No. of birth (thousands)	% of infants with low birth-weight (1980 1988)
1. Mozambique	15.2	331	297	190	173	168	20
2. Afghanistan	15.7	381	296	215	169	776	20
3. Angola	9.7	345	292	208	173	460	17
4. Mali	8.9	369	287	210	166	456	17
5. Sierra Leon	4.0	385	261	219	151	195	17
6. Malawi	8.4	366	258	207	147	475	20
7. Guinea	5.6	336	241	203	142	284	
8. Burkina Faso	8.8	363	232	205	135	412	
9. Ethiopia	47.9	294	226	175	133	2383	
10. Niger	7.5	321	225	191	132	387	15
11. Central African Rep.	3.0	308	219	183	129	134	15
12. Chad	5.5	325	219	195	129	245	
13. Somalia	7.3	294	218	175	129	358	
14. Mauritania	2.0	321	217	191	124	91	11
15. Liberia	2.5	310	209	184	137	118	
16. Rwanda	7.0	248	201	146	119	356	17
17. Cambodia	8.1	218	200	146	127	324	
18. Burundi	5.3	260	196	153	116	254	9
19. Bhutan	1.5	298	193	187	125	57	
20. Nepal	18.7	298	193	187	125	721	
21. Yemen	11.3	378	192	214	116	587	
22. Senegal	7.1	299	189	172	85	321	11
23. Bangladesh	112.5	262	184	156	116	4659	28
24. Madagascar	11.6	364	179	220	117	532	10
25. Sudan	24.5	292	175	170	105	1083	
26. Tanzania	26.3	249	173	147	103	1329	14
27. Namibia	1.7	262	171	155	103	76	
28. Nigeria	105.0	316	170	190	102	5083	20
29. Gabon	1.1	287	167	171	100	47	
30. Uganda	18.1	223	167	133	100	942	
31. Bolivia	7.1	282	165	167	105	302	12
32. Pakistan	118.8	276	162	163	106	5452	25
33. Laos	4.0	233	156	155	106	181	39
34. Benin	4.5	310	150	185	89	221	8
35. Cameroon	11.4	275	150	163	92	547	13
36. Togo	3.4	305	150	182	92	153	20
37. India	835.6	282	145	165	96	26071	30
38. Ghana	14.6	224	143	132	87	644	17
39. Cote d'Ivoire	11.1	264	139	165	93	575	14

Source: UNICEF, 1991.

1: Nations are listed in descending order of their 1989 under five mortality rates.

APPENDIX 2 : Composition of Mineral and Multivitamin Tablets used for Supplementation at the Ante-natal Centres.

Tablet	Nutrient	Quantity
Multivites (B.P.C, Dannex)	Vitamin A (IU)	2,500
	Vitamin D (IU)	300
	Vitamin B_1 (mg)	1.0
	Vitamin B_2 (mg)	0.5
	Vitamin C (mg)	15.0
	Nicotinamide (mg)	7.5
Vitafol (West-Ward Pharmaceutical Corp, Eatontown, NJ 07724)	Vitamin A (IU)	6,000
	Vitamin D (IU)	400
	Vitamin E (IU)	30
	Folic Acid (mg)	1.0
	Vitamin C (mg)	60
	Thiamine mononitrate (mg)	1.1
	Riboflavin (mg)	1.8
	Pyridoxine hydrocholride (mg)	2.5
	Vitamin B_{12} (μg)	5.0
	Niacin (mg)	15
	Calcium (mg)	125
	Ferrous fumarate (Iron) (mg)	65
Unicap M (Upjohn Ltd, Crawley, U.K)	Vitamin A (IU)	5,000
	Vitamin B_1	2.5
	Vitamin B_2	2.5
	Vitamin C	50
	Vitamin B_6	0.5
	Vitamin B_{12}	2.0
	Calcium pantothenate (mg)	5
	Iron (Fumarate) (mg)	30.42
	Iodine (KI) (mg)	0.196
	Copper (Sulfate) (mg)	3.928
	Manganese (sulfate) (mg)	3.076
	Magnesium (oxalate) (mg)	9.95
	Potassium (sulfate) (mg)	11.142
	Calcium (phosphate) (mg)	2.198
	Calcium (carbonate) (mg)	87.5
	Vitamin D (μg)	12.5

APPENDIX 3: Extra Daily Nutrient Allowance for pregnant women

Nutrient	Nonpregnant	Pregnant
Energy	2,235kcal	+ 160kcal (1st trimester)[a] + 350kcal (2nd and 3rd trimesters)
Protein (g)	41	+ 6g[b]
Retinol (μg)	800	1000
Vitamin D (μg)	7.5	12.5
Vitamin E (mg)	8	10
Vitamin C (mg)	60	80
Riboflavin (mg)	1.3	1.6
Nicotinic acid (mg)	14	16
Vitamin B_6 (mg)	2.0	2.6
Folate (μg)	400	800
Thiamin (mg)	1.1	1.5
Calcium (mg)	800	1200
Iron (mg)	18	S+
Zinc (mg)	15	20

a, b: Allowances set by FAO/WHO, 1985
S+: The increased requirement cannot be obtained from the diet and thus supplemental iron was recommended.

Source: FAO/WHO, 1974

Appendix 4: Pregnancy Weight-gain In some countries.

Country	Pregnancy weight-gain (Kg)
United states of America	17.0
Scotland	12.5
United Kingdom	11.7
Sri Lanka	6.5
South India	5.3 - 6.3
Gambia	2.7 - 5.5
Ghana	-

Source: Food and Nutrition Board, 1971, N.R.C, USA.

Appendix 5: Infant Birth-weight Distribution (n = 502)

Birth-weight groups	Number of infants	Percentage of infants
< 2.50	42	8.37
2.50 - 2.99	168	33.47
3.00 - 3.49	219	43.63
3.50 - 4.00	68	13.55
> 4.00	5	1.00
Total	502	100.00

Appendix 6: Number of mothers and birth-weight of infants according to health centre of study

Health Centre	Number of mothers	Percentage of mothers	Infant birth-weight (Mean ± S.D) (kg)
University Hospital	162	32.27	3.085 ± 0.417
La Polyclinic	183	36.45	2.998 ± 0.421
Kaneshie Polyclinic	71	14.15	2.826 ± 0.808
Nerzit Maternity	86	17.13	2.987 ± 0.504
Total	502	100.00	2.999 ± 0.511

Appendix 7 : Maternal Weight-gain and haemoglobin levels according to health centre of study

Health Centre of Study	Number of mothers	Maternal weight-gain (Kg)	Haemoglobin level during pregnancy (g/dl)
University Hospital	41	11.171 ± 0.752	11.587 ± 0.752
La Polyclinic	35	10.514 ± 1.931	11.564 ± 0.303
Kaneshie Polyclinc	36	10.014 ± 1.447	11.088 ± 0.443
Nerzit Maternity	16	10.094 ± 1.099	11.503 ± 0.603
Total	128	10.531 ± 0.681	11.503 ± 0.603

Appendix 8: Mean Monthly Maternal Weight-gain during Pregnancy (n = 128). (Longitudinal study)

Gestational Age (weeks)	Observed weight-gain (Kg)	Reference weight-gain[1] (Kg)
10	-	0.65
16	1.511	2.683
20	3.273	4.00
24	4.981	5.804
28	6.969	7.602
30	8.031	8.500
32	9.043	9.352
36	10.531	10.871

1: Food and Nutrition Board, 1971; N.R.C, U.S.A.

Appendix 9: Effect of Maternal weight-gain on Infant Birth-weight (n = 128)[1]

	Weight-gain as percentage of recommended (Reference weight-gain: 12.5Kg)[2]					
	50 - 60%	61 - 70%	71 - 80%	81 - 90%	91 - 100%	> 100%
Number of subjects	3	6	25	35	27	32
Percentaage of total	2.34	4.69	19.53	27.34	21.10	25.00
Mean Infant birth-weight (Kg)	2.567[a] ± 0.808	2.967 ± 0.489	2.818[a] ± 0.395	2.887[a] ± 0.395	3.144[b] ± 0.293	3.382[b] ± 0.401

1: Mean values labelled (a) and (b) are significantly different from each other $P < 0.05$
Significant test: Duncan's multiple range test.
2. Reference weight-gain; FAO/WHO, 1985.

Appendix 10: Mean Monthly Maternal Haemoglobin Levels of the Pregnant Women at Various Gestational Ages (n = 128).

Gestational age (weeks)	Mean Monthly Maternal Haemoglobin level (g/dl)
12	11.705 + 1.010
16	11.553 ± 0.927
20	11.465 ± 0.928
24	11.434 ± 0.817
28	11.182 ± 0.746
32	10.856 ± 0.719
36	11.065 + 0.524

Appendix 11. **Sample of the questionnaire used for data collection.**

DEPARTMENT OF NUTRITION AND FOOD SCIENCE

UNIVERSITY OF GHANA, LEGON

AN INVESTIGATION INTO THE NUTRITIONAL HABITS OF PREGNANT GHANAIAN WOMEN AND THEIR EFFECTS ON PREGNANCY OUTCOME

(A) Background Information on subjects.

Date .... Serial No.....................

Name of health centre ....

Name of subject ....

Birth date/Age ....

Place of residence ....

House number ....

Region of birth ....

Marital status:

1) Single [ ] 3) Divorced [ ]

2) Married [ ] 4) Widowed [ ]

Educational level of subject:

1) Primary school [ ] 4) Tertiary [ ]

2) Middle school [ ] 5) Other..........

3) Secondary/Technical/ Vocational school [ ] 6) None [ ]

Main Occupation of subject:

1) Farmer [ ]
2) Trader [ ]
3) Hairdresser [ ]
4) Seamstress [ ]
5) Teacher [ ]
6) Driver [ ]
7) Lecturer [ ]
8) Housewife [ ]
9) Other ....

Main occupation of husband:

1) Farmer [ ]
2) Trader [ ]
3) Mechanic [ ]
4) Mason [ ]
5) Teacher [ ]
6) Driver [ ]
7) Lecturer [ ]
8) Unemployed [ ]
9) Other ....

(B) Biomedical and Psychological determinants of pregnancy outcome:

Do you lose appetite in early pregnancy?

1) All the time [ ]
2) Sometimes [ ]
3) Never [ ]

For how long do you lose appetite?

1) Up to 3 months [ ] 2) More than 3 months [ ]

How often do you vomit during pregnancy?

1) All the time [ ] 2) Sometimes [ ]
3) Never [ ]

For how long do you vomit?

1) Up to 3 months [ ] 2) More than 3 months [ ]

In what month of pregnancy do you stop vomiting.................

Have you developed oedema?

1) Yes [ ]   2) No [ ]

Type of oedema:

1) Generalized [ ]   2) On limbs [ ]

Have you modified your diet (food) because of this pregnancy?

1) Completely [ ]   2) A little bit [ ]

3) Not at all [ ]

If yes, what have you changed about your diet?

1) Type of food [ ]

2) Quality/quantity of food [ ]

3) Other ....

Why did you make changes in your diet? ....

What food do you dislike (avoid) during pregnancy?..............

....

Reason for not liking it ....

Do you eat clay during pregnancy?

1) All the time [ ]   2) Sometimes [ ]   3) Never [ ]

Reason for eating clay ....

Do you eat chalk during pregnancy?

1) All the time [ ]   2) Sometimes [ ]   3) Never [ ]

Reason for eating chalk ....

What other non-food items do you eat? ....

Do you take alcohol during pregnancy?

1) Always [ ]   2) Sometimes [ ]   3) Never [ ]

What type of alcohol do you take?

1) Local gin [ ]
2) Beer/Gulder [ ]
4) Schnapps [ ]
5) Other ....

Specify quantity of alcohol:

1) About 100ml per week [ ]
2) Half bottle per week [ ]
3) 1 or 2 bottles per week [ ]
4) 3 to 5 bottles per week [ ]
5) More than five bottles per week [ ]

Reason for taking alcohol ....

Are you on vitamin or mineral supplement?

1) Yes [ ]
2) No [ ]

If yes, what type of supplement?

1) Folic acid [ ]
2) Multivites [ ]
3) Fersolate [ ]
4) Calcium [ ]
5) Other ....

How long have you been on the supplement?

1) One month [ ]
2) Two months [ ]
3) Three months [ ]
4) Four months [ ]
5) Five months [ ]
6) Other ....

Have you been immunized against tetanus?

1) Yes [ ]
2) No [ ]

If no, why not? ....

Have you been immunized against others? (specify) ....

....

Is this your first pregnancy?

1) Yes [ ] 2) No [ ]

If, no how many pregnancies have you had?

1) One [ ] 5) Five [ ]

2) Two [ ] 6) Six [ ]

3) Three [ ] 7) Other ....

4) Four [ ]

Why this number of pregnancies? ....

How many times have you experienced spontaneous abortion?

1) None [ ] 4) Three times [ ]

2) Once [ ] 5) More than three times [ ]

3) Two times [ ]

Have you experienced any stillbirths?

1) None [ ] 3) Twice [ ]

2) Once [ ] 4) More than three times [ ]

What was the age of this pregnancy when you first visited the ante-natal clinic?

1) One month [ ] 4) Four months [ ]

2) Two months [ ] 5) Five months [ ]

3) Three months [ ] 6) More than five months [ ]

Reasons for delayed visit to ante-natal clinic ....

....

Have you suffered from some kind of sickness during this pregnancy?

1) Never [ ] 3) Three times or more [ ]

2) Once or twice [ ] 4) All the time [ ]

Type of sickness ....

How often have you suffered from the following diseases?

a) Malaria:

1) All the time [ ] 2) Sometimes [ ]

3) Never [ ]

b) Diarrhoea:

1) All the time [ ] 2) Sometimes [ ]

3) Never [ ]

c) Hypertension:

1) All the time [ ] 2) Sometimes [ ]

3) Never [ ]

Have you suffered from something else? (Specify) ....

....

What size of babies do you prefer at birth?

1) Small babies [ ] 3) Big babies [ ]

2) Medium [ ] 4) No preference [ ]

Give reason for your choice ....

What do you do to achieve your choice of baby size? ....

....

What do you think of diet (food) during pregnancy?

1) Important [ ] 4) Dangerous [ ]

2) Has no effect [ ] 5) I don't know [ ]

3) Not necessary [ ]

THE LONGITUDINAL STUDY

A. Food Intake

Twenty-four-hour Dietary Recall.

List of all food items eaten by the subject a day before the interview and their quantities

Meal Pattern	Food Item	Quantity
Breakfast		
Am snack		
Lunch		
Pm snack		
Supper		
Bedtime snack		

Comments.......................................

B. Height, weight and haemoglobin measurements

Health centre...

Name of subject.......................................

Age of subject..................................

Height of subject (cm) ....

Pre-pregnancy weight (Kg) ....

Gestational age (weeks)	Maternal weight (Kg)	Maternal weight-gain (Kg)	Haemoglobin level (g/dl)
8			
12			
16			
20			
24			
28			
32			
36			
40			

Age of pregnancy at delivery:

1) 28 weeks [ ]

2) 36 weeks [ ]

3) 40 weeks [ ]

4) Other........

Type of delivery:

1) Forceps [ ]

2) Pump/suction [ ]

3) Caesarean section [ ]

4) Spontaneous [ ]

5) Other ....

Birth-weight of infant

(Kg)..

Sex of infant:

1) Male [ ] 2) Female [ ]

Remarks: ....

Thank you.