COMPARATIVE NUTRITIONAL STATUS OF ADULT AND ADOLESCENT MOTHERS AND THEIR INFANTS

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BY

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DECLARATION

I Ethel Mannzamako Quarshie, declare that this work was done wholly by me in the Department of Nutrition and Food science, University of Ghana, under the supervision of Dr. Gloria E. Otoo and Dr. Agartha Ohemeng. All references cited in this work have been fully acknowledged.

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DEDICATION

I dedicate this work to the Almighty God whose grace has seen me through this work and to my parents Mr. and Mrs. W. L. Quarshie.

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LIST OF ABBREVIATIONS

ACC/SCN	Administration Committee on Coordination–Sub-Committee on Nutrition
BAZ	Body Mass Index-for-age z-score
BMI	Body Mass Index
CED	Chronic Energy Deficiencies
FAO	Food and Agricultural Organization
GDHS	Ghana Demographic and Health Survey
GHS	Ghana Health Service
GSS	Ghana Statistical Service
IUGR	Intra-uterine growth retardation
LAZ	Length-for-age z-score
MUAC	Mid-Upper arm circumference
MUACZ	Mid-Upper arm circumference-for-age z-score
SNNPR	Southern Nations, Nationalities and Peoples Region
UNICEF	United Nations Children's Fund
WAZ	Weight-for-age z-score
WHO:	World Health Organisation

ABSTRACT

Introduction: There exist some variation in nutrient needs, and general physiology of adult and adolescent women, as well as physiologic stress imposed by pregnancy which can affect their infants. This may result from their nutrients demands due to differences in their developmental stage.

Objective: To compare the nutritional status of adult and adolescent mothers and their infants.

Methodology: The study was a cross sectional study design. Two Hundred and sixty mother-child pairs participated in the study (130 adult mother-child pairs and 130 adolescent mother-child pairs) and were recruited during post natal and child welfare clinic at four health centres within the Kpone, Ashaiman, Teshie Nungua and Tema municipal Assemblies. Semi-structured questionnaires were used in collecting background socio demographic data and data on maternal nutrition knowledge. A food frequency questionnaire was used in collecting dietary data. Anthropometric measurements and haemoglobin concentrations were taken for both adult and adolescent mothers and their infants.

Results: Average nutrition knowledge was lower in adult mothers as compared to adolescent mothers (8.25±2.75 vs. 9.90±4.04;$p<0.001$); daily, weekly and monthly dietary diversity was lower in adult mothers as compared to adolescent mothers, (8.31 ±2.83 vs. 10.11±2.76, $p<0.001$), (13.39 ± 1.95 vs. 14.38 ±1.66 $p<0.001$) and(14.49± 1.51 vs. 14.95± 1.31,$p=0.009$). There was significant difference in the height measurement of the adult and adolescent mothers (157.70±7.41 vs. 153.91±9.18, $p<0.001$) weight

measurement (64.36±13.40 vs. 60.53±12.4, p<0.001) and Mid upper arm circumference (MUAC) measurement (29.85±3.62 vs. 28.49±4.04, p<0.001) but not the body mass index (BMI) categories (underweight, normal, overweight and obese). Prevalence of anaemia in the adult and adolescent mothers was not significant. With the exception of length-for-age z-score where there was a significant difference between children of adult and adolescent mothers, weight-for-age z-score and weight-for-length z-score were not significantly different. Mothers who had high dietary diversity score as compared to mothers who had low diversity score were less likely to be undernourished than normal. On the other hand, mothers who had high dietary diversity score as compared to low dietary score were more likely to be overweight/obese than normal.

Conclusion: Adolescents have more easy access to health and nutrition information through schools, recreational activities, and mass media than they have later in their lives and so this may have influenced the high level of nutrition knowledge and dietary diversity of the adolescent mothers. Growth of adolescent mothers during the adolescent stage might have increased the rate of stunting in their children as compared to that of the adult mothers.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

The nutritional status of an individual is key to his or her growth and development. Nutrition especially in women is important as they undergo a lot of physiological changes especially during adolescence and pregnancy which requires the need for adequate nutrition to support those changes which usually occur during these developmental stages of their lives. During pregnancy, there is an increased demand for both energy and nutrients. A woman who is well nourished requires a small amount of additional energy during this stage because with a reduced physical activity and a lowered metabolic rate, the body adapts to the increased energy requirement.

Women during pregnancy undergo some physiology as well as during adolescence. During the last trimester of pregnancy, the energy requirement of an average-sized well-nourished woman is about 1460kJ/day (Ladipo, 2000). Energy is needed in the growth of existing maternal breast, uterus, deposition of extra maternal fat, and the delivery of a full term and healthy baby (Williamson, 2006). Increase in thiamine to 0.9mg/day is also essential in the release of energy and with an increase of 700µg/day, vitamin A is needed in the growth and maintenance of tissues and maternal tissue growth. To help in the absorption of non-haem iron, extra 50mg/d vitamin C is needed (Williamson, 2006).

Increased growth rate and changes in body composition of adolescents requires increase in their nutritional needs such as energy, protein, minerals and vitamins (Barooah, 2012). During adolescence, milk and other dairy products are most important sources of

calcium. Kranz *et al.* (2007) in a study in United States of America found out that adolescents' consumption of dairy products was lower than the recommended intake. Fruits and vegetables are the main micronutrient sources. Przyslawski *et al.* (2011) conducted a study where most of adolescent girls did not fulfil the World Health Organization's recommendation of eating vegetables at least 5-6 times a day and fruits about 4-5 times a day (WHO,1993), with only 5.6% of them eating more than three times a day. Similar observations of low fruits and vegetable intake were reported among English and Irish teenagers (Hurson and Corish, 1997; Prescott-Clarke and Pimatesta, 1998).

Montazerifar (2012) in a study on adolescent girls' dietary intake in Iran reported that, the most common deficiencies were related to iron (71.7%), Calcium (75%), zinc (65.6%), vitamin C (61.9%) and folate (97.2%). In Ghana, Owusu *et al. (*2007) conducted a study in the Eastern and Greater Accra regions among adolescents and found out that intake of fruits and vegetables were less than 3 servings per week. Thus, intake of these micro-nutrient-rich foods among adolescents in Ghana is low and similar to practices of their counterparts in high-income countries.

There are some factors which could influences food choices of adolescent and adult mothers in general. These factors may include their knowledge levels concerning nutritional contents of the food as well as some social and economic factors. According to Baric *et al.* (2000) social pressure may strongly influence their dietary intake and in many instances, they may prefer to be thin to be accepted by both sexes (Bester and Schnell, 2004). They may engage in chronic dieting, self-induced vomiting and binge

eating (Neumark-Sztainer *et al*., 1998) which may result in nutritional deficiencies (Gharib and Rasheed, 2011). In low income countries, female adolescents may be exposed to hard physical work and there may also be gender discrimination when meals are served resulting in low nutrient intake among females resulting in nutrient deficiencies (Darnton Hill *et al*., 2005). In Ghana, there are some taboos among some rural and urban dwellers concerning intake of certain foods and this may have caused certain alterations in the eating habits of adolescents and consequently their nutrient intake (Amos *et al.,* 2012). For example, in some communities, a pregnant woman is not supposed to eat snails because her offspring will end up with excess water coming from his mouth.

The pregnant adolescent unlike the adult pregnant woman, would have to go through the transition stage of adolescent and also pregnancy therefore may require both the nutrition demands of adolescent stage and pregnancy thus having an increase nutritional demand compared to those of adult pregnant women. There is little change in adolescent female dietary pattern during the course of pregnancy as compared to the preconception period. As such, pregnant adolescents may enter pregnancy with reduced nutrient stores and increased risk of nutritional inadequacy (Montgomery, 2003).

Adolescence pregnancies have led to poor outcomes. A study conducted in Thailand showed that when obstetric outcomes were compared in both adult and adolescent mothers, adolescent pregnancies have about two times increased risk of preterm births and low birth infants (Watcharaseranee *et al*., 2006). Moore *et al.,* (1998) have also

revealed that among adolescents, the incidence of having a low birth infant is more than double the rate for adults and the rate of neonatal death rate (within 28 days of birth) is almost 3 times higher. In younger women, there is poor child feeding behaviour which could lead to morbidity and mortality among their infants (Kurz, 1997).

1.2 Rationale for the Study

Every year about 16 million adolescent girls give birth mostly in low and middle-income countries (WHO, 2013). The World Bank in 2008 stated that the prevalence of adolescent pregnancies in Ghana was about 13.3%.

Considering the variation in nutrient needs, and general physiology of adults and adolescents, as well as the physiologic stress imposed by pregnancy and pregnancy outcome, there is the need to generate more information about the nutritional status of adult and adolescent mothers and their infants. This study seeks to add on to existing knowledge in this area.

1.3 Objectives of study

1.3.1 Main Objective

The main objective was to compare the nutritional status of adult and adolescent mothers and their infants

1.3.2 The Specific Objectives were to:

- Assess the level of nutrition knowledge in adult and adolescent mothers.

- Determine the dietary diversity of adult mothers and adolescent mothers.
- Compare the nutritional status of the adult and adolescent mothers and their infants.
- Find the relationship between dietary diversity and nutritional status of adult and adolescent mothers.

1.4 Hypotheses

- $Ho_{1:}$ There is no difference in maternal nutrition knowledge among adult mothers and adolescent mothers.
- Ho_2: The dietary intake of adult mothers and adolescent mothers will not be different.
- Ho_3: There would be no difference in the nutritional status of the adult mothers and adolescent mothers and their infants.
- $Ho_{4:}$ There would be no relationship between the dietary diversity and nutritional status of adult and adolescent mothers.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Global Prevalence of Malnutrition

Nutrition is important for the survival, health and well-being, growth and mental development, cognition and performance of an individual throughout the lifespan (Abbansy *et al.*, 2013). One of the most serious health concerns worldwide is malnutrition and is a major contributor to the total global disease burden (Abbansy *et al.*, 2013). Even though it is mostly referred to as undernutrition, it also encompasses the extra intake of calories which leads to obesity. Of child deaths worldwide, one-third are attributed to undernutrition.

According to Elia, (2000), malnutrition describes a deficiency, excess or imbalance of a wide range of nutrients, resulting in measurable adverse effects on body composition, function and clinical outcome. Malnutrition also refers both to undernutrition and overnutrition (Blössner, and de Onis, 2005).

From the year 2010 to 2012, of the 868 million people worldwide estimated to be chronically undernourished, 852 million were in developing countries (FAO, 2011). The highest prevalence was observed in sub-Saharan Africa, which includes some of the least developed countries in the world. Over 200 million men and nearly 300 million women were classified as obese in the world in 2008 (WHO, 2012 a). In Africa and south Asia, 27−51% of women of reproductive age are underweight (ACC/SCN, 2000).

Malnutrition among mothers, including chronic energy and micronutrient deficiencies remains prevalent in the non-westernized world especially sub-Saharan Africa, where more than 20% of women have a BMI below 18.5 (Black *et al*., 2008). About one-third of the children in the developing world are either underweight or stunted, and more than 30 per cent of the developing world's population suffers from micronutrient deficiencies (Akram *et al*., 2007). The poor are the most affected. Asia continues to have the highest rates and the largest number of malnourished children in the world. Africa is the only continent that has witnessed an increased rate of undernutrition.

According to a World Bank report (2006) on nutrition strategy, 27 per cent (more than 147 million) of the children under age 5 are stunted and 23 per cent (more than 126 million) are underweight in developing countries. Comparable figures for the developed world are 2.6 per cent for stunted children and 1.1 per cent for underweight children (Akram *et al*., 2007). About 24 per cent of the children in Africa are underweight and 35 per cent are stunted; between 35 million and 50 million children under age 5 are affected. In Asia, average underweight rates are higher than in Africa (26 per cent), and in several large South Asian countries, both underweight and stunting rates are nearly double of those in Africa (38 to 51 per cent). Undernutrition is therefore worst in Asia, which has 92 million stunted and 89 million underweight children (World Bank, 2006).

Malnutrition is caused by many factors and can be metabolic effects of underlying disease and also, reduced nutritional intake. Additional factors such as higher age and educational level of the patient or living situation might increase the general risk of developing nutritional deficits (Volkert *et al*., 1992). Malnutrition prevalence could also

be dependent on the health care system and the economic condition of the country where the study was performed (Waitzberg *et al*., 2001).

2.2 Malnutrition Situation in Ghana

Malnutrition continues to be an issue in Ghana due to lack of adequate nutritional education and the diet pattern of people. According to the Ghana Demographic and Health Survey (GDHS) (2008), a woman's nutritional status can affect her health as well as the health of her children. A study by Dake (2013) examined the trend in obesity among Ghanaian women over a 15-year period and found out that there was an increase in prevalence of obesity among Ghanaian women and if the current trend continues, the prevalence of obesity is likely to increase further in the future (Dake, 2013). The study also anticipated that Ghana is likely to face health challenges including increased prevalence of co-morbidities associated with obesity (e.g. diabetes, hypertension, cancers, stroke and heart diseases), reduced life expectancy, increased general and maternal mortality rates, increased pregnancy-related complications, low productivity and low economic growth (Dake, 2013).

According to GDHS (2008), the proportion of children under five who are stunted decreased from 34 % in 1988 to 31 % in 1998, and then peaked at 35 % in 2003 before decreasing to 28% in 2008. The proportion of children who are wasted has also decreased over the past 15 years from 14 % in 1993 to 9 % t in 2008, with no marked change over the past five years. The proportion of underweight children decreased from 23 % in 1988 and 1993 to 14% in 2008.

Ghana is also faced with issues relating to malnutrition and this has been established in some nutritional studies. It has been estimated that among children aged 0-36 months, 26% are stunted, 31% are underweight and 12% are wasted (Ghana Statistical Service, 1999). According to UNICEF (2009) in Ghana 28% of children under the age of five are stunted, 14% are underweight, and 9% are wasted (UNICEF, 2009).

Malnutrition rate among children under-two years recorded 2.7% in 2003, 5.4% in 2004, and 7.5% in 2005 in Ghana (GHS, 2005). Prevalence of underweight, which in 1993 was 27%, has dropped by half in Ghana (GDHS, 2008). Stunting rate has also decreased by eight percentage points over the same time period but is still high, and wasting rates remain virtually unchanged. It is important that progress continues (GDHS, 2008).

GDHS (2003) also suggest that the nutritional status of children in Ghana has changed since previous three GDHS surveys. Compared to 1988, chronic malnutrition rates (stunting) went down in 1993 and 1998 by fourpercentage points. The rates have come up again in 2003 by three percentage points compared to 1998.

A two percentage point decline in the rate of acute malnutrition (wasting) has been observed compared to 1998. Over the years, wasting has fluctuated. However due to seasonality of wasting, meaningful interpretations cannot be made. The rates of underweight have come down from 30% in 1988 to 22% in 2003. This decline in the rates of underweight is statistically significant from year 1998 to 2003.

According to Antwi (2008) malnutrition is widespread in developing countries like Ghana with a prevalence of 21.2%. Most malnourished children miss the opportunity for

being diagnosed in clinical settings largely due to lack of routine measurements of anthropometric indices, particularly height interventions to address malnutrition (Antwi, 2008).

2.3 Consequences of Malnutrition

Malnutrition is a serious public-health problem and has been linked to a substantial increase in the risk of mortality and morbidity. Women and young children bear the effect of the disease burden associated with malnutrition. In developing countries, malnutrition continues to be a primary cause of ill health and mortality among children. It is a major public health problem and accounts for about half of all child deaths worldwide (UNICEF, 2004).

Malnutrition is a health outcome as well as a risk factor for disease and can increase the risk both of morbidity and mortality. Although it is rarely the direct cause of death (except in situations, such as famine), child malnutrition was associated with 54% of child deaths (10.8 million children) in developing countries in 2001 (WHO, 2004). Overweight and obesity in children and adolescents are associated with chronic diseases and premature deaths in adulthood. Reilly *et al*. (2003) highlighted that cardiovascular diseases and psychological morbidity were the main side effects of childhood obesity.

Ampaabeng and Tan (2013) investigated the long-term effects of early childhood malnutrition on the cognitive development individuals who survived famine who were between the ages of 0 and 8 at the time of the famine. Their result revealed a direct, negative, and significant impact of early childhood malnutrition on the cognitive development of famine survivors (Ampaabeng and Tan, 2013). They also suggested that

the effects persist to adolescence and adulthood and that this loss of cognitive ability results in poorer performance on cognitive achievement tests (Ampaabeng and Tan, 2013). According to Monckeberg (1968), a direct association exists between deficits in height and weight of malnourished children and retardation in psychomotor, adaptive, language, and social-personal behaviour, as measured by the Gesell, Cattell, or Bayley techniques

Studies of mental performance of kwashiorkor patients during the period of rehabilitation indicated that, as children recovered from malnutrition, developmental quotients increased in most cases with the magnitude of the increment varying in direct relation to the age at which the children suffered the disease (Cravioto and Robies, 1965).

Recent longitudinal studies among cohorts of children from Brazil, Guatemala, India, the Philippines and South Africa confirmed the association between stunting and a reduction in schooling, and also found that stunting was a predictor of grade failure (Martorell *et al.,* 2010). Some research also links anaemia and the ability of children to capitalize on educational opportunities. In addition to diminished cognitive ability, lack of energy undermines an anaemic child's ability to concentrate and participate in learning experiences with some recent study linking anaemia to significantly reduced school attendance (Haas and Brownlie, 2001).

Studies by Wells *et al.* (2012) reveal that becoming stunted but then gaining weight disproportionately after 24 months is likely to increase the risk of becoming overweight and developing other health problems.

Poor nutritional status of a pregnant woman is likely to have long-term effects on the offspring. Stein *et al.,* (1996) reported that babies born to undernourished women have a

higher risk of developing chronic diseases during adulthood compared with babies born to women who are better nourished. At present, however, evidence is inadequate to support a link between poor maternal nutritional status and the determinants or consequences of chronic disease in the offspring of such women as children or as adults (Rasmussen, 2001).

The association between maternal malnutrition and bearing low birth weight babies is well established (Allen *et al*., 1994) and evidence suggests that adult women in the developing countries suffer from nutritional stress that begins at birth and continues onward. The energy cost of reproduction further exacerbates an already fragile state of energy balance with harmful consequences for both women and their offspring (Merchant and Martorell, 1989).

Malnutrition in women causes reduction in productivity, an increased susceptibility to infections, slow recovery from illness, and heightened risks of adverse pregnancy outcomes. Women with poor nutritional status as indicated by a low body mass index (BMI), short stature, or other micronutrient deficiencies have higher risk of obstructed labour, of having a baby with low birth weight, of producing lower quality breast milk, of dying from post-partum haemorrhage, and of contracting diseases along with her baby (GDHS, 2008). A malnourished child has a higher risk of getting sick and is at risk of early death (Man *et al*., 1998). Severe malnutrition can result in increased morbidity and mortality, as well as lead to impaired psychological and intellectual development (Blössner and de Onis, 2005).

According to studies by WHO (1995), pre-pregnancy body mass index (BMI) below 20 kg/m2 is associated with a significantly greater risk for Intrauterine growth restriction (IUGR), relative to a BMI above 24 kg/m2, with an overall odds ratio of 1.8 (95% confidence interval (CI): 1.7–2.0). It has also been estimated in developing countries that poor nutritional status in pregnancy accounts for 14% of foetuses with IUGR, and maternal stunting may account for a further 18.5% (ACC/SCN, 2000).

According to Fishman *et al*., (2004), there exists a relationship between maternal underweight status and neonatal mortality and this is estimated by deriving the proportion of IUGR attributable to poor maternal pre-pregnancy anthropometric status, and the proportion of neonatal mortality attributed to IUGR.

Dewey and Begum, (2011) suggests that stunting is associated with poor school achievement and poor school performance. A research study carried by Thomson (1968) which documented that in primigravidae short stature is associated with a greatly increased liability to delivery by caesarean section. That of perinatal deaths due to birth trauma also showed that 43.6 caesarean sections per thousand mothers of less than 60 inches of stature, and only 4.2 per thousand when stature was equal to 62 inches. Similarly, perinatal deaths due to birth trauma rose from 2.7 per thousand in infants from mothers with heights around 64 inches to 8.6 in infants from mothers of only 60 inches or less.

2.3.1 Birth Outcomes of Infants of Adult and Adolescent Mothers as a Consequence of Malnutrition

The outcome of birth of an infant could be influenced by the age of an individual. Maternal nutrition from before pregnancy through to delivery can have an effect on foetal growth and size at birth (Bloomfield *et al*., 2013). Teenagers are exposed more to poor nutrition and these maternal life-style problems may contribute to the delivery of low birth weight infants, resulting in disadvantaged babies who are not only exposed to the impact of the intrauterine environment,, but have the additional burden of being born with low weight, making them less able to cope with the hazards of extra-uterine life (Chandra *et al*., 2002). The risks of miscarriage, prematurity and low birth weight are severe in adolescent girls who are still growing at the time of conception (Wallacea *et al*., 2006) and many adolescent females who become pregnant have inadequate or marginal nutritional status during pregnancy.

According to Wallacea *et al*., (2006), limiting maternal intake in this way gradually diminishes maternal body reserves leading to a lower transplacental glucose gradient and a modest slowing of foetal growth in late pregnancy. In the longer term, the children of adolescent mothers are found as having poorer cognitive development, lower educational attainment, more frequent criminal activity, and a higher risk of abuse, neglect and behavioural problems during childhood (Maynard, 1997).

Available research suggests, that small infants or disproportionate at birth have increased health threats later in life (Godfrey, 1998). There is evidence that such infants have had to adapt to a limited supply of nutrients and that in so doing their physiology and

metabolism are permanently changed, although there is a challenge to this evidence (Susser and Levin, 1999).

Birth weight is significantly reduced in the offspring of growing adolescents and is attributed to a competition for nutrients between the maternal body and her gravid uterus. Sub-optimal dietary intakes are commonplace in sections of the general adolescent population and many adolescent girls have a risk of entering pregnancy with inadequate dietary intakes (King, 2003).

2.4 Nutrition Issues of Adolescents Mothers

The diet of a person could contribute to their total well-being and health with health issues related nutrition being very critical. There is a relationship between the diet components, eating behaviours, and overweight among adolescents (Davis and Carpenter, 2009). Associated with puberty are increased growth rate and changes in body composition which demands an increase in nutritional need (Amos *et al*., 2012). Many factors interrupt the intake of nutrients (Amos *et al*., 2012). Acceptance by peers and independence, increased mobility, greater time spent at school and/or work activities, preoccupation with self-image, routine, marketing, cultural and social issues, high availability of foods, parental influence, gender, self-concept, and personality contribute to the unhealthy eating behaviours among adolescents (Bester and Schnell, 2004; Demory-Luce and Jensen, 2009; Rea, 2007).

In youth, aged 12–17 years, dietary patterns which are unhealthy are the most frequently occurring chronic disease risk behaviour (Lowry *et al*., 1996). Eating habits formed in adolescence continue into adulthood (Nicklas *et al.*, 1988). Individuals are at risk for

chronic diseases such as cancers, diabetes, hypertension, and cardiovascular disease due to inadequate consumption of fruits and vegetables (Steinmetz and Potter, 1996).

According WHO (2002), overweight and obesity are the emerging threats to the health status of adolescents living in developed countries as well as in Asia and Asia Pacific regions. Obesity and overweight prevalence over the last twenty years has increased at an alarming rate not only in developed countries, but also around the world. According to the new data from some countries where surveys have been done, one in three adolescents is obese and overweight and obesity are now rising in low- and middle income countries (WHO, 2014). Maddah (2007) and Rashidi *et al*. (2007) have reported a prevalence of overweight and obesity in adolescents was 21.9%, 5.3% and 23.1%, 8.3%, respectively.

2.5 Nutritional Status and Pregnancy

Good maternal nutrition during pregnancy is important for the mother and the growing foetus. A diet with sufficient energy, with a variety of nutrients, minerals, and vitamins, and the mother's avoidance of toxins and contaminants is regarded to be important during reproductive life (Kaiser and Allen, 2008). Beside the influences on fertility, embryogenesis and organogenesis, foetal growth and maternal adaptation to pregnancy are affected as well (Brown, 1993). Impaired maternal nutrition may be related to some kind of intrauterine 'programming' during the early life of a foetus, of diseases expressed during adult life such as cardiovascular disease and non-insulin-dependent diabetes (Barker, 1994). Furthermore, there have been some indications that maternal in-utero exposure to malnourishment, does affect obstetric performance (Lumey, 1992).

There is an increase in energy and nutrients requirement during pregnancy (Picciano,2006). According to Hytten (1983), in well-nourished women, only a small amount of additional energy is required because the body adapts to the increased energy requirements and becomes more energy efficient through reduced physical activity and a lowered metabolic rate. Although the average-sized, well-nourished woman requires <10460 kJ/d (2000 kcal/d) during the last trimester of pregnancy, many women in developing countries restrict their food intake during pregnancy to have smaller infants, on grounds that smaller infants will carry a lower risk of delivery complications (Brems and Berg, 1988).

Deficiency of micronutrients such as folate, iron and zinc and vitamins A, B_6, B_{12}, C, E and riboflavin are highly prevalent and may occur concurrently among pregnant women (Black *et al*., 2008). Micronutrient deficiencies can occur as a result of inadequate intake of meat, fruits and vegetables and also infections. Multiple micronutrient supplementations in pregnant women are believed to help reduce adverse pregnancy outcomes through improved maternal nutritional and immune status (Allen, 2005).

The World Health Organization (WHO, 2012b) recommends iron and folic acid supplementation as a way of reducing the risk of iron deficiency anaemia among pregnant women. Since many developing countries already have systems in place for the delivery of iron and folic acid supplements, micronutrient supplements could be provided at little additional cost (Shrimpton *et al*., 2002). Several systematic reviews of trials investigating the effects of maternal multiple micronutrient supplementation have been carried out (Haider and Bhutta, 2006).

Requirements for many, but not all, micronutrients increase during pregnancy. Deficiencies can occur because of losses or improper absorption associated with disease or inadequate intakes, lack of knowledge about adequate prenatal nutrition, or dietary taboos associated with pregnancy (Gittelsohn *et al*., 1997), with potential adverse consequences for both mothers and newborn infants. Calcium deficiency is rare in pregnancy but appears in cases of hypoparathyroidism and severe dietary inadequacy and in individuals who are do not eat a diet rich in dairy products (Kazzi *et al*., 1998).

Low magnesium and calcium concentrations have been associated with hypertensive disorders of pregnancy, although a causal effect has not been shown (Maine, 2000). Most foods contain phosphorus, and dietary deficiency is rare (National Research Council, 1989). Iron deficiency mainly due to poor dietary iron bioavailability causes anaemia (Bothwell, 2000) and has been associated with maternal mortality (Rush, 2000). Iron deficiency is known to affect immune status by reducing the delayed-type hypersensitivity reaction, graft rejection, and cytotoxic activity of phagocytes (Yoshida, 1999).Iron therefore plays a vital role in maintaining maternal health and reducing the risk of infection.

Few data exist on biochemical zinc deficiency in pregnant women, which is partly due to the lack of a consensus on the appropriate indicator to use (Caulfield *et al*., 1998). Low plasma concentrations of zinc during pregnancy, resulting from low dietary bioavailability (Tuttle, 1983) or very high amounts of copper or iron in the diet that compete with zinc at absorption sites (Sheldon, 1985), have been associated with congenital abnormalities, abortions, intrauterine growth retardation, premature birth

(Jameson, 1993), and preeclampsia (Kiiholma *et al.*, 1984). Deficiency of zinc can also affect the immune response because it results in reductions in T cell development, hormone release from the thymus, and T cell functions (Yoshida *et al.*, 1999).

Foetal loss, stillbirths, cretinism, and mental retardation of the newborn infant may occur as a result of inadequate iodine intake (Delange, 1996). Keshan disease is associated with selenium deficiency, which has been found in women of reproductive age in China; thus, like iodine deficiency, selenium deficiency tends to be geographically specific because of deficiencies in the soil. No evidence exist that prenatal copper deficiency has teratogenic effects in humans as has been observed in experimental animals (Taper *et al*., 1985).

2.6 Determinants of Mothers' and Children Nutritional Status

Women are at greater risk of malnutrition than men in households which are vulnerable to food insecurity. Pregnant or breastfeeding mothers who are malnourished can set up a cycle of deprivation that increases the likelihood of low birth weight, child mortality, serious disease, poor classroom performance and low work productivity (http://www.fao.org/gender, 2014). Socioeconomic and cultural factors are the major determinants of the health and nutritional status of women (Ene-Obong *et al*., 2001). Malnutrition during childhood is associated with mothers' education and employment, family support and social network (Reyes *et al*., 2004). A number of biomedical characteristics, such as birth interval preceding and following each child birth, maternal age at child birth, child's age and gender could also be related to childhood malnutrition (Vella *et al*., 1992). Women who are vulnerable, especially those in female-headed households, frequently have limited access to nutrition information and the resources they

need to improve food security, such as income, land, equipment, financial services and training (http://www.fao.org/gender, 2014).

2.6.1 Household Economic Status

The financial status of a household can contribute to their nutritional status. According to studies by UNICEF (1990), the economic status of a household shows access to adequate food supplies, use of health services, availability of improved water sources, and sanitation facilities, which are prime determinants of child and maternal nutritional status. As in the case of women, the economic status of a household is also one of the most important determinants of child nutritional status (UNICEF, 1990). Studies that have been conducted in developing countries showed that malnutrition affected women from low economic status households (Loaiza, 1997; Teller and Yimar, 2000). Comparative studies on child nutrition for more than 15 countries (Sommerfelt *et al*., 1994) and some local studies in Ethiopia (Yimer, 2000) showed that the higher the level of economic status of the household, the lower the level of child stunting. Turnbull (1973) also suggest that if the household is larger, it comprises a large number of able-bodied people of working age then by virtue of economies of scale in consumption, the welfare of household members should be higher and so child health and nutrition status better. Anderson *et al.,* (2010) suggest that property owned by families, as well as resources available to them, can influence the household's nutritional status.

2.6.2 Educational Status of Women

Education is believed to be a tool for creating awareness with that on nutrition not being an exception. Education is one of the most important resources that enable women to

provide appropriate care for their children, which is an important determinant of children's growth and development (Engle and Menon, 1996). Studies in the Philippines (Aguillion *et al*., 1982), Libya (Popkin and Bisgrove, 1988), Uganda (Statistics Department and Macro International Inc., 1996), and Ethiopia (Yimer, 2000) show a decreased incidence of malnutrition among young children with an increase in the level of mothers' education.

Women education can enable them make independent decisions which would be recognized by other household members, and to have greater access to household resources that are important to nutritional status (ACC/SCN, 1990). A comparative study on maternal malnutrition showed that the advanced the level of education, the lower the proportion of undernourished women (Loaiza, 1997; Teller and Yimar, 2000).

There is high probability of an educated woman getting a job that carries good pay and there is better child nutrition associated with high incomes (Buor, 2003). According to Barrett and Brown (1996) more money can be spent on nutritional food that can directly impact children's health nutritionally. This can be achieved by spending more money.

2.6.3 Place of Residence

A person's immediate environment is known to directly affect him or her. Depending on whether a person is in a rural or urban environment he/she may have access to or lack certain facilities which are essential to his or her health. Studies by Teller and Yimar (2000) have showed that women in rural areas are more likely to suffer from chronic

energy deficiency than urban women. Higher prevalence of rural malnutrition have also been reported by local studies in Ethiopia (Zerihun *et al.*, 1997). Stunting have been found to be high in certain studies on child nutrition among rural than urban children (Yimer, 2000).

2.6.4 Employment Status of Women and the Control over Income

Engaging women in employment increases household income, with consequent benefit to household nutrition in general and the woman's nutritional status in particular. Employment can influence an increase women's position in society, and may bolster a woman's preference to spend her earnings on health and nutrition of her family. Though employed, women without control over their income and decision making authority within the household are deprived of economic and social power and the ability to take actions that will benefit their own well-being. Kennedy and Haddad have conducted studies in Africa and have found out that, at similar levels of income, households in which women have greater controls over their income are more likely to be food secured (Kennedy and Haddad, 1991). Studies by Casterline *et al.*, (1989) suggest that income earned by women or expenditure controlled by them may have a greater propensity to be used to benefit child health and nutrition than men's income.

Although women's employment enhances the household's accessibility to income, it may also have negative effects on the nutritional status of children, as it reduces a mother's time for childcare. Some studies have revealed that mothers of the most malnourished children work outside their home (Popkin, 1980). Another study argued that there is no association between maternal employment and children's nutritional status (Leslie, 1988).

2.6.5 Age of Women

The age of women and parity are vital factors that affect maternal depletion, especially in countries with high fertility rates (Zerihun *et al.*, 1997). DHS surveys conducted in Burkina Faso, Ghana, Malawi, Namibia, Niger, Senegal, and Zambia show a greater proportion of mothers age 15-19 and 40-49 that exhibit chronic energy deficiencies (CED). A local study in Ethiopia also showed that women in the youngest age group (15-19) and women in the oldest age group surveyed (45-49) are the most affected by malnutrition (Teller and Yimar, 2000)

2.6.6 Marital Status of Women

Household headship and other social and economic status of the women that affects their nutritional status are associated with marital status of most women and as a result, their nutrition can be endangered by a negative change in marital status. A study on the SNNPR Region of Ethiopia revealed that women's malnutrition is significantly associated with marital status indicating that compared to married women malnutrition is higher among unmarried rural and divorced/separated urban women compared to married ones (Teller and Yimar, 2000).

2.6.7 Source of Household Amenities

Household amenities such as potable water and places of convenience are very critical in determining the health and consequently the nutritional status of the household. Poor health environment caused by inadequate water and sanitation can increase the probability of infectious diseases and indirectly cause certain types of malnutrition (UNICEF, 1990). Research findings in some developing countries revealed that

unprotected water source and non-availability of latrine were associated with low child stature (Sommerfelt *et al*., 1994; Getaneh *et al*., 1998).

2.6.8 Child Morbidity

Some disease conditions can affect the nutritional status of an individual. Diarrhoea and other infectious diseases manifested in the form of fever affect both dietary intake and utilization, which may have a negative effect on improved child nutritional status. A comparative study on children's nutritional status (Sommerfelt *et al*., 1994) indicated that stunting was highest among children with recent diarrhoea.

2.6.9 Age of Child

Factors such as feeding/weaning practices, care, and exposure to infection at specific ages may influence children's nutritional status. A cumulative indicator of growth retardation (height-for-age) in children is positively associated with age (Aschalew, 2000). Local and regional studies in Ethiopia have also shown a rise in malnutrition with increase in age of the child (Yimer, 2000).

2.6.10 Birth Order

When parents give birth to a new child who needs much attention and care, they give less attention to older children. One study indicated that stunting is rare in birth child malnutrition (Jeyaseelan, 1997).

2.6.11 Birth Interval of the Child

Pregnancies which are closely spaced are often associated with the mother having little time to regain lost fat and nutrient stores (ACC/SCN, 1990). Child nutrition, is likely to

improve in higher birth spacing since the mother gets enough time for proper childcare and feeding. Studies in developing countries showed that children born after a short birth interval (less than 24 months) have higher levels of stunting in most countries where DHS surveys have been conducted (Sommerfelt *et al*., 1994). Zhu *et al*., (1999) also found that infants conceived 18 to 23 months after a live birth had the lowest risks of low birth weight, preterm birth, and small size for gestational age. There is high risk associated with both shorter and longer inter-pregnancy intervals.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study Design

This was a cross sectional study.

3.2 Study Sites

The study took place in the Greater Accra region of Ghana. Study participants were recruited from four health care facilities:- Manhean Health centre in Tema New Town, Kpone Health centre in Kpone, Ashaiman Polyclinic in Ashaiman and Ledzokuku Krowor Municipal Hospital in Teshie-Nungua. These health care facilities were chosen because of the high turnout in attendance of both adult and adolescent mothers and also, they are situated in peri-urban communities where adolescent motherhood is common.

3.2.1 Description of Study Sites

3.2.1.1 Tema New Town

Tema New town is about 25 kilometres from Ghana's capital Accra. The present settlement was located after the government ejected the inhabitants before independence to build the new Tema industrial and habour city. The population of the town is about 150,000 with two second cycle institutions, six public Junior high schools and over forty private Junior high schools and primary schools. A police post and the Eastern Naval Base in the town help with security matters and a public health post which attends to the health needs of the inhabitants. St. Johns clinic and about four pharmacies provide private health care to the inhabitants. There are four financial institutions that operate in the town; The Dangbe rural bank, Beige Capital, Sky Bank, and Opportunity Bank..

Inhabitants have access to electricity and pipe-borne water. The primary occupation is fishing and the main language spoken is Ga although most of them speak Twi in addition.

3.2.1.2 Ashaiman

Ashaiman is located about four kilometres north of Tema and about 30 kilometres from Accra, the capital of Ghana. It shares a boundary on the north and east with Kpone-katamanso district, on the West with Adjei-kojo community and on the south with Tema. Its population is about 190,000. Of the economically active population aged between 15 and 65 years, 91.6% are employed. About five percent of the employed population are in public (government sector), 20.5% in private formal sector, and 73.1% in the private informal sector and the remaining 0.9% are in the semi-public sector, NGOs and other international organizations. Thirty-seven public schools, made up of 18 Junior High schools, 18 primary and 1 Senior High school as well as 290 private schools can be found in Ashaiman. Majority of the youth attend senior high schools in Tema. There are about 17 health facilities in Ashaiman, with Ashaiman polyclinic being the only public health centre. The main languages spoken are Hausa and Ewe.

Ashaiman central market and the Nii Annang Adjor markets are the two main markets in the town. Fourteen financial institutions were found to be situated here. Okro, Pepper, cabbage and cucumber are the crops cultivated in the area.

3.2.1.3 Kpone

Kpone is sited near the city of Tema. The town has a population of about two hundred thousand. The main language spoken by the people is Ga.

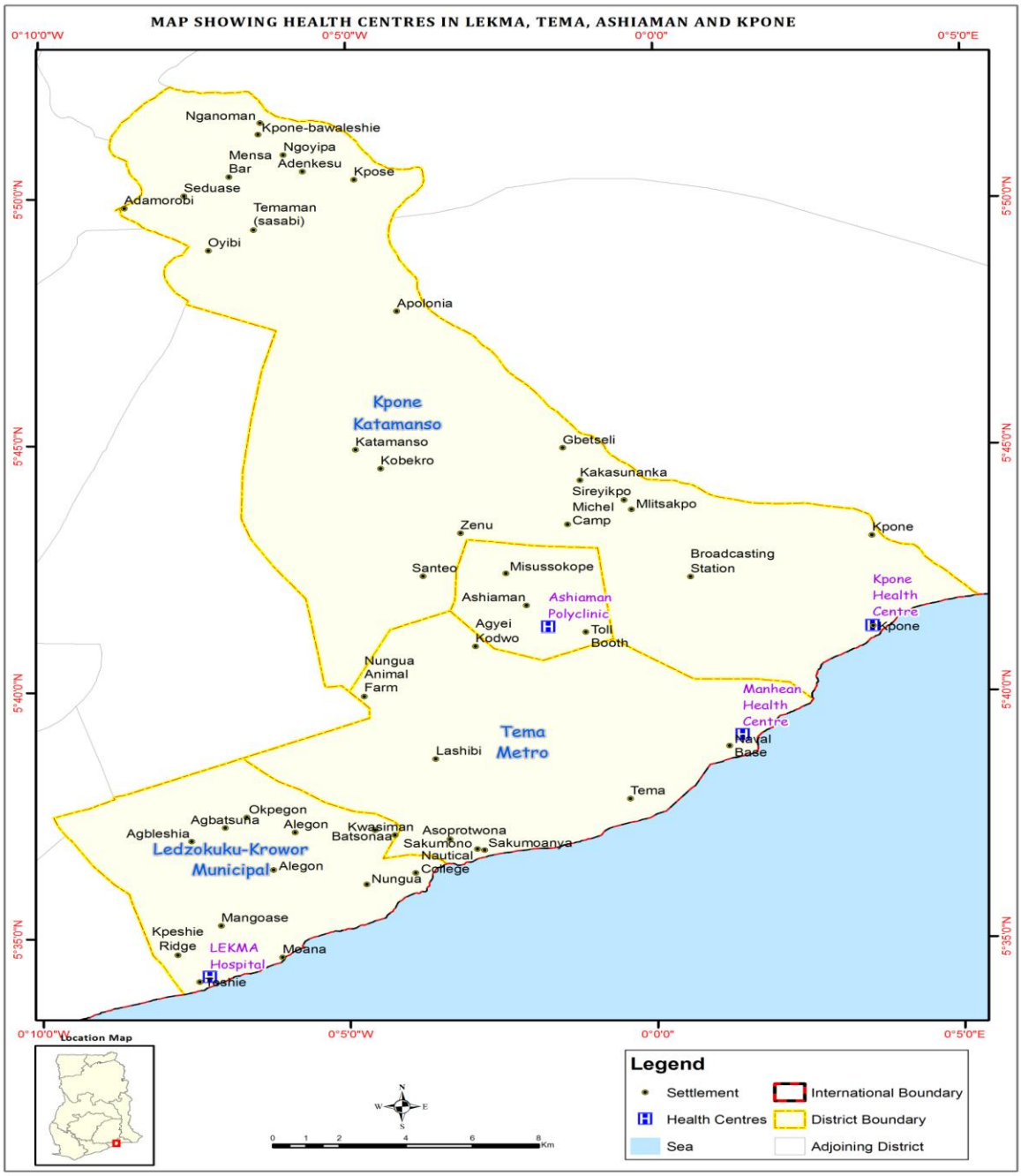
The main occupation of the people of Kpone are farming and fishing. They celebrate Homowo festival in August every year.

Kpone as a town enjoys electricity and pipe-borne water and has four (4) mission schools (Primary and Junior High school) and one (1) public primary and junior high school. There is a maternal clinic and a health post aside a few private chemists and traditional healers. The maternal clinic also serves as the family planning and immunization centre.

3.2.1.4 Teshie

The people of Teshie migrated from Ningo, Tema, La and Nungua. With a population of about two hundred thousand, their primary occupation is fishing. The people are also engaged in cash crop farming and some of their women are also fish mongers. They celebrate Homowo festival in August or September of every year. Their main source of light is electricity and they have access to pipe-borne water. They have a hospital, polyclinic and several private clinics and pharmacies.

FIGURE 3.1: Map Showing Study Hospitals



3.3 Sample Size Calculation

The sample size was calculated using an average prevalence of stunting among children in Ghana less than five years old. Stunting in children under five: males (25.3%) and Females (20.3%). Average prevalence was 22.8%. (Ghana Statistical Service, 2011)

Using the formula $N=t^2 \times p(1-p)/m^2$ from Magnani, (1997)

Where N=the required sample size

t=95% confidence interval (1.96)

m=margin of error at 5% (standard value of 0.05)

p=average prevalence of malnutrition in children below five in Ghana is 22.8%.

A sample size of two hundred and seventy was calculated. Two hundred and seventy mother-child pairs were calculated to participate in the study. However, two hundred and sixty mother-child pairs participated in the study. This due to the same mothers turning up at the health centres.

3.4 Sampling Techniques

All eligible mothers visiting the study health centres between February and March (2014) were recruited until the sample size required was obtained. All the health centres were visited on their post natal clinics and their child welfare clinic days. Tuesdays were the post natal and child welfare clinic days for Ledzokuku Krowor Municipal hospital (LEKMA) and Tema Manhean Health centre. Tema Manhean health centre had satellite clinics for child welfare clinic on Tuesdays at some locations in the township for mothers to visit conveniently. These centres were also visited. Kpone Health Centre was visited on Thursdays and Ashaiman Polyclinic on Fridays. Kpone Health Centre had a satellite

child welfare clinic at another side of the community on the third Monday of every month to ease mothers the stress of having to commute long distance to the main health centre. This satellite clinic was also visited on the third Monday of March 2014, where some mothers participated.

3.5 Inclusion and Exclusion Criteria

3.5.1 Inclusion Criteria

Participants were recruited into the study if they were: adult mothers (20-40 years) and adolescent mothers (13-19 years) with infants 0-24 months of age and attended post natal and child welfare clinic during the study period.

3.5.2 Exclusion Criteria

Mothers and infants who were going to see the doctor for medical attention and mothers who were pregnant were excluded from the study.

3.6 Data Collection

Semi-structured questionnaires were used in collecting data on; Section A (Background and household characteristics); Section B (Morbidity); Section C (Maternal nutrition knowledge); Section D (Food frequency); Section E (Anthropometry) and Section F (Biochemical-Haemoglobin)

3.6.1 Background Data

This included background information on child (age, sex, and birth weight), maternal information (age, marital status, religion), household information (source of drinking

water, type of toilet facility, household size), possession of household items (television set, radio, fan) and possession of livestock (goat, poultry, sheep).

3.6.2 Morbidity

Mothers were asked if they and their children had experienced fever, diarrhoea, fast breathing/shortness of breath and cough in the past two weeks, whether they sought for medical assistance and the kind of assistance they sought.

3.6.3 Nutrition Knowledge

Mothers were asked questions on the various food groups, their sources and their functions. Answers given by the mothers were used in determining their level of nutrition knowledge.

3.6.4 Dietary Data

Information on dietary intake was obtained using a Food and Agriculture Organization (FAO) guidelines for measuring household and individual dietary diversity which was modified to suit the foods available in Ghana. The frequency with which different foods from each food group were eaten daily, weekly and monthly was recorded.

3.6.5 Anthropometric Measurements

3.6.5.1 Maternal Anthropometry

The weight of mothers (kg) was taken by the use of analogue weighing scale with a least count of 0.1 kg and height of each mother was taken using a standard stadiometer using standard procedures(Gibson, 2005). The mid upper arm circumference was taken with a mid-upper arm circumference (MUAC) tape using standard procedures (Gibson, 2005).

3.6.5.2 Child Anthropometry

An analogue weighing scale was used to take the weight of the mother alone. This was recorded and the infant with minimal clothing was weighed together with the mother using the same scale. The difference in the two weights was recorded as the weight of the child.

An infantometer was used in taking the length of children less than 85 cm using standard procedures (Gibson, 2005). The mid upper arm circumference was taken using standard procedures (Gibson, 2005).

3.6.6 Haemoglobin Concentration

Haemoglobin concentration was obtained using a URIT haemoglobin meter. At the beginning of each survey, the accuracy of the URIT haemoglobin meter was checked using the URIT haemoglobin meter calibration strip. Subjects were made to sit comfortably. Infants were made to sit on their mother's lap. Each subject's middle finger was rubbed to keep it warm to enable free blood circulation before pricking. The finger was relaxed but not bent to allow for maximum blow flow. The site to be pricked was wiped with ethanol and the finger pressed lightly from the top knuckle towards the tip with the thumb. This stimulated blood flow towards the site to be pricked. When the thumb reached the fingertip, gentle pressure was maintained and the palm side surface of the finger halfway between the nail and the finger pad was pricked with a sharp, quick motion. The lancet was disposed of immediately. Using a dry gauze pad, the first two drops of blood were wiped away to stimulate blood flow. The finger was pressed gently until another blood drop appeared. A plastic micro pipette was filled by touching its

pointed tip to the middle of the blood drop. The plastic micro pipette filled automatically by capillary action which helped to avoid air being trapped in the plastic micro pipette. Excess blood was cleaned from the micro pipette using a clean tissue. The micro pipette was inspected for air bubbles. Blood was dropped from the micro pipette and placed on the strip for haemoglobin meter which was inserted in the URIT haemoglobin meter for readings to be taken. Haemoglobin meter strip was discarded afterwards.

3.7 Ethical Considerations and Data Quality

Ethical approval for the study was sought from the Institutional Review Board (IRB) of Noguchi Memorial Institute for Medical Research, University of Ghana, Legon. Mothers were recruited into the study after they had signed an informed consent form. The questionnaires were pretested before administration. This was to ensure clarity in the questions, to test the length of time needed for the administration of each questionnaire and to allow for appropriate modifications and corrections to be made.

Three field assistants were trained on how to administer questionnaires. A nurse was trained to take the haemoglobin concentration. All measurements were taken in duplicates to minimize random errors to ensure accuracy and precision. All the instruments were calibrated on the day of visit at the health centre before measurements were taken using standardized techniques.

3.8 Statistical and Data Analysis

Data was entered and analyzed using SPSS version 16.0. The means and standard deviations were calculated for continuous variables (e.g. age, income, height, weight).

The categorical variables (e.g. anaemia status, sex, level of education, marital status) were analyzed using chi-square test. Declaration of significance was done at $p<0.05$.

3.8.1 Nutrition Knowledge

Level of nutritional knowledge of mothers was based on scores obtained after answering questions under the nutrition knowledge section of the questionnaire. There were sixteen questions and each correct answer attracted a score of one. The minimum score was zero and the maximum score was sixteen. This was then split into tertiles (Table 3.2).

Table 3.2 Interpretation of scores obtained for nutrition knowledge

Marks out of sixteen	Interpretation
0-5	Low knowledge
6-11	Average knowledge
12-16	High knowledge

Frequencies were obtained for each interpretation (low, average and high knowledge) and compared between the adult and adolescent mothers using chi-square test.

3.8.2 Dietary Assessment of Mothers

A dietary diversity score was created. Sixteen food groups were considered : Cereals, white roots and tubers, vitamin A rich vegetables and tubers, dark green leafy vegetables, other vegetables, other fruits, organ meat, flesh meat, eggs, fish and sea food, legumes, nuts and seeds, milk and milk products, oils and fats, sweets and spices, condiments and beverages used in assessing the diversity of the mother's diet. This was adapted from FAO Guidelines for measuring household and individual dietary diversity (2011). Mean

daily, weekly and monthly diversity and comparison between adult and adolescent mothers were done using independent sample t-test.

Dietary diversity was classified as high or low. An individual with diversity between 0 and 8 was classified as having low diversity and individual having diversity from 9 to 16 was classified as having high diversity.

3.8.3 Analysis of nutritional status

3.8.3.1 Child Anthropometry

Weight, length and age information were converted to weight-for-length (WLZ), length-for-age (LAZ) and Weight-for-age (WAZ) Z-scores using WHO Anthro Software (version 3.0.1WHO, 2006). WLZ, LAZ, WAZ <-2 standard deviations from the reference mean were defined as wasting, stunting, and underweight respectively. Chi- square test was used in comparing wasting, stunting and underweight between children of adult and adolescent mothers.

3.8.3.2 Maternal Anthropometry

Body Mass Index (BMI) calculated as weight/height^2 (kg/m^2) was used to determine maternal nutritional status. The following classifications were used: BMI<18.5 kg/m^2 =underweight, BMI 18.5-24.9 kg/m^2 = normal, BMI $\geq$ 25.0 kg/m^2 = Overweight/obese. Chi-square test was used in comparing the BMI categories between the two groups of mothers.

3.8.3.3 Haemoglobin Concentration

The classifications for haemoglobin (Hb) concentration were: Hb < 12.0 g/dl = anaemic and Hb ≥ 12.0 g/dl = non anaemic for women and for children between 6 months and 24 months, Hb<11.0 g/dl as anaemic and Hb ≥11 g/dl as non-anaemic (WHO, 2008). Chi-square test was used in comparing the anaemia prevalence between the two groups of mothers.

3.8.4 Relationship between dietary intake and nutritional status

Multinomial logistic regression was used in finding the relationship between dietary diversity and nutritional status. The dependent variables were under weight, normal and overweight/ obese. Dietary diversity (Low and High dietary diversity) were the independent variables.

CHAPTER FOUR

4.0 RESULTS

4.1 Background Characteristics of Participants

Two hundred and sixty mother-infant pair participated in the study, consisting of:- 130 adult mother-child pairs and 130 adolescent mother-child pairs. Their socio demographic factors are summarized in Table 4.1. There were no significant differences between adult and adolescent mothers in terms of the sex, birth weight of their children, ethnic group, education and region. Marital status, occupation of the mothers, age of mothers and age of their children were significantly different ($p<0.001$, <0.001, <0.001 and 0.002). Majority (76.2%) of adult mothers were married as compared to 44.6% of adolescent mothers who were married (p- value <0001). Mean age of the adult mother was 28.81±5.26 years and that of the adolescent mother was 18.08± 1.14 years. Mean age of the child of an adult was 5.82±4.62 months and that of the child of 7.74±5.41 months.

Ownership of household by the adult and adolescent mothers or their households, number of rooms in their households, location of water, toilet facility, disposal of rubbish, and fuel for cooking were statistically significant. There was no significant difference in the source of water and source of lightening. Majority of the mothers lived in one-bed room (46.5%), had the main source of water being pipe-borne (98.1%) with the location of their source of water being mainly outside their compound (46.5%). Most of the mothers also used public toilets (52.3%), disposed their rubbish far from their houses (41.9%), had electricity as their main source of lightening (87.7%) and used firewood or charcoal as fuel for cooking (53.1%) as shown in Table 4.2.

Table 4.3 shows the possession of household items and domestic animals by study households. More of the households of adult mothers (83.1%) had radios as compared to adolescent mothers (70.8%), 81.5% of adult mothers had fans while 62.3% adolescent mothers had fans in their households. The percentage of adult mothers who had cars was 21.5% while that of the adolescent mothers was 11.5%. There was no significant difference in the possession of the household items such as telephone/mobile phone, television, computer, fridge, motor bicycle and bicycle. The percentage of adult and adolescent mother who had air conditioners was 3.1%.

Table 4.1: Socio-demographic Characteristics of Children of study participants (N=260)

Variable	Total sample (N=260)	Adult Mothers (n=130)	Adolescent Mothers (n=130)	p- value[1]
Sex of child				
Male	132(50.8)	64(49.2)	68(52.3)	0.620
Female	128(49.2)	66(50.8)	62(47.7)	
Marital status				
Married	157 (60.4%)	99 (76.2%)	58 (44.6%)	<0.001*
Single	61 (23.5%)	12 (9.2%)	48 (36.9%)	
Co-habitation	42 (16.2%)	19(14.6%)	24 (18.5%)	
Ethnic Group				
Akan	83 (31.9%)	45 (34.6%)	37(28.5%)	0.489
Ga-Adangme	74 (28.5%)	33 (25.4%)	41 (31.5%)	
Ewe	76 (28.8%)	40 (30.8%)	36 (27.7%)	
Other[2]	28 (10.8%)	12 (9.2%)	16 (12.3%)	
Education				
None	18 (6.9%)	11 (8.5%)	7 (5.4%)	0.610
Primary	82 (31.5%)	41 (31.5%)	41 (31.5%)	
Secondary	160 (61.5%)	78 (60.0%)	82 (63.1%)	
Occupation				
Unemployed	74 (28.5%)	18 (13.8%)	56 (43.1%)	<0.001*
Trader	114 (43.8%)	69 (53.1%)	45 (34.6%)	
Artisan	44 (16.9%)	28 (21.5%)	16 (12.5%)	
Professional	28 (10.8%)	15 (11.5%)	13 (10%)	
Religion				
Christian	237 (91.2%)	122 (93.8%)	115 (88.5%)	0.183
Muslim	21 (8.1%)	8 (6.2%)	13 (10%)	
Other[3]	2 (0.8%)		2 (1.5%)	
	(Mean ± SD)	(Mean ± SD)	(Mean ± SD)	p-value[4]
Age of mother (y)	23.58 ± 6.97	28.81± 5.26	18.08 ± 1.14	<0.001*
Age of child (months)	6.78 ±5.11	5.82±4.62	7.74 ±5.41	0.002*
Birth weight	3.34 ±2.90	3.52 ±3.06	3.19±2.71	0.379
Amount Earned per Month(GHC)	156.39±230.96	187.40±239.79	125.39±218.33	0.03*

*Statistically significant at $p < 0.05$
SD – standard deviation
[1]Pearson's Chi- square for categorical variables
[2] Dagomba, Kokomba, Frafra
[3]Traditional, no religion
[4]Independent-samples t-test for continuous variables

Table 4.2: Household Characteristics of Adult and Adolescent Mothers (N=260)

Variable	Total sample (N=260)	Adults Mothers (n=130)	Adolescent Mothers (n=130)	p-value[1]
	N (%)	N (%)	N (%)	
Ownership of House	122(46.9)	53(40.8)	69(53.1)	0.047*
Number of rooms				
One	121(46.5)	70(53.8)	51(39.2)	<0.001*
Two	65 (25)	39(30)	26(20)	
Three	23 (8.8)	8(6.2)	15(11.5)	
Four or more	51 (19.6)	13(10)	38(29.2)	
Main source of water				
Pipe	255(98.1)	127(97.7)	128(98.5)	0.652
Others[2]	5 (1.9)	3(2.3)	2(1.5)	
Location of water				
Within your Household	78 (30)	34(26.2)	44(33.8)	<0.001*
In your yard	61 (23.5)	45(34.6)	16(12.3)	
Outside household	121 (46.5)	51(39.2)	70(53.8)	
Toilet Facility				
Water closet at home	48 (18.5)	29(22.3)	19(14.6)	<0.001*
Public toilet	136 (52.3)	54(41.5)	82(63.1)	
KVIP	34 (13.1)	27(20.8)	7(5.4)	
Bush/river	42 (16.2)	20(15.4)	22(16.9)	
Disposal of rubbish/garbage				
Buried/burnt	31 (11.9)	18(13.8)	13(10)	<0.001*
Near the compound	19 (7.3)	4(3.1)	15(11.5)	
Far from the house	109(41.9)	42(32.3)	67(51.5)	
Garbage collector	101(38.8)	66(50.8)	35(26.9)	
Source of Lightening				
Electricity	228(87.7)	118(90.8)	110(84.6)	0.131
Others[3]	32 (12.3)	12(9.2)	20(15.4)	
Fuel for Cooking				
Gas	122(46.9)	72(55.4)	50(38.5)	0.006*
Others[4]	138(53.1)	58(44.6)	80(61.5)	

*Statistically significant at $p < 0.05$
Pearson's chi square for categorical variables
[2]Well, borehole [3]Lantern, Candle, Torchlight / Rechargeable lamp [4]Firewood, Charcoal

Table 4.3: Possession of Household Items by Adult and Adolescent Mothers (N=260)

Variable	Total Sample(N=260)	Adult mothers (n=130)	Adolescent mothers(n=130)	p-value[1]
Possession of household items	N (%)	n (%)	n (%)	
Telephone/Mobile phone	233 (89.6)	120(92.3)	113 (86.9)	0.155
Television	210 (80.8)	110 (84.6)	100 (76.9)	0.116
Radio	200 (76.9)	108 (83.1)	92 (70.8)	0.019*
Fan	187 (71.9)	106 (81.5)	81 (62.3)	0.001*
Computer	41 (15.8)	25 (19.2)	16 (12.3)	0.126
Refrigerator	129 (49.6)	72 (55.4)	57 (43.8)	0.063
Air conditioner	8 (3.1)	4 (3.1)	4 (3.1)	1.000
Car	43 (16.5)	28 (21.5)	15 (11.5)	0.030*
Motorcycle	25 (9.6)	13 (10)	12 (9.2)	0.833
Bicycle	65 (25)	32 (24.6)	33 (25.4)	0.886
Ownership of domestic animals				
Poultry	66 (25.4)	35 (26.9)	31(23.8)	0.569
Goat	21 (8.1)	115 (88.5)	15(11.5)	0.410
Sheep	8 (3.1)	2 (1.5)	6(4.6)	0.281
Cattle	3(1.2)	2 (1.5)	1(0.8)	1.000
Pigs	2(0.8)	1 (0.8)	1(0.8)	1.000
Rabbit	4(1.5)	3 (2.3)	1(0.8)	0.622

*Statistically significant at $p < 0.05$

[1]Pearson's chi square for categorical variables

4.2 Morbidity Survey of Adult and Adolescent Mothers for the Past Two Weeks (N=260)

Fever was the most common cause of morbidity among the mothers (16.2%). Concerning their source of treatment, most adult mothers obtained treatment from the hospital while the adolescent mothers got treatment from pharmacies (Table 4.4).

Table 4.4: Morbidity Status of Adult and Adolescent Mothers (N=260)

Variable	Total sample (N=260) N (%)	Adults Mother (n=130) n (%)	Adolescent Mother (n=130) n (%)	p-value
Fever	42(16.2)	15 (11.5)	27 (20.8)	0.043*
Fever Treatment	37(14.2)	11 (8.5)	26 (20)	0.014*
Source of Fever treatment				0.015*
Hospital/clinic	14 (5.4)	8 (72.7)	6 (23.1)	
Pharmacy	20 (7.7)	3 (27.3)	17 (65.4)	
Traditional practitioner	3 (1.2)	0 (0.0)	3 (11.5)	
Diarrhoea	7 (2.7)	2 (1.5)	5 (3.8)	0.250
Diarrhoea Treatment	6 (2.3)	2 (1.5)	4 (3.1)	0.427
Source of diarrhoea treatment				0.112
Hospital/clinic	1(0.4)	1 (50)	0(0.0)	
Pharmacy	3(1.2)	0(0.0)	3 (75)	
Traditional practitioner	1(0.4)	1 (50)	0(0.0)	
Friend	1 (0.4)	1 (50)	0(0.0)	
Fast breathing/shortness of breadth	10(3.8)	3 (2.3)	7 (5.4)	0.197
Fastbreathing/shortness of breadth Treatment	9 (3.5)	3 (100)	6 (85.7)	0.490
Source of treatment				0.072
Hospital/clinic	2 (0.8)	2 (66.7)	0(0.0)	
Pharmacy	6 (2.3)	1 (33.3)	5 (83.3)	
Traditional practitioner	1 (0.4)	0(0.0)	1 (16.7)	
Cough	24(6.9)	14 (10.8)	10(7.7)	0.391
Cough Treatment	18(6.9)	11 (78.6)	7 (70)	0.633
Source of Treatment				0.377
Hospital/clinic	7(2.7)	4 (36.4)	3(42.9)	
Pharmacy	10(3.8)	7 (63.6)	3 (42.9)	
Traditional Practitioner	1 (0.4)	0(0.0)	1 (0.4)	

*Statistically significant at $p < 0.05$: Pearson's chi square for categorical variables

4.3 Morbidity survey of children of adult and adolescent mothers for the past two weeks (N=260)

Fever was the most common cause of morbidity among children of adult and adolescent mothers. Table 4.5 shows the morbidity data on the children of adult and adolescent mothers. Of the 13.1% of adult mothers' children who had fever all of them sought treatment and all of the adolescent mothers' children(18.5%) who also had fever sought treatment.

The percentage of adult mothers' children who had diarrhoea was 10% and that of adolescent mothers' children was also 10%. All the children of adult mothers who had diarrhoea sought treatment while only 84.6% of the adolescents' children who had diarrhoea sought treatment. None of the children of the adult mothers were sick of fast breathing while 1.5% of the adolescent mothers children had fast breathing with the hospital being the major place where treatment was sought.

Table 4.5: Morbidity Status of children of Adults and Adolescents (N=260)

Variable	Total sample (N=260)	Adult Mother (n=130)	Adolescent Mother (n=130)	p- value[1]
	N (%)	N (%)	N (%)	
Fever	41(15.8)	17(13.1)	24(18.5)	0.234
Treatment of Fever	41(15.8)	17(100)	24(100)	
Source of Treatment				
Hospital/clinic	21(8.1)	9(52.9)	12(50)	0.450
Pharmacy	19(7.3)	7(41.2)	12(50)	
Traditional practitioner	1(0.4)	1(5.9)		
Diarrhoea	26(10)	13(10)	13(10)	1.000
Treatment of Diarrhoea	24(9.2)	13(100)	11(84.6)	0.141
Source of Treatment				0.223
Hospital/clinic	14(5.4)	7(53.8)	7(63.6)	
Pharmacy	7(2.7)	3(23.1)	4(36.4)	
Traditional practitioner	3(1.2)	3(23.1)	0(0.0)	
Fast breathing/shortness of breadth	2(0.8)	0(0.0)	2(1.5)	0.156
Treatment of Fast breathing/shortness of breadth	2(0.8)	0(0.0)	2(100)	
Source of treatment				
Hospital/clinic	1(0.4)	0(0.0)	1(50)	
Pharmacy	1(0.4)	0(0.0)	1(50)	
Cough	46(17.7)	17(13.1)	29(22.3)	0.051

*Statistically significant at $p < 0.05$
[1]Pearson's chi square for categorical variables

4.4 Nutrition Knowledge of Adult and Adolescent Mothers

The level of nutrition knowledge between the adult and adolescent mothers was significantly different with the adolescent mothers having a higher knowledge than the adult mothers'. Generally, most of the mothers were seen to have an average knowledge of nutrition. The mean nutrition knowledge among adult mothers was 8.25±2.75 while that of the adolescent mothers was 9.90±4.04. This is shown in table 4.6

Table 4.6: Nutrition Knowledge of Adult and Adolescent Mothers

Variable	Total Sample (N=260)	Adults(n=130)	Adolescent (n=130)	p-value[1]
Nutrition Knowledge				
Low	45(17.3)	21(46.7)	24(53.3)	<0.001*
Average	121(46.5)	81(66.9)	40(33.1)	
High	94(36.2)	28(29.8)	66(70.2)	
	Mean ±SD	Mean ±SD	Mean ±SD	**p-value[2]**
Nutrition knowledge	9.07 ±3.55	8.25±2.75	9.90±4.04	<0.001*

*Statistically significant at $p < 0.05$
SD – standard deviation
[1]Pearson's chi square for categorical variables
[2]Independent t test for continuous variables

4.5 Dietary Diversity of Adult and Adolescent Mothers

The mean daily dietary diversity of the adult mothers was 8.31 ±2.83 and that of the adolescent mothers was 10.11±2.76 and this difference was significant. Weekly and monthly diversities also showed a similar pattern where there was significant difference in the mean dietary diversity. This is shown in table 4.7

Table 4.7: Dietary Diversity among Adult and Adolescent Mothers (N=260)

Variable	Total Sample(n=260)	Adult Mothers(n=260)	Adolescent Mothers(n=130)	p-value[1]
	Mean ±SD	Mean ±SD	Mean ±SD	
Daily	9.21 ±2.93	8.31 ±2.83	10.11±2.76	<**0.001***
Weekly	13.89 ±1.87	13.39 ± 1.95	14.38 ±1.66	**<0.001***
Monthly	14.72 ± 1.43	14.49± 1.51	14.95± 1.31	**0.009***

[1]Independent t test for continuous variables

4.6 Nutritional Status of Adult and Adolescent Mothers and their Infants

Adult mothers were observed to have higher values for height, weight and mid-upper arm circumference (MUAC) compared to the adolescent mothers. There was significant difference in the height, weight and mid-upper arm circumference (MUAC) of the adult and adolescent mothers but there was no significant difference in the body mass index (BMI) and BMI categories of the mothers (Table 4.8).

Children from adolescent mothers were observed to have higher values for length for-age-z score (LAZ), weight for age z-score (WAZ) and mid-upper arm circumference z score (MUACZ) as compared to children from adult mothers However, weight for length z score and Body mass index for age z- score (BAZ) was higher for children from adult mothers compared to those from adolescent mothers. There was no significant difference in the length and MUAC of the children. The difference in weight of the children were however significant. There was no difference in the growth indices (weight-for-length z-score (WLZ), weight-for-age z-score (WAZ), BMI-for-age z-score (BAZ), MUAC z-score (MUACZ)) of the study children. However, there was significant difference in the LAZ of the study children. Most children were normal (76.5%) (Table 4.9) 23.5 % of the children were also found to be malnourished.

The differences in the haemoglobin concentration and the anaemic status of the adult and adolescent mothers were not significantly different (Table 4.10). The incidence of anaemia among children of adolescent mothers was lower than among children of adult mothers (Table 4.11) though this was not significant. Children of adult and adolescent

mothers showed no significant difference in their haemoglobin concentration and their anaemic status (Table 4.11).

Table 4.8: Anthropometry of Study Mothers (N=260)

Variable	Total sample(N=260)	Adult Mother(n=130)	Adolescent Mother(n=130)	p-value[1]
	Mean ±SD	Mean ±SD	Mean ±SD	
Height	150.13±9.24	157.70±7.41	153.91±9.18	<0.001*
Weight	56.69±9.97	64.36±13.40	60.53±12.4	<0.001*
MUAC[2]	27.13±3.99	29.85±3.62	28.49±4.04	<0.001*
BMI[3]	25.34±4.93	25.93±5.37	25.64±5.15	0.355
	N (%)	**n (%)**	**n (%)**	**p-value[2]**
BMI categories				
Underweight (<18.5kg/m^2)	14 (5.4)	7 (5.4)	7 (5.4)	0.498
Normal(18.5-24.9kg/m^2)	124(47.7)	59(45.4)	65(50.0)	
Overweight(25-30kg/m^2)	81 (31.2)	39(30)	42(32.3)	
Obese(>30kg/m^2)	41 (15.8)	25(19.2)	16(12.3)	

*Statistically significant at $p < 0.05$
SD – standard deviation
[1]Independent t test for continuous variables
[2]Pearson's chi square for categorical variables

Table 4.9: Anthropometry of Children of study participants

Variable	Total Sample(N=260)	Children of Adults(n=130)	Children of Adolescents(n=130)	p-value[1]
	Mean ±SD	Mean ±SD	Mean ±SD	
Length	67.03±8.58	65.96±8.11	66.31±8.36	0.168
Weight	7.46±2.12	6.93±1.90	7.20±2.03	0.035*
MUAC	14.18±1.58	14.13±1.64	14.22±1.53	0.645
Growth indices(Z-scores)				
WLZ	-0.31±1.63	-0.49±1.44	-0.14 ±1.79	0.087
LAZ	0.11 ± 1.57	0.49±1.50	-0.26 ±1.55	<0.001*
WAZ	-0.17±1.28	-0.07±1.27	-0.28 ±1.29	0.185
BAZ	-0.31 ±1.56	-0.45±1.39	-0.17±1.70	0.141
MUACZ	0.45 ±1.13	0.51 ±1.20	0.39 ±1.07	0.460
	N (%)	**n (%)**	**n (%)**	**p-value[2]**
Normal	199(76.5)	105(52.8)	94(47.2)	0.107
Malnourished[3]	61(23.5)	25(41.0)	36(59.0)	

*Statistically significant at $p < 0.05$
SD =standard deviation
[1]Independent samples t-test for continuous variables
[2]Pearson's Chi -square for categorical variables
[3]Malnourished= Stunted, wasted or underweight

Table 4.10: Haemoglobin Concentration and Anaemia Prevalence of Study Mothers

Variable	Total Sample(N=260)	Adult Mother(n=130)	Adolescent Mother(n=130)	p-value[1]
	Mean ±SD	Mean ±SD	Mean ±SD	
Haemoglobin	11.90±1.42	12.00 ±1.38	11.81±1.45	0.177
	N (%)	N (%)	N (%)	p-Value[2]
Anaemia Status				
Anaemic[3]	107(41.2)	46(35.4)	61(46.9)	0.059
Non anaemic[4]	153(58.8)	84(64.6)	69(53.1)	

SD – standard deviation
[1]Independent t test for continuous variables
[2]Pearson's chi square for categorical variables
[3]Anaemic= <12.0g/dl
[4]Non anaemic= ≥12.0g/dl

Table 4.11: Haemoglobin Concentration and Prevalence of Anaemia Among Children of Adult and Adolescents

Variable	Total Sample(N=260)	Children of Adult Mothers(n=130)	Children of Adolescent Mothers(n=130)	p-value[1]
	Mean ±SD	Mean ±SD	Mean ±SD	
Haemoglobin	10.10±1.57	10.30± 1.58	9.91 ±1.55	0.045*
	N(%)	N(%)	N(%)	p-value[2]
Anaemia Status				
Anaemic	188(72.3)	101(77.7)	87(66.9)	0.052
Non anaemic	72(27.7)	29(22.3)	43(33.1)	

*Statistically significant at $p < 0.05$
SD – standard deviation
[1]Independent t test for continuous variables
[2]Pearson's chi square for categorical variables
Anaemic= <11.0g/dl
Non anaemic= ≥11.0g/dl

4.7 Relationship between Daily Dietary Diversity and Nutritional Status of Study Participants

Mothers who had high dietary diversity score as compared to mothers who had low diversity score were less likely to be underweight. On the other hand, mothers who had high dietary diversity score as compared to low dietary score were more likely to be overweight/obese.

Table 4.12: Dietary Diversity and Nutritional Status of Study Mothers

Nutritional status	Dietary diversity	Odds ratio	p-value	95% Confidence Interval	
				Lower	Upper
Under weight	High diversity	0.62	0.41	0.20	1.96
	Low diversity	ref			
Over weight/obese	High diversity	1.15	0.61	0.67	1.98
	Low diversity	ref			

The reference category for nutritional status is normal.

CHAPTER FIVE

5.0 DISCUSSION

5.1 Nutrition Knowledge

Adolescent mothers had a higher knowledge in nutrition than adult mothers since most of the adolescent mothers had higher scores for knowledge in nutrition. Mothers are given nutrition education at child welfare clinics. They are usually taught the importance and functions of the different nutrients which are present in the various kinds of foods given to the children. Nutrition education can improve nutrition knowledge as was found in the study by Walsh *et al.*,(2003) where a community- based nutrition programme contributed to the improved knowledge of nutrition.

Most adolescent mothers were observed to have higher education compared to adult mothers although this was not significant and this could have influenced the difference in the adult and adolescent mothers' knowledge on nutrition. The results observed could have been due to the fact that adolescent mothers were more current as compared to the adult mothers as such they could have gotten access to nutrition education through modern social electronic media.

A study titled Public health at a glance on adolescent nutrition (2003), showed that adolescents have more easy access to health and nutrition information through schools, recreational activities, and mass media than they have later in their lives. Studies by Alam *et al.* (2010) also showed that education is positively associated with knowledge.

5.2 Dietary Diversity

Adolescent mothers were found to have a more diverse diet than the adult mothers According to Ruel (2003), dietary diversity is the number of foods or food groups consumed over a given reference period. It is also a measurement of food intake qualitatively, reflects household access to a variety of foods and also a proxy for nutrient adequacy of the diet of individuals (FAO, 2011).

The results of the study indicated that adolescent mothers have a higher daily, weekly and monthly diversity than the adult mothers with reference to their mean diversities. Even though the nutrition education given to the mothers was mainly for their children, it improved adolescent mother's knowledge and had positive impact on the dietary diversity of mothers. As part of the nutrition education given, mothers are educated on the importance of diverse diet.

High income is associated with high dietary diversity (Taruvinga *et al.*, 2013). However in this study, adult mothers who had higher income had a lower dietary diversity compared to adolescent mothers with lower income. This could be explained by the fact that adolescent mothers had higher knowledge than adult mothers as explained by the study. From observations on the field, not all the adolescent mothers were able to tell the amount of money they made in a month or they spent on food. This can be attributed to them obtaining food from their parents who they might have been staying with thus having a high dietary diversity although their income and the amount of money they spent on food was less.

Higher dietary diversity in the adolescents mothers compared to the adult mothers as observed in the study could also be due to the adolescent mothers having more access to variety of food than adult mothers. This situation could be due to adolescent mothers having more time for variety of food selection compared to adult mothers.

Studies by Wen *et al.* (2010) shows that individual dietary diversity scores have been shown to indicate adequate nutrient intake through diet. Dietary diversity can be used as a proxy indicator for measuring nutrient adequacy among pregnant females.

5.3 Morbidity

Both adult and adolescent mothers and their infants had the same common illness affecting them which was usually fever. Treatments of illness however, differ between adolescent mothers and adult mothers. The major sources of treatment were the same for both adult mothers and adolescent mothers as well as for their infants. Fever gives an indication of a person status concerning malaria and thus can be used as a measure of a person malaria condition or not (GDHS, 2008).

The high prevalence of fever indicates high prevalence of malaria among children from both adult and adolescent mothers and this could be explained by the fact that mothers within the study area were living in areas endemic with malaria. The difference in prevalence between children from adult and adolescent mothers could be due to the fact that adolescent mothers either were not able to protect their children from getting malaria or did not provide adequate treatments for fever and thus malaria for the children.

5.4 Nutritional Status of Adolescent and Adult Mothers

The body mass index of the adult and the adolescent mothers did not differ significantly. Most of the adult and the adolescent mothers were in the normal body mass index range. The number of mothers who were overweight and obese was more than the number of women who were underweight. In recent times the prevalence of overweight and obesity among women is increasing. Obesity is becoming a common problem in developing countries including Ghana (Maxwell *et al.,* 2000).

Body mass index classification obtained from the study was different from that reported by the GDHS (2008).The percentage of adult and adolescent mothers who were underweight were observed to be higher while that who were normal were lower compared to those in Greater Accra as reported in the GDHS(2008). Also the percentage of adult and adolescent women who were overweight and obese were lower than that observed in Greater Accra. The area of residence of the study populations (GDHS and this study) were different. The GDHS recruited from participants from all the ten regions in Ghana while this study focused on only four peri-urban communities in the Greater Accra region. Area of residence can have an effect on an individual's nutritional status. Mothers from more deprived areas fared worse in employment, education, and lacked access to pipe-borne water (Nnyepi, 2007) Higher incomes, better health and nutrition knowledge, food habits, nutrient intakes are associated with a higher education of women (Ene-Obong *et al.*, 2001).

Mid-upper arm circumference measurement is an indicator of malnutrition and readings less than 18.5cm is an indicator of moderate under nutrition and less than 16.0 as an

indicator of severe under nutrition (www.unsystem.org, 2014). The average mid-upper arm circumference of the adult mothers and adolescent mothers was greater than 18.5 cm which is an indication of a good nutritional status.

Iron deficiency anaemia prevalence in adolescent females according to GDHS (2008) was higher than that obtained from the study. Anaemia prevalence in adult women in Ghana is generally higher than that of the study population. Lower prevalence of anaemia in adult mothers compared to adolescent mothers could have been due to higher disease condition which affects iron status of mothers such as fever. This was confirmed the prevalence of fever among adolescent and adult mothers where adolescent mothers were observed to have higher prevalence of fever compared to adult mothers.

Iron deficiency in women in usually caused by inadequate intake of foods that contain haem iron or vitamin C rich foods. Iron deficiency anaemia results in poor work performance by women as they easily get tired (Hadary and Cohenand, 1999).

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5.5 Nutritional Status of Children of Adolescent and Adult Mothers

Adult mothers' children weigh lesser than the adolescent mothers' children. This was due to the fact that the mean age of the adult mothers' children measured was less than that of the adolescents. Stunting was higher in children of adolescents than children of adults. This could be due to inadequate intake of nutrients by adolescent mothers during pregnancy resulting in lesser weight in their children. Research studies by King (2003) suggest that there is an increased risk of entering a reproductive cycle with reduced

maternal nutrient reserves as found in women with early pregnancies. Most children from adult mothers in the study were anaemic compared to those of adolescent. Anaemia reflects the iron status of a person. Anaemia in children results in impaired mental development and this can contribute to poor academic performance (Nokes *et al*., 1998). The result from anaemia suggests that children from adult mothers either lack iron in their diets or were more prone to infectious disease such as malaria which usually results in anaemia. The result on the fever status of the children of the adult and adolescent mothers confirms that children from adolescent mothers are more prone to fever than those from adult mother.

5.6 Dietary Diversity and Nutritional Status

Dietary diversity is a qualitative way of assessing dietary data. In the study by Torheim *et al.*,(2004) it was found that dietary diversity is a count of all the food items consumed and the amounts are not considered.

Dietary diversity does not significantly affect the nutritional status of adult and adolescent mothers. Mothers with low dietary diversity were observed to be more undernourished compared to mothers with a high dietary diversity. Mothers with high diversity were observed to be more overweight/obese compared to mothers with low diversity. This is in line with a study conducted by Savy *et al*., (2006) where they found an association between dietary diversity and nutritional status.

Disease state such as diarrhoea can affect their nutritional status. Children from both adult and adolescent mothers show the same prevalence for diarrhoea but adolescent mothers showed a higher prevalence for diarrhoea compared to adult mothers. This could

have resulted in adolescent having a better nutritional status compared to adult mothers although they ate a more diversified diet.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATION

6.1 CONCLUSION

Adolescent mothers had a higher level of nutrition knowledge and a more diverse diet as compared to the adult mothers. There was a difference in the weight and height measurement of the mothers but not the body mass index (BMI) categorization. Prevalence of anaemia was not different in the adult and adolescent mothers. With the exception of length-for-age z-score which was higher for adolescent mothers' children, there was no difference in the other growth indices; weight-for-length z-score and weight-for-age z-score of the children of adult and adolescent mothers. There was no difference in the anaemia prevalence of children of adult and adolescent mothers. Mothers who had a lower dietary diversity were more likely to be undernourished as compared to mothers with a higher dietary diversity.

6.2 LIMITATIONS OF THE STUDY

Even though at a point in time, the same mothers kept on visiting the health centres and so the study was rounded off, new mothers might have turned up if there was much time available to spend on the field.

Funds available was not adequate to support the study. Field assistants could no longer be paid while no new mother turned up.

6.3 RECOMMENDATIONS

- More nutrition education must be given to adult mothers to improve the nutritional knowledge of adult mothers.
- There should be campaign against adolescent pregnancies to improve stunting prevalence in children.

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APPENDICES

APPENDIX ONE

INFORMED CONSENT FORM

Title: Comparative Nutritional Status of Adult and Adolescent mothers and their Infants

Principal Investigator: Ethel M. Quarshie

Address: University of Ghana, Department of Nutrition and Food Science P.O BOX LG 134, Legon

General Information about Research

The objectives of this project are to determine what mothers know about nutrition, to find out what foods are eaten and how often they are eaten by adult and adolescent mothers, to establish the relationship between what they eat and their nutritional status and to compare the nutritional status between the two groups of mothers and their infants.

Your participation in the study will be once and will take little of your time. You would be asked some questions about yourself, what you know about food and what you have been eating as well as how often you have been eating them. Your weight, height, a measurement of the middle portion of your arm and a small blood samples by finger-prick would be taken for blood level determination as well as that of your infant.

You will be asked to sign or thumbprint to serve as a proof of your agreement. A copy of this form would be given to you. If there is any section of the form you may not understand, please ask for explanation. Participation in this study is Voluntary. You have

the right to know about procedures, risks and benefits of this study so that you can make a decision about whether or not to participate. This is called informed consent.

Possible Risks and Discomforts
The potential risk involved are minimal to the extent that the procedures have been assessed by qualified health professionals affiliated to University of Ghana. There might be a little discomfort during the finger- pricking for blood samples to be taken.

Possible Benefits
You may not benefit directly by participating in this study. The data obtained would provide a better basis for policy making concerning the nutrition of adult and adolescent mothers as well as their infants.

Confidentiality
The results obtained from this study are confidential. You would not be required to write your name on the questionnaire.

Compensation
You will be given a packet of diapers at the end of the study.

Voluntary Participation and Right to Leave the Research
Your participation in the study is confidential. You can withdraw from the study any time you feel like without any penalty.

Contacts for Additional Information
For any pertinent questions please contact:

Ethel M. Quarshie
0242005510

Your rights as a Participant
This research has been reviewed and approved by the Institutional Review Board of Noguchi Memorial Institute for Medical Research (NMIMR-IRB). If you have any questions about your rights as a research participant you can contact the IRB Office

between the hours of 8am-5pm through the landline 0302916438 or email addresses:

nirb@noguchi.mimcom.org

VOLUNTEER AGREEMENT

The above document describing the benefits, risks and procedures for the research title **Comparative Nutritional Status of Adult and Adolescent Mothers and their Infants** has been read and explained to me. I have been given an opportunity to have any questions about the research answered to my satisfaction. I agree to participate as a volunteer.

_____ _____

Date Name and signature or mark of volunteer

If volunteers cannot read the form themselves, a witness must sign here:

I was present while the benefits, risks and procedures were read to the volunteer. All questions were answered and the volunteer has agreed to take part in the research.

_____ _____

Date Name and signature of witness

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual.

_____ _____

Date Name Signature of Person Who Obtained Consent

APPENDIX TWO

PARENTAL CONSENT FORM

Title: Comparative Nutritional status of Adult and Adolescent mothers and their Infants.

Principal Investigator: Ethel M. Quarshie

Address: University of Ghana, Department of Nutrition and Food Science, P.O Box LG 134, Legon.

General Information about Research

The objectives of this project are to find out what mothers know about nutrition, to know which foods mothers eat and how often they eat them, to relate what they eat to their nutritional status and to compare the nutritional status between the two groups of mothers and their infants.

Your ward's participation in the study will be once and will take little of her time. She would be asked some questions about herself, what she knows about food, what she has been eating as well as how often she has been eating them. Her weight, height, the measurement of the middle portion of her arm, and a small blood sample by finger-prick would be taken to find out her blood level. This would be carried out on her infant as well.

You, her parent would be asked to sign or thumbprint to serve as a proof of your agreement for her to take part in the study. A copy of the consent form will be given to you. If you do not understand any section, you can ask for explanation. Participation in this study is voluntary. Everybody taking part in this study has the right to know about the procedures, risks, and benefits of the study so that a decision can be made whether or not to participate. This is called informed consent.

Possible Risks and Discomforts

The potential risk involved are minimal to the extent that the procedures have been assessed by qualified health professionals affiliated to University of Ghana . There might be a little discomfort during the finger-pricking for blood samples to be taken.

Possible Benefits

Your child may not benefit directly by taking part in this study. The data obtained would provide a better basis for policy making concerning the nutrition of adolescent and adult mothers and their infants.

Confidentiality
Any information provided will be treated with strict confidentiality. Your child will not be named in any report.

Compensation
Your child would be given a packet of diapers at the end of the study.

Voluntary Participation and Right to Leave the Research
The research is voluntary and the child can withdraw without penalty.

Contacts for Additional Information
Ethel M. Quarshie
P.O Box BT 446,
Tema
Mobile : 0242 00 55 10

Your Child's Rights as a Participant
This research has been reviewed and approved by the Noguchi Memorial Institute for Medical Research Institutional Review Board (NMIMR-IRB). If you have any questions about your child's rights as a research participant you can contact the IRB Office between the hours of 8am-5pm through the landline 0302916438 or email addresses: nirb@noguchi.mimcom.org .

VOLUNTEER AGREEMENT

The above document describing the benefits, risks and procedures for the research title **Comparative Nutritional status of Adult and Adolescent mothers and their Infants** has been read and explained to me. I have been given an opportunity to have any questions about the research answered to my satisfaction. I agree that my child should participate as a volunteer.

_____ _____

Date Name and signature or mark of parent or guardian

If volunteers cannot read the form themselves, a witness must sign here:

I was present while the benefits, risks and procedures were read to the child's parent or guardian. All questions were answered and the child's parent has agreed that his or her child should take part in the research.

_____ _____

Date Name and signature of witness

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual.

_____ _____

Date Name Signature of Person Who Obtained Consent

APPENDIX THREE

NOGUCHI MEMORIAL INSTITUTE FOR MEDICAL RESEARCH INSTITUTIONAL REVIEW BOARD (NMIMR-IRB)

CHILD ASSENT FORM

Introduction

My name is Ethel Quarshie and I am from the Department of Nutrition and Food Science at University of Ghana, Legon. I am conducting a research study entitled Comparative Nutritional Status of Adult and Adolescent mothers and their Infants. I am asking you to take part in this research study because I am trying to learn more about what adult and adolescent mothers know about nutrition, the kinds of food they eat and how often they eat them, to know the relationship between their dietary intake and nutritional status and to compare the nutritional status of the two groups of mothers and their children. This will take about thirty minutes of your time.

General Information

If you agree to be in this study, you will be asked to questions about yourself, what you know about nutrition and the kinds of foods you eat. Your weight, height, a measurement around the middle portion of your arm would be taken. A small blood sample by finger-prick would be taken to determine your blood level. Measurement would be taken on your child as well.

Possible Benefits

Your participation in this study will result in determining whether there is the need to make serious policies concerning the nutrition of adult and adolescents mothers and their infants.

Possible Risks and Discomforts

There is no risk however, there may be little discomfort felt during pricking for blood samples to be taken.

Voluntary Participation and Right to Leave the Research

You can stop participating at any time if you feel uncomfortable. No one will be angry with you if you do not want to participate.

Confidentiality

Your information will be kept confidential. No one will be able to know how you responded to the questions and your information will be anonymous.

Contacts for Additional Information

You may ask me any questions about this study. You can call me at any time. This is my phone number 0242005510 or talk to me the next time you see me.

Please talk about this study with your parents before you decide whether or not to participate. I will also ask permission from your parents before you are enrolled into the study. Even if your parents say "yes" you can still decide not to participate.

Your rights as a Participant

This research has been reviewed and approved by the Institutional Review Board of Noguchi Memorial Institute for Medical Research (NMIMR-IRB). If you have any questions about your rights as a research participant you can contact the IRB Office between the hours of 8am-5pm through the landline 0302916438 or email addresses: nirb@noguchi.mimcom.org

VOLUNTARY AGREEMENT

By making a mark or thumb printing below, it means that you understand and know the issues concerning this research study. If you do not want to participate in this study, please do not sign this assent form. You and your parents will be given a copy of this form after you have signed it.

This assent form which describes the benefits, risks and procedures for the research titled **Comparative nutritional status of adult and adolescent mothers and their infants** has been read and or explained to me. I have been given an opportunity to have any questions about the research answered to my satisfaction. I agree to participate.

Child's Name:…… **Researcher's Name:……**

Child's Mark/Thumbprint…… **Researcher's Signature:……**

Date: …… **Date:** ……

STUDY QUESTIONNAIRE

DEPARTMENT OF NUTRITION AND FOOD SCIENCE
UNIVERSITY OF GHANA, LEGON

Study Questionnaire on Comparative Nutritional Status of Adult and Adolescent Mothers and their Infants

Date of interview……../……../2014
Health Centre…….

SECTION A BACKGROUND AND HOUSEHOLD CHARACTERISTICS

(In this section, you would be required to answer some questions on your background and household characteristics. The appropriate box would be ticked by the interviewer to indicate answers where applicable)

1. How old is your child? …….. (Completed months)

2. What is the date of birth of your child...../……/20…..

3. Sex of child.
   1. Male [ ] 2. Female [ ]

4. What was the weight of your child at birth?…… (Kg)

5. How old are you? …… (Completed years)

6. What is your marital status?
   1. Married [ ] 2. Cohabiting [ ] 3.Single [ ] 4. Divorced [ ] 5.Widowed [ ]
   6. Separated [ ]

7. Which ethnic group do you belong to?
   1. Akan [ ] 2. Ga-Adangme [ ] 3. Ewe [ ] 4.Other (Specify)……

8. What is your religion?
   1. Christian [ ] 2.Islam [ ] 3.Traditional [ ] 4.Other (Specify)……

9. What is your highest level of education?
   1. None [ ] 2.Primary [ ] 3.Secondary [ ] 4.Tertiary [ ] 5.Other (Specify)…...

10. What is your occupation?
    1. Unemployed [ ] 2.Trader [ ] 3.Artisan [ ] 4. Office Worker [ ]
    5. Professional [ ] 6. Other…….....

11. How much do you make in a month? ..... (GHC)

12. How much money do you spend on food per month? ..... (GHC)

13. Do you or household own the house you live in?
1. Yes [ ] 2. No [ ]

14. How many rooms are in the household?
1. One [ ] 2. Two [ ] 3. Three [ ] 4. Four [ ] 5. More than four [ ]

15. What is the main source of water for household use?
1. Pipe [ ] 2.Well [ ] 3.Borehole [ ] 4.River/Stream [ ] 5. Other (Specify).....

16. Where is the source of water located?
1. Within your household [ ] 2. In your yard [ ] 3. Other (specify)……

17. What kind of toilet facility does this household use?
1. Water closet at home [ ] 2. Public toilet [ ] 3. KVIP [ ] 4. Bush/River [ ]
5. Other (Specify)…….....

18. How is refuse disposed of in your house?
1. Buried/burnt [ ] 2.Dumped near the house [ ] 3. Dumped at refuse site far from the house [ ] 4. Collected by a garbage collector [ ] 5.Other (Specify)……

19. What is the main source of energy for lightening in your household?
1. Electricity [ ] 2. Lantern [ ] 3. Candle [ ] 4.Torchlight /Rechargeable light [ ] 5. Other (Specify) .....……..

20. What is your main source of energy for cooking?
1. Gas [ ] 2.Charcoal [ ] 3.Firewood [ ] 4. Other (specify)…….....

Kindly tell me if you have any of these possessions in your household

21. Which of these possessions do you have at home?

Item	Yes[1] No [2]	Item	Yes[1] No [2]
Telephone/Mobile phone		Refrigerator	
Television		Air conditioner	
Radio		Car	
Fan		Motorcycle	
Computer		Bicycle	

Kindly tell me if you have any of these domestic animals in your household

22. Which of these domestic animals do you have at home?

Item	Yes[1] No [2]	Item	Yes[1] No [2]
Poultry		Pigs	
Goat		Rabbit	
Sheep		Others (Specify)	
Cattle			

SECTION B MORBIDITY SURVEY

In this section, you are going to be asked questions on your health as well as your child

23. Have you been sick of any of the following in the past two weeks, whether you sought treatment or not and the source of treatment.

Morbidity	**Sick**	**Treated**	**Source of Treatment**
	Yes[1] No [2]	Yes[1] No[2]	Hospital/Clinic[1] Pharmacy[2] Traditional practitioner[3] Friend[4] Other(specify)
Fever			
Diarrhoea			
Fast breathing/shortness of breath			
Cough			

24. Has your child has been sick of the following in the past two weeks, whether you sought treatment or not and the source of treatment

Morbidity	**Sick**	**Treated**	**Source of Treatment**
	Yes[1] No [2]	Yes[1] No[2]	Hospital/Clinic[1] Pharmacy[2] Traditional practitioner[3] Friend[4] Other(specify)
Fever			
Diarrhoea			
Fast breathing/shortness of breath			
Cough			

SECTION C: NUTRITION KNOWLEDGE OF MOTHER

(In this section, you are going be asked certain questions on your knowledge of nutrition)

25. Cassava, Yam and Gari are rich sources of
    1. Protein [ ] 2.Carbohydrates [ ] 3. Fats [ ] 4. Iodine [ ] 5. Don't know [ ]

26. Chicken, Eggs and Fish are rich sources of
    1. Protein [ ] 2. Carbohydrates [ ] 3. Fats [ ] 4. Iodine [ ] 5. Don't know [ ]

27. Which of the following is a rich source of fat?
    1. Orange [ ] 2.Margarine [ ] 3. Carrot [ ] 4.Rice [ ] 5. Don't know [ ]

28. Milk and milk products are rich in
    1. Sodium [ ] 2. Calcium [ ] 3. Iron [ ] 4. Zinc [ ] 5. Don't know [ ]

29. Which of the following is a rich source of iodine?
    1. Sea foods [ ] 2. Meat [ ] 3. Orange [ ] 4. Carrot [ ] 5. Don't know [ ]

30. Which of the following is a rich source of iron?
    1. Meat [ ] 2.Tomatoes [ ] 3.Carrot [ ] 4. Rice [ ] 5.Don't know [ ]

31. Which of the following is a rich source of dietary fibre/roughage?
    1. Wheat [ ] 2.Cheese [ ] 3. Groundnut [ ] 4. Beef [ ] 5. Don't know [ ]

32. Inadequate intake of carbohydrates could result in
    1.Overweight [ ] 2.Underweight [ ] 3.Obesity [ ] 4. Blood shortage [ ] 5.Don't know [ ]

33. Kwashiorkor is caused by inadequate intake of
    1. Protein [ ] 2.Carbohydrates [ ] 3. Vitamin A [ ] 4. Vitamin K [ ] 5.Don't know [ ]

34. Rickets/ bow legs in children are caused by lack of
    1.Vitamin K [ ] 2.Vitamin D [ ] 3.Vitamin E [ ] 4. Vitamin A [ ] 5.Don't know [ ]

35. Goitre is caused by lack of...
    1. Iodine [ ] 2. Iron [ ] 3. Calcium [ ] 4. Sodium [ ] 5. Don't know [ ]

36. Low level of blood is caused by inadequate intake of...
    1. Iodine [ ] 2.Iron [ ] 3. Calcium [ ] 4. Sodium [ ] 5. Don't know[ ]
37. Bleeding of gums is caused by inadequate intake of...

1.Vitamin C [ ] 2.Vitamin K [ ] 3. Vitamin E [ ] 4. Vitamin A [ ]
5. Don't know [ ]

38. Which of the following is best for infants under 6 months?
1. Infant formula [ ] 2.Breast milk [ ] 3. Koko [ ] 4. Tom brown [ ]
5.Don't know[ ]

39. When serving food at home, who do you think should get the greatest portion of fish?
1. Father [ ] 2.Mother [ ] 3.Older children [ ] 4. Young children [ ]
5. Don't know [ ]

40. Fruits and vegetables must be eaten frequently? 1. Yes [ ] 2. No [ ] 3. Don't know [ ]

SECTION D FOOD FREQUENCY QUESTIONNAIRE

(This is a food frequency questionnaire showing different foods belonging to different food groups. Kindly inform the interviewer on how frequently you consume the foods)

Food Item	**Frequency of consumption**				
	Daily	**Weekly**	**Monthly**	**Rarely**	**Never**
Cereals					
Corn(e.g. banku, porridge)					
Oats					
Millet					
Rice					
Sorghum					
Other					
White roots and Tubers					
Cassava(e.g. gari, fufu)					
Plantain(ripe and green)					
Potatoes					
Sweet potatoes					
Yam					
Other					
Vitamin A rich vegetable and Tubers					
Carrot					
Pumpkin					
Squash(orange or dark yellow					

Food Item	**Frequency of consumption**				
	Daily	**Weekly**	**Monthly**	**Rarely**	**Never**
flesh only)					
Sweet potato(orange/dark yellow flesh only)					
Red Pepper					
Cocoyam leaves					
Alfafa greens					
Dandelion					
Bitter leaf					
Lettuce(dark green)					
Other					
Other vegetables					
Cucumber					
Cauliflower					
Cabbage					
Onion /Shallot					
Garlic					
Green Pepper					
Lettuce(light green)					
Other					
Vitamin A rich fruits					
Mango					
Pawpaw					
Other					
Other fruits					
Apple					
Banana					
Coconut					
Grape fruit					
Grapes					
Guava					
Lemon					
Pineapple					
Tangerine					
Watermelon					
Other					

Food Item	**Frequency of consumption**				
	Daily	**Weekly**	**Monthly**	**Rarely**	**Never**
Organ Meat(e.g. liver, kidney, gizzard)					
Flesh Meat					
Beef, goat, lamb, mutton, pork, etc.					
Poultry					
Reptiles(frogs)					
Other					
Eggs(from poultry)					
Fish and Seafood					
Fresh or dried food					
Canned fish					
Shark, whale					
Crab, shrimps lobsters, other shellfish					
Octopus, Squid					
Other					
Legumes, Nuts, Seeds					
Peanut/groundnut					
Beans(any type)					
Soya bean and products					
Cashew					
Almond					
Other					
Milk and Milk Products					
Whole, low-fat and skimmed milk					
Powdered milk					
Cheese					
Other					
Oils and Fats					
Butter					
Margarine					
Other					

Food Item	Frequency of consumption				
	Daily	Weekly	Monthly	Rarely	Never
Sweets					
Biscuits					
Cakes					
Candies					
Chocolates					
Honey					
Jam/Marmalades					
Pastries, Pie					
Sweetened fruit juice and sugary drinks					
Other					
Spices, Condiments and Beverages					
Fish powder					
Ketchup					
Herbs					
Cubes					
Soya sauce					
Tea, Coffee					
Beer, wine hard liquor					
Other					

SECTION E: ANTHROPOMETRIC MEASUREMENTS

Anthropometric measurement taken on mother

Measurement	1st reading	2nd reading
Weight /kg		
Height /cm		
Mid Upper arm circumference /cm		

Anthropometric measurement taken on child

Measurement	**1st reading**	**2nd reading**
Weight /kg		
Height/ cm		
Mid Upper arm circumference /cm		

SECTION F: HAEMOGLOBIN READING

Haemoglobin concentration reading of mother

Time of reading: ___ ___: ___ ___ am/pm (***Circe one***)

	1st reading	2nd reading
Hb(g/dL)		

Time of reading: ___ ___: ___ ___ am/pm (***Circe one***)

Haemoglobin concentration reading of child

	1st reading	2nd reading
Hb(g/dL)		