

**SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA LEGON**

**AGE AT MENARCHE AMONG SCHOOL GIRLS IN MADINA -GA
EAST DISTRICT OF ACCRA**



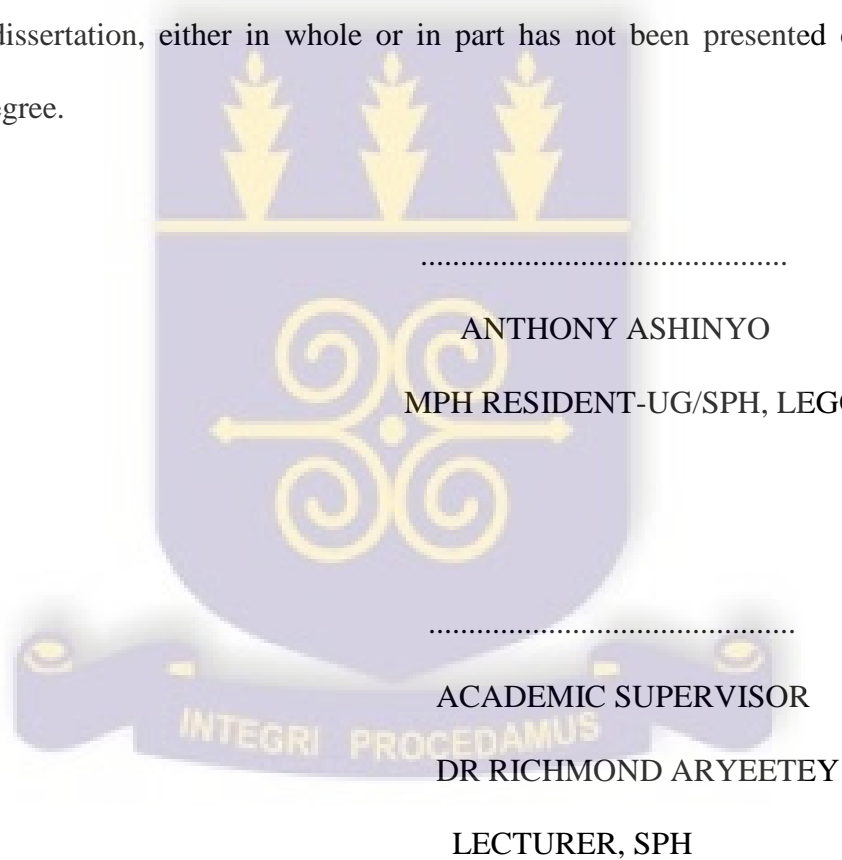
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DECLARATION

I, ANTHONY ASHINYO declare that except for the other people's investigations which have been duly acknowledged, this work is the result of my own original research, and that this dissertation, either in whole or in part has not been presented elsewhere for another degree.



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DEDICATION

Dedicated to mum Mary, my loving wife Eyram, my son Selorm my siblings Peace, Asem, Rev. Comfort, Boogie, Philip and Kwame and to all my friends. From each of you, I had the inspiration and support needed to be who I am. May this work stand as a gesture of my immense gratitude.



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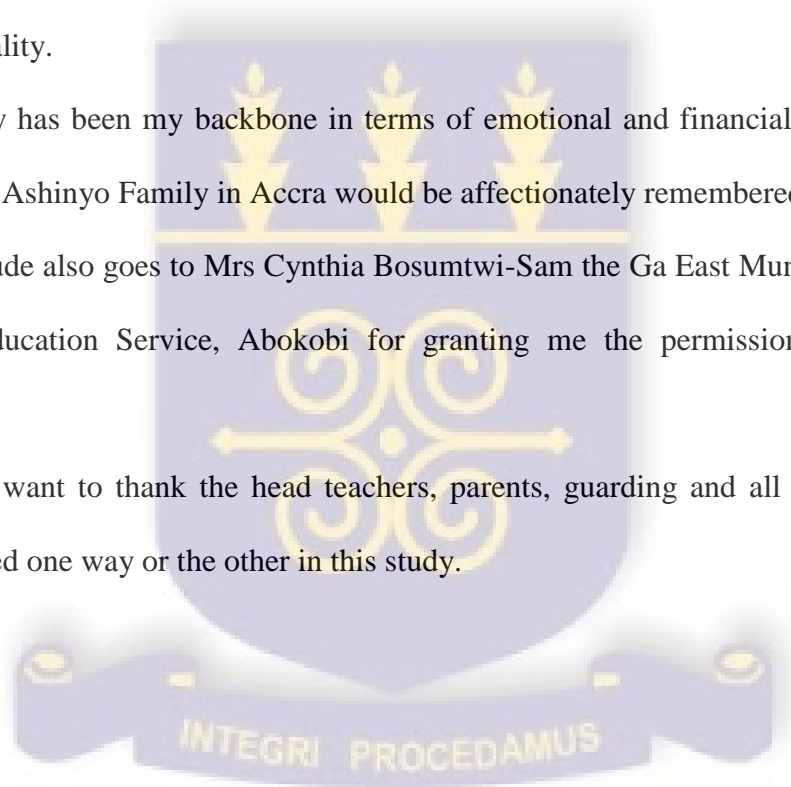
I am highly indebted to the Almighty God and without whose protection this work would not have been a reality.

My sincerest thanks go to my Supervisor Dr Richmond Aryeetey of the Department of Population and Family Health, University of Ghana Legon, for his constructive criticisms, guidance and insistence on a classy work. His contributions have made this work a reality.

My family has been my backbone in terms of emotional and financial support. For this cause, the Ashinyo Family in Accra would be affectionately remembered.

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ABSTRACT

BACKGROUND:

Age at menarche is an important indicator of sexual maturity in females. It is known to be modified by both genetic and environmental factors. Downward trends in menarche have been recorded in many countries.. In Ghana, a cross-sectional study has been done about two decades ago that determined the age at menarche among school girls in Kumasi. The determinants of age at menarche onset in the Ghanaian population are unknown.

OBJECTIVE:

This study was done to determine the mean age at menarche and its determinants among school girls in Madina, Ga East District of the Greater Accra Region.

SUBJECTS AND METHODS:

A cross-sectional study was conducted. Data for the study was obtained through questionnaires administered to 600 school girls in class 5, 6, JHS 1& 2 in four schools chosen at random through balloting. The heights and weights of the girls were also measured. The mean age at menarche was estimated by the recall method and linear regression used to determine the association between ages at menarche and the predictor variables.

RESULTS:

Mean age at menarche (\pm SD) was 12.7 ± 1.2 years. In a multivariate regression model, age at menarche was positively associated with birth order and inversely associated with nutritional status (BMI) and socio-economic status. There was an association between the girl's age at menarche and that of their mothers.

CONCLUSIONS:

In conclusion, the mean age at menarche estimated for girls was 12.7 ± 1.2 years, a decline from the age of 13.98 years reported two decades ago by Adadevoh and colleagues (Adadevoh et al., 1989). Socioeconomic status was the strongest predictor of age at menarche. Health and sex education targeted at teenage youth needs revision to take into account the lower age at which girls are reaching menarche.



TABLE OF CONTENTS

DECLARATION	ii
DEDICATION	iii
ACKNOWLEDGEMENTS	iv
ABSTRACT	v
LIST OF TABLES	ix
LIST OF FIGURES	xi
LIST OF ABBREVIATIONS	xii
CHAPTER ONE	13
1. INTRODUCTION	13
1.1. BACKGROUND	13
1.2. STATEMENT OF THE PROBLEM	15
1.3. JUSTIFICATION	15
1.4. OBJECTIVES	16
1.4.1. General Objective	16
1.4.2. Specific Objectives	16
CHAPTER TWO	17
2. LITERATURE REVIEW	17
2.1. INTRODUCTION	17
2.2. AGE AT ONSET OF MENARCHE	19
2.3. SOCIOECONOMIC STATUS	21
2.4. NUTRITIONAL STATUS	24
2.5. FAMILY SIZE, BIRTH ORDER AND NUMBER OF SIBLINGS	26
2.6. STRESSFUL FAMILY ENVIRONMENT DURING CHILDHOOD	27
2.7. BIRTH WEIGHT	29

2.8.	EARLY CHILDHOOD PLACE OF RESIDENCE.....	30
2.9.	GENETIC FACTORS (FAMILIAL PATTERN, ETHNICITY)	31
	CHAPTER THREE	33
3.	METHODOLOGY	33
3.1.	STUDY DESIGN.....	33
3.2.	STUDY AREA	33
3.2.1.	Study Location	33
3.2.2.	Socio-demographic characteristics.....	33
3.3.	STUDY POPULATION.....	34
3.4.	VARIABLES	34
3.4.1.	Outcome Variable	34
3.4.2.	Explanatory Variables.....	34
3.5	SAMPLE SIZE	35
3.6	SAMPLING METHOD.....	35
3.7	DATA COLLECTION TECHNIQUES AND TOOLS.....	36
3.8	ETHICAL CONSIDERATIONS.....	38
3.9	DATA ENTRY AND QUALITY CONTROL.....	39
3.10	DATA ANALYSIS.....	39
	CHAPTER FOUR.....	40
4.	RESULTS.....	40
4.1.	SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENTS ...	41
4.2.	AGE AT MENARCHE.....	43
4.3.	PREDICTORS OF AGE AT MENARCHE.....	45
	CHAPTER FIVE	47
5.	DISCUSSION.....	47

6. CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS	52
6.1. CONCLUSION.....	52
6.2. RECOMMENDATION	52
REFERENCES	53

APPENDICES

APPENDIX 1: QUESTIONNAIRE

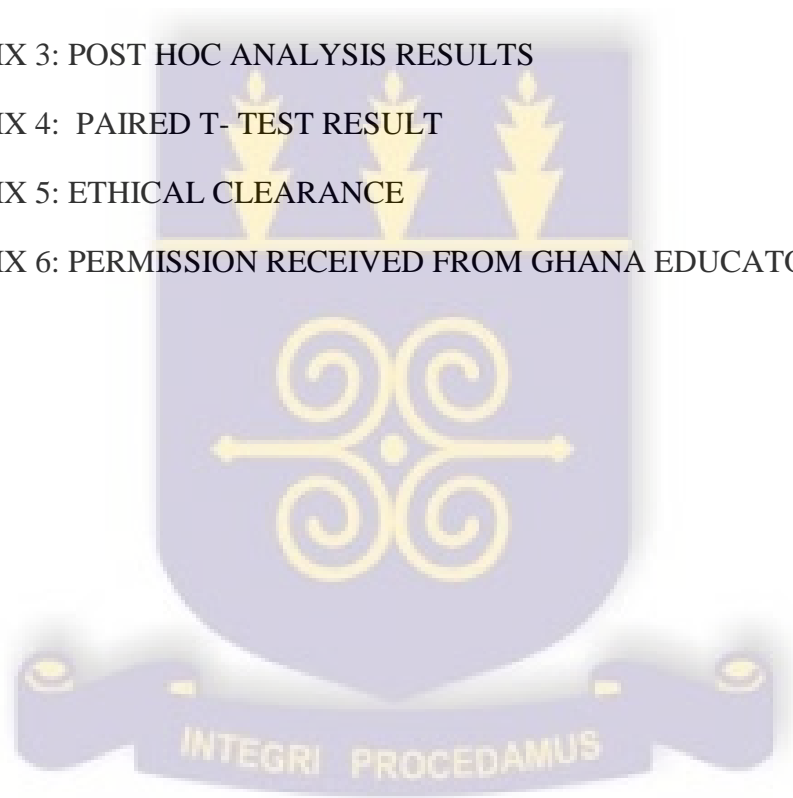
APPENDIX 2: WRITTEN CONSENT

APPENDIX 3: POST HOC ANALYSIS RESULTS

APPENDIX 4: PAIRED T- TEST RESULT

APPENDIX 5: ETHICAL CLEARANCE

APPENDIX 6: PERMISSION RECEIVED FROM GHANA EDUCATON SERVICE



LIST OF TABLES

Table 4-1: Socio-demographic Characteristics of School Girls in Madina Ga –East District of Greater Accra Region (n=529)	34
Table 4-2: Age at Menarche among school girls in Madina, Ga East District of Greater Accra Region	35

Table 4-3: Relationship between age at menarche and the characteristics of the study population (one-way ANOVA)..... 36

TABLE 4-4: determinants of age at menarche identified using multivariate regression model..... 38



LIST OF FIGURES

Fig 3.1 Map Of Ga East District.....24

LIST OF ABBREVIATIONS

BMI	Body Mass Index
DHMT	District Health Management Team
FSH	Follicle Stimulating Hormone
GABA	Gamma-Amino Butyric Acid
GES	Ghana Education Service
GHS	Ghana Health Service
GnRH	Gonadotrophin Releasing Hormone
JHS	Junior High School
LH	Luteinizing Hormone
MSLC	Middle School Leaving Certificate
SES	Socio economic Status
SPSS	Statistical Package for Social Sciences

CHAPTER ONE

1. INTRODUCTION

1.1. BACKGROUND

Menarche is the onset of menstruation, a late stage in the development of puberty. It marks the transition of a girl from pre-sexual to a sexual being, a final passage from childhood to adulthood. In many societies it marks the time when the girl can be married.

Clinically, menarche is said to be early when it occurs between 8 and 12 years of age and late when it occurs after 14 years of age (Apter and Vihko 1983; Montero et al., 1999). For most females, it occurs between the ages of 10 and 16 years; however, it shows a remarkable range of variation (Chumlea et al., 2003; Thomas et al., 2001; Swenson and Havens 1987).

It is recommended by reproductive endocrinologists to begin medical evaluation on young girls who have had their menarche before the age of 8 years or had not begun to have their menses by 16 years, although the secondary sexual characteristics are well-developed (McDonough 1998). Even though this recommendation is a useful general guide, these age limits, which have been used for several decades and are still used currently in some countries, have in recent times been declining.

Most studies agree that the average age of menarche in girls in modern societies has declined (Kaplowitz, 2006; Herman-Giddens, 2006; Oduntan, et al., 1976; Adadevoh, et al., 1989; Cameron, et al., 1991). The decline in age at menarche has been associated in some studies with “”improvement in sanitation, nutrition, social and economic factors and healthcare (Chumlea et al., 2003, Thomas et al., 2001). The degree of decline and the factors responsible have been found to vary from population to population.

This decline necessitate that the age limits used currently are subjected to local assessment and regular revision. The estimation of current appropriate age limits is critical for diagnostic evaluation and possible therapeutic interventions to children with abnormal development.

Early menarche is a window of vulnerability to health problems including conduct disorders (Burt, 2006), drug abuse, (Graber, 2004), teenage pregnancy (Deardorff, 2005) and breast cancer (Anderson, 2007). Earlier menarche may also have implications related to population change as it connotes a longer duration of the reproductive life span of the maturing girl.

Studies have shown that as menarcheal age decreases, the overall risk of developing cancer of the breast increases (Anderson, 2007; Iwasaki, 2007; Okobia and Bunker, 2005; Shantakumar, 2007). Menarche before age 12, for example, raises breast cancer risk by 50 percent compared to menarche at 16 (Grumbach and Styne, 2003).

In Ghana, breast cancer which is the leading malignancy accounting for about 15.4% of all malignancies appear to be on the increase (Bado and Baakoo, 2000).

A cross-sectional study done about two decades ago in Ghana that investigated the age at menarche among school girls in Kumasi (Adadevoh et al., 1989) had found the mean age at menarche to be 13.98 ± 1.42 years. However there has been no documentation on the inherent and specific factors in the Ghanaian population which relate to and influence the age at onset of menarche.

The general assumption is that the secular trend in the age at onset of menarche and the factors influencing it in Ghana are similar to those recorded for other countries especially Europe and the USA even though the trend in nutritional and socioeconomic development,

which has been shown to influence menarche, varies from population to population and from one geographical area to the other.

It is therefore important to identify these inherent and specific factors which relate to and influence the age at onset of menarche in the Ghanaian population. Understanding these factors and identifying those individuals who may be vulnerable to diseases early in life may result in the adoption of interventions or preventive strategies relevant to diseases in adult life.

This study is therefore conducted to determine the age at onset of menarche and its determinants among student girls in Madina -Ga East district of Accra

1.2. STATEMENT OF THE PROBLEM

A trend towards decreasing age at menarche has been recorded in many populations (Herman-Giddens, 2006). In Ghana there has been only one study conducted to determine the age at menarche since 20 years ago. No information is available on the current status of age at menarche and its determinants

This study therefore seeks to answer the following questions.

- What is the age at onset of menarche among school girls in Madina- Ga East District of Accra?
- What factors explain the age at onset of menarche among school girls in Madina- Ga East District of Accra?

1.3. JUSTIFICATION

Knowledge of the age at menarche will help in decision making to design and implement programmes about reproductive health of women such as family planning, comprehensive

abortion care, deciding the appropriate age at which sex education, contraception and sanitary practices can be incorporated in school curriculums and also for child-centred interventions.

The knowledge of the mean age of onset of menarche is also clinically important because it establishes the baseline for determination of precocious and delayed puberty, both of which could result from a pathology in the hypothalamic-pituitary-gonadal axis. Such information would assist clinicians in restricting diagnostic evaluation and possible therapeutic intervention to children with abnormal development. It will also assist teachers and parents in integrating the early maturing girls into society and to provide appropriate sanitation and personal hygiene measures.

1.4. OBJECTIVES

1.4.1. General Objective

- To determine the age at onset of menarche and its determinants among school girls

1.4.2. Specific Objectives

- To determine the age at onset of menarche among school girls in Madina
- To determine the factors associated with age at menarche among school girls in Madina

CHAPTER TWO

2. LITERATURE REVIEW

2.1. INTRODUCTION

Menarche is a physical manifestation of the hormonal changes in the hypothalamic-pituitary-gonadal axis as part of child pubertal development process. It is a late stage event in the processes of puberty. In girls, puberty begins with a growth spurt (Grumbach and Styne, 2003) and then continues with the onset of breast development, (thelarche) appearance of pubic hair (pubarche), and ends with the appearance of menstruation (menarche) and ovulation, which typically follows the first menstrual period by about 10 months (Papathanasiou and Hadjiathanasiou, 2006).

Timing of menarche has been associated with the maturation of the hypothalamo-pituitary – gonadal axis which occurs late during the period of pubertal development characterized by a peak pulsatile release of GnRH (Palmert et al., 2001). In response to the pulsatile GnRH signals, the pituitary releases two hormones; follicle stimulating hormone (FSH) and luteinizing hormone (LH) which travel through the bloodstream to the ovaries where they initiate a dramatic rise in the production of steroidal sex hormones estradiol. The result is breast development (thelarche) and onset of menstruation (Grumbach and Styne, 2003).

Stimulation of the hypothalamic-pituitary-gonadal axis occurs twice in human development. There is minimal stimulation of the hypothalamic-pituitary-gonadal axis in-utero by placental hormones during foetal development following which the hypothalamo-pituitary –gonadal axis then enters into a period of relative but not absolute quiescence, a few months after birth

until late childhood when pubertal maturation occurs (Plank et al., 2004; Terasawa et al., 2000).

Current studies suggest that the inhibitory neuronal system suppresses the release of GnRH during the prepubertal period, and that during the subsequent maturation of the hypothalamus, this prepubertal inhibition of the hypothalamus is removed, allowing the adult pattern of pulsatile release of GnRH. It is suspected that gamma-amino butyric acid (GABA) is the neurotransmitter responsible for inhibiting GnRH release before puberty (Plank et al., 2004; Terasawa et al., 2001).

The timing of puberty can be influenced by a number of signalling pathways including hormones, enzymes, neurotransmitters and neuropeptides that originate in the hypothalamus, in addition to peripheral or gonadal signals that have been known to affect the secretion of GnRH. Signals linked to the environment such as nutrition, stressful family environment, and endocrine disrupting chemicals affect the hypothalamic signalling network directly or through peripheral signals. With these numerous signalling pathways, the neuro-endocrine apparatus by which the onset of menarche is controlled is inherently susceptible to disruption. The evolutionary history of mammals has shown that sexual maturation among females is governed by interplay between excitatory and inhibitory signals streaming into the brain from both internal and external environment of the organism. Exposures to these endocrine-disrupting chemicals and environmental factors potentially alter the regulation of the secretion of GnRH and hasten the age at onset of menarche in girls

2.2. AGE AT ONSET OF MENARCHE

Many studies have examined the age at menarche in different populations (Adadevoh et al., 1989; Chavarro et al., 2004; Argnani et al., 2004). During the past century the age at menarche has been reported to have declined in many countries (Kaplowitz, 2006; Herman-Giddens, 2006). Mean menarcheal age in Europe has been found to decline by 3-4 months per decade. These declines in the mean age at menarche have also been noted for a few decades, in some developing countries, including countries in sub-Saharan Africa (Oduntan, et al., 1976; Adadevoh, et al., 1989; Cameron, et al., 1991).

Among girls in southern Nigeria, a decline towards earlier maturation at a rate of 5 months per decade was observed, between 1949 and 1986, among urban girls (Modebe 1987) while in Ghana, the decline was about 6 months per decade between 1946 to 1976 (Adadevoh et al., 1989). At present, the fastest rates of decline in mean menarcheal ages are occurring among newly industrialized countries (Ong, 2006).

The decline in age at onset of menarche has been attributed to improvements in nutrition and health. This hypothesis has been supported by the fact that menarche is seen to be delayed in the poor in developing countries where there remains disparities in nutrition and health comparing the poor with the 'well to-do' in those populations (Eveleth and Tanner, 1990; Uche and Okorafor, 1979).

The age at onset of menarche can be assessed directly and preferably by the use of the status quo method, which involves asking girls in different age groups whether or not they have had their first menses. Retrospective assessment through the recall method where girls were asked to specify age at menarche in years and months can also lead to the generation of comparable data in some conditions although a longer recall period can result in a loss of accuracy.

Recent data from Kazakhstan (Faccchini et al., 2008) suggest that there are no significant differences between these two methodologies for determining average age at menarche

Published literature, reports mean age at onset of menarche in some studies, with the assumption that the data is normally distributed, or as median and percentiles in other studies. This issue is important because the mean and median are comparable only when the distribution of data is assumed to be normal; however this assumption may not be true, always. In situations of asymmetrical distribution of data, the calculated mean age of onset of menarche will be greater than the median. The median age is therefore used since it is more resistant to the effect of outliers in the menarcheal age distribution. It is however limited in deciding on a girl's percentile group.

Different methods have been used by various researchers to analyse data on age at onset of menarche. One approach is the use of life tables which estimates expected time for menarche from an observed age at menarche among a study group. It allows for the calculation of the proportion of people who would have experienced the event (menarche) by a particular time (Rowland, 2003).

One advantage of the use of this method is that it gives a more accurate estimate of the expected median age of menarche among a group of girls where some have not yet had their menarche rather than a simple estimation using information from only those who have experienced menarche (Eveleth and Tanner, 1990, Adanu et al., 2006).

When a life table approach is not used the time contributed by people who have not experienced the menarche at the time of analysis is not taken into account which can lead to an underestimation of the median age (Eveleth and Tanner, 1990, Adanu et al., 2006). However the used of life tables and other parametric survival models seem better adapted to estimating median ages at puberty stages in longitudinal studies (Eveleth and Tanner, 1990).

Another method that has been used to estimate menarcheal age is use of probit regression (Padez, 2003). This method allows for the calculation of the proportion of people who would have experienced the event (menarche) among the study groups. It gives a more accurate estimate of the expected median age of menarche among a group of girls where some have not yet had their menarche. Probit analysis uses data generated from the status quo method and assumes the distribution of the study population to be normal. It is the most frequently used statistical method for estimating median age at entry into pubertal stages and at menarche (Eveleth and Tanner, 1990).

2.3. SOCIOECONOMIC STATUS

Socioeconomic status is an important factor determining how much and what kind of nutrition, life style and healthcare is available to households. It can be used to classify families or individual on a hierarchical social structure based on their access to, or control over wealth, prestige and power (Mueller and Parcel, 1981). It is expected that the higher the socioeconomic status of a household, the more capable that household is able to spend on food and healthcare. On the other hand, the lower the socioeconomic status of a household the less capable that household is able to spend on food and healthcare.

An association between socioeconomic status and age at onset of menarche has been observed in many different populations (Padez, 2003; Chavarro et al., 2004). Several studies have shown that girls of lower social status exhibits a delay in their first menstruation, compared with girls from well-off families (Laska-Mierezejewska 1995; Henneberg and Louw 1995; Parent, 2003). Socioeconomic factors however, do not affect menarche directly, but are strongly linked with dietary habits, lifestyle and healthcare (French et al., 2001).

In most industrialized countries, there is almost no difference in mean age at menarche across socioeconomic status groups. This has been attributed to the fact that there is uniformity in

the standard of living, healthcare and nutritional status among the population. Although inequalities in social and economic status may exist at the level of high standard of living, good healthcare and nutrition, a further improvement or slight deterioration does not affect the rate of development of the maturing girl (Okasha et al., 2001; Padez and Rocha 2003).

In 'Third World' settings in Asia and Africa, where differences between the poor and the rich are more obvious, a large difference between the age at menarche exist across social classes (Attallah et al., 1983). This difference in the age at menarche may be due to the wide variations in the standard of living, healthcare and nutritional status existing in these third world countries.

Socioeconomic status has been measured in most studies by the use of either a single indicator or by combination of indicators (Multiple and composite measures). Single variable measures include measurement of occupational status, educational attainment, and income (Graetz, 1995). Multiple and composite measures are derived from a range of variables such as father's and mother's occupation and educational attainment, income and household assets such as video recorders, television, cars, size of home, the number of books in the home, and home ownership.

In auxological studies, socio-economic status has occasionally been evaluated using features such as population size, number of children in the family and education of parents (Padez 2003; Chavarro et al., 2004).

Occupational status is used to examine the effects of SES because of its role in positioning individuals within a social structure, thus defining access to resources, exposure to psychological risks and physical hazards and its influence on lifestyle (Burgard et al., 2006).

It ranks selected groups of occupations in terms of prestige or social standing which generally correlate with income and education although there are numerous exceptions such as the clergy (high prestige, low income), entrepreneurs (low prestige, high income) and

scientists (high education but relatively low income). These prestige studies however only provide rankings for a selected list of occupations, those common occupations whose status was well understood. In order to provide an exhaustive ranking of occupations, there is the need to rank all the occupations that were not initially included in the ranking procedure.

Educational attainment is the most widely used indicator of SES due to the ability to characterize the educational achievement level of most individuals. Years of completed schooling are reported with reasonable ease and reliability and are a meaningful indicator of SES for virtually all adults. Education has been called the most basic component of SES because of its influence on future occupational opportunities and earning potential (Adler and Newman, 2002). However, because education is typically completed early in adulthood, it captures neither differential on-the-job training nor other career investments made.

Income status which represents the flow of economic resources over a period of time has also been used to examine the effects of SES. Persons with higher incomes are more likely to have the means to pay for healthcare and to afford better nutrition compared to those in the lower-income groups (Stewart et al., 2002). Income has been used more widely as a measure of SES in studies based in the United States than elsewhere. The most typical income-based measure is a household's total cash income, measured over the month, calendar year, or 12-month period prior to the point of measurement (Duncan et al., 1998; Carstairs and Morris, 1989). It is however difficult to accurately measure the level of income of subjects, firstly because of the high volatility in income level from one month of the year to the next and secondly because most people in many countries including Ghana are unwilling to provide accurately information on their incomes.

Wealth is an indication of the ability to meet emergencies or to absorb economic shocks. It captures the stock of assets or economic reserves at a given point in time. In most populations, wealth is tied up in cars and home items. Increasingly principal components analysis (PCA) using asset data have been used by most researchers to create socio-economic status (SES) indices (Filmer and Pritchett, 2001; Cortinovic et al., 1993; Schellenberg et al., 2003; Houweling et al., 2003).

To measure SES, studies have used variables such as ownership of land (Filmer and Pritchett, 2001), farm animals and whether living in rented or owner-occupied housing (Schellenberg et al., 2003), literacy or education level of head of household, demographic conditions and other economic proxies such as occupation of head of household (Cortinovic et al., 1993). In some studies, the SES has been found to be closely associated with the choice of variables included in the index (Houweling et al., 2003). However, Filmer and Pritchett (2001), in their analysis, concluded that the categorization of households was robust to the measure used. The advantage of collecting asset data, highlighted by McKenzie (2003), is that survey non response bias is minimized.

2.4. NUTRITIONAL STATUS

Nutritional status has an important role in pubertal development and a bearing on the age at menarche. Several studies have shown strong association between nutrition and onset of menarche (Simodon et al., 1997; Chowdhury et al., 2000). For a developing girl, optimal nutritional status is important particularly for the normal initiation of menarche.

Nutritional deficits during early childhood have an adverse impact on the timing of puberty (Norgan, 2000; Rogol et al., 2002). Malnutrition and in particular stunting have been linked to late, prolonged puberty and growth (Rogol et al., 2002; Simondon et al., 1998). A longitudinal study carried out on Senegalese adolescent girls found that girls who were

chronically malnourished tended to have delayed puberty (Simondon et al., 1997). Sexual maturation was found to be even later if stunting was severe in childhood (Simondon et al., 1998).

Childhood overweight and obesity, which is more common in developed countries, have been associated with early onset of sexual maturation (Freedman et al., 2003; Kaplowitz et al., 2001; Wang, 2002). A longitudinal study from Louisiana found that children who are fat tended to experience menarche sooner than those who are thin (Freedman, 2003). In a cohort study of Australian girls who were followed from prenatal life to adolescence, girls with high BMI during childhood were found to have earlier menarche compared with those with low BMI (Sloboda, 2007). Increase in the amount of body fat stores, especially during the female prepubertal period; have been proposed to be important in signalling the central hypothalamic neurons of the body's preparedness for reproduction resulting in an increase plasma concentration of the sex hormones implicated in pubertal onset especially the pituitary hormones and the gonadotropins (luteinizing hormone (LH) and follicle-stimulating hormone) ultimately leading to the onset of puberty

The relationship between age at menarche and fat mass has been estimated through BMI by some researchers (Must, et al., 2005; Onland-Moret, et al., 2005). Although a reasonable tool to estimate body fat in the community (Pietrobelli et al., 1998), the BMI correlates with only the total body fat and fat-free mass, but does not account for differences in body fat distribution. It is also only a ratio and therefore an abstract index. The value of the BMI is limited by the fact that the classification can seriously be over-estimated in the study of a population. Dual energy X-ray absorptiometry scans for body composition, the sum of skin fold thickness and computed tomography scans for fat distribution can also be used in the

estimation of the fat mass however these are not feasible in large population-based study of girls.

2.5. FAMILY SIZE, BIRTH ORDER AND NUMBER OF SIBLINGS

The size of the family during childhood is important for predicting age at onset of menarche. Several studies have shown positive association between age at menarche and the number of siblings (Clegg, 1980; Dann and Roberts, 1984; Okasha et al., 2001). According to Cameron and Nadgdee (1996) girls from families with large number of siblings have delayed onset of menses compared with those with small number of siblings. The effect of the size of the family and the number of siblings on age at onset of menarche has always been attributed to inadequate allocation of food and resources which has an adverse effect on the feeding practices that exist in large size families, resulting in inadequate nutrition and poor health status and delayed physical development of growing children.

Several studies have also shown an association between parity order and age at onset of menarche (Matchock and Susman, 2006).it was found that girls with high parity order are associated with early onset of menarche (Matchock and Susman, 2006) while those with low parity order are associated with delayed menarche (Hoier, 2003).This was explained by the fact that within a family of a given size the youngest receive preferential treatment in food allocation and healthcare provision which may lead to an earlier attainment of critical body weight resulting in early age at menarche.

In Ghana, children in large families often eat together from the same bowl. Younger children are not able to compete with the older children, especially where the food is not sufficient and so are deprived of essential nutrients both in quality and quantity if this continues over a long period of time, the situation can likely lead to under feeding and subsequent under nutrition

of the child (Ray 2000) resulting in delayed age at onset of menarche in the girl with high parity order.

2.6. STRESSFUL FAMILY ENVIRONMENT DURING CHILDHOOD

The family environment during childhood has an important bearing on the age at onset of menarche. Several studies have shown positive association between age at menarche and Stressful family environment (Moffitt et al., 1992; Bellis, 2006; Ellis and Garber, 2000; Kaplowitz, 2004; Zabin, 2005). As a group, girls who were exposed to stressful family environments during childhood have been found to reach menarche earlier (Bellis, 2006; Ellis and Garber, 2000; Kaplowitz, 2004; Zabin, 2005). In a study done in Poland, girls who were exposed to prolonged stressful family environment were found to reach menarche four months earlier than girls living in families free of stressful events (Hulanicka, 2001). Similar results were reported in Canada, where adverse family conditions were associated with precocious puberty (Tremblay and Frigon, 2005). Several hypotheses have been postulated to explain the mechanism of the effect of stressful family environment during childhood on early onset of menarche. According to Belsky and colleagues (1991), stressful family environment leads to the development of an internalizing disorder in girls that lowers their metabolism thereby inciting a weight gain that accelerates menarche.

Ellis and Garber (Ellis and Garber, 2000) on the other hand explained that early age at menarche and accelerated physical maturation that occurs in stressful family environment are reproductive strategies of increasing reproductive successes of females of uncertain future. Studies of these relationships between age at menarche and stressful family environment during childhood are hindered by the necessity of finding features that define what constitute a stressful family environment.

While early stress researchers focused on unpleasant physical stressors in the family (Selye 1982), social scientists have particularly focused on events or conditions that are linked to individuals' and families' social characteristics, positions, and roles.

Stressful family environment during childhood has been measured in most studies by the use of checklist of stressful life event such as divorce, absence of biological father, not being raised by both biological parents in the household and the presence of a stepfather in the household (Belsky et al., 1991). This list captures the set of life events that happened to a child during childhood and assumed that an estimate of the amount of change would be generally the same for all who experienced the event. However, researchers have shown that the same event does not have uniform effects on different people (Blair-Wheaton, 1990; Jekielek, 1998). They found that the impact depends in part on the circumstances prevailing prior to the specific life event and on the resources and coping mechanisms that individuals and families possess (Blair-Wheaton, 1990, Jekielek, 1998).

Blair Wheaton (Blair-Wheaton, 1990) has shown that in the case of widowhood, divorce, fathers absence from home and the separation of child's from biological parents, the more stressful prior conditions in that role, the less the impact. Jekielek (1998) found that the response of children's to their parents' divorce is less adverse when there has been more marital conflict. Fathers' absence has consistently been associated with early menarcheal onset (Hoier, 2003; Maestripieri, 2004; Matchock and Susman, 2006).

The presence of a Stepfather has also been found in several studies to be associated with early age at menarche (Ellis and Garber, 2000; Ellis, 2004). These association have been explained to be mediated through pheromone activity also referred to as the male effect (

Ellis, 2004) which was supported by animal studies that demonstrated accelerated onset of menarche when unrelated adult males were introduced into the colony (Ellis, 2004).

2.7. BIRTH WEIGHT

Many diseases and events presenting in adolescence and adulthood have been suggested to have early developmental origins a line of thinking which relates to the Barker hypothesis (Baker, 1990). Increasing evidence has suggested the possibility of timing of menarche being set in-utero (Silva et al., 2003). Studies investigating the developmental origins of health and disease have used birth weight as a surrogate marker of developmental influences. The influence of birth weight on onset of menarche has been investigated by several studies (Stark et al., 1989; Cooper et al., 1996; Ibáñez et al., 2000; Lazar et al., 2003; Ibanez, 2006; Neville and Walker, 2005; Parent, 2003; Veening, 2004). Some of these studies have found that children who had low birth weight (defined as <2500 g) or were small for gestational age have earlier timing of puberty (Ibáñez et al 2000; Lazar et al., 2003).

In the United Kingdom, age at menarche was found to be earlier in girls with birth weight below 2.85 kg by 0.2 yr compared with those weighing more than 3.75 kg (Cooper et al., 1996). Also among Spanish girls it was found that the age at menarche was about 1 yr earlier in girls with a birth weight below 2.7 kg compared with the rest of the cohort (Ibanez et al 2000). In a study from Israel, the age at onset of menarche of intra- uterine growth restricted (IUGR) girls was found to be earlier 1.3 yr compared with girls with birth weight appropriate for their gestational age. Premature birth and low birth weight that results from intrauterine growth retardation are both well-established risk factors for precocious puberty in girls (Ibanez, 2006; Neville and Walker, 2005; Parent, 2003; Veening, 2004). One hypothesis is that children who are born small and subsequently go through very rapid catch-up growth may start puberty earlier (Parent et al., 2003, dos Santos Silva et al., 2002). However some

authors have found no significant correlation between birth weight and menarcheal age (Stark et al., 1989).

2.8. EARLY CHILDHOOD PLACE OF RESIDENCE

A growing body of research has established associations between place of residence and health outcomes (Cole, 2000; Blakely & Woodward, 2000; Castle, 2000; Hauenstein, 2003). It has been clearly recognized that where one lives, and the characteristics of that place affect the health outcome of that individual (Wadsworth 1997; Cole 2000).

Studies have suggested that the adverse effect of environmental factors has their strongest effects during childhood (Brundtland et al., 1980; Tanner, 1992; Nystrom Peck and Lundberg, 1995; Schmidt et al., 1995; Wadsworth, 1997; Cole, 2000).

The general living conditions at a child's place of residence play an important role in the timing of puberty (Abioye-Kuteyi et al., 1997; Adair, 2001). Place of childhood residence has been found in some studies to be associated with age at menarche (Khadilkar, 2006; Gillett-Netting et al., 2004; Padez, 2003).

According to Khadilkar, (Khadilkar, 2006) urban-dwelling girls experience earlier menarche than rural girls. The earlier age at menarche in urban girls has been linked to better nutrition and improved living conditions in urban settings (Eveleth & Tanner, 1990; Wyshak & Frisch, 1982). Increased exposure to psychosexual stimulation by suggestive posters, movies, literature etc by the urban girls and, differences in dietary preferences among rural and urban areas, has also been used to explain the urban-rural differences in particular in Africa, where urban adolescent girls are more advanced in puberty than rural adolescent girls (Gillett-Netting et al., 2004; Padez, 2003).

In developing countries including Ghana, inequalities related to socioeconomic status or life setting is still prominent and might account for important variations in timing of onset of menarche among the population.

2.9. GENETIC FACTORS (FAMILIAL PATTERN, ETHNICITY)

Puberty timing has been shown in several studies to be controlled by genetic factors (Palmert and Boepple, 2001; Speroff et al., 2005). Factors such as ethnic origin, family heredity and constitutional type have been listed (Loesch et al., 1995; Malina et al., 1997; Treoloar and Martin, 1990). These factors have also been reported to have a major contribution on age at menarche (Towne et al., 2005). The genetic basis of the age at onset of menarche has been shown in most studies by resemblance between sisters (Reymert and Jost, 1947), twins (Treoloar and Martin 1990; Meyer et al., 1991; Loesch et al., 1995) and between mothers and their daughters (Malina et al., 1994; Campbell and Udry, 1995).

A study by Grumbach and Styne (Grumbach and Styne, 2003) has shown similarities in pubertal timing and tempo between Mothers and daughters. Several studies have also shown significant association between age at menarche and ethnicity (Adadevoh et al., 1989; Herman-Giddens et al., 1997; Anderson and Must, 2005; Freedman, 2002; Kaplowitz, 2006; Wu et al., 2002). A cross sectional study by Adadevoh and colleagues among selected school girls in Kumasi Ghana have also found an association between age at menarche and the major ethnic groups in the Ghana. The pathways through which ethnicity contribute to age at menarche are complex and involves various mechanisms. Apart from genetic heritage, ethnicity-related factors such as lifestyle, dietary practices, attitudes toward disease prevention, residence, culture and family size preference, which vary among ethnic groups, may also impact independently on the age at onset of menarche.

CHAPTER THREE

3. METHODOLOGY

3.1. STUDY DESIGN

A cross sectional design was used for this study.

3.2. STUDY AREA

3.2.1. Study Location

The study was carried out in Madina in the Ga East Municipality. The Ga East Municipality is located in the North-Eastern part of Greater Accra Region. It is bounded on the north by Adenta and Danfa, on the west by Taifa and Dome, on the east by Tema, and on the South by Accra Metropolis.

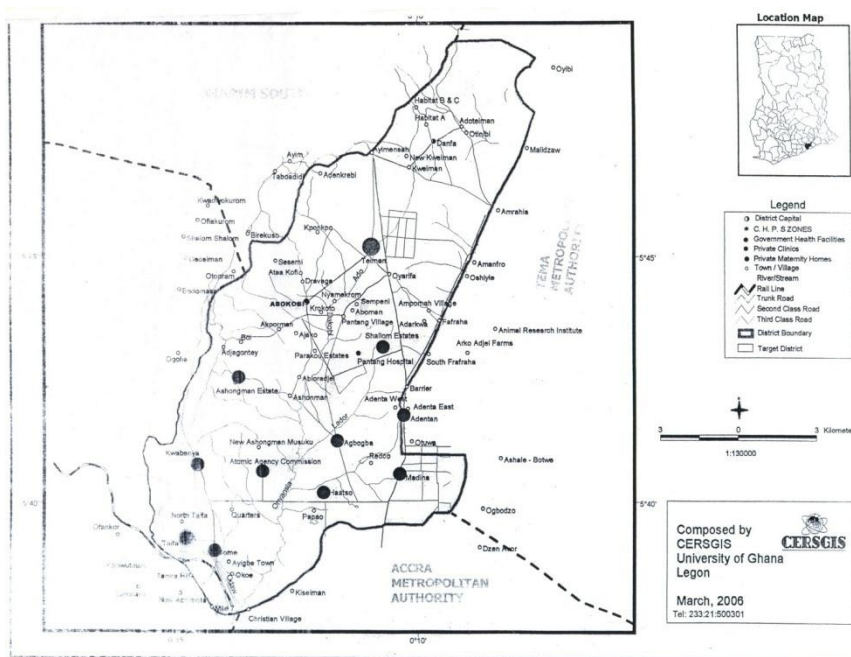
3.2.2. Socio-demographic characteristics

Madina has an estimated population of 108,825 with an annual growth rate of about 4.5%. About 82% of population occupies urban, peri-urban and mixed settlement areas of Madina while 18% occupies the rural areas. The main economic activity in the Municipality is Public services and trading followed by farming and craftsmanship. However, a sizeable proportion of the working force in the district is unemployed reflecting the high poverty level (MHD Annual Report 2009). A total of thirty nine (39) health facilities have been recorded in the district. Public facilities constitute only 12 % (6). Thirty one are private, 1 CHAG and 1 quasi government health facility.

There are currently 25 basic schools (Primary and JHS) in the Municipality. Eleven (11) of the schools are public while fourteen (14) are private. Some of the schools, mainly the public, are organized in clusters. The public schools generally have on average 50 students per class and the private schools generally have an average of 30 per class. Boys and girls were equally distributed in each class.

The Municipal Health Directorate undertakes school health education programs through its School Health Program. Community health nurses visit schools conducting examinations and health education. This however usually is restricted to lower primary students. Almost all the private schools have sick bay while the public schools don't. Generally, children who attend private schools come from relatively better socio-economic groups.

FIGURE: 3-1 MAP OF GA EAST DISTRICT



3.3. STUDY POPULATION

The study was conducted among girls in Primary 5 and 6 and JHS 1 and 2 in Madina in the Ga East District of the Greater Accra Region of Ghana.

3.4. VARIABLES

3.4.1. Outcome Variable

- Age at menarche

3.4.2. Explanatory Variables

The major independent variables used in this study were

- Socioeconomic status
- Place of birth and residence
- Body mass index(BMI)
- Parents level of education
- Birth weight
- Stressful home environment
- Household (family)size
- Number of siblings
- Mother's age at menarche
- Ethnicity
- Religion

3.5 SAMPLE SIZE

All girls aged 9 years and above, and in upper primary (classes 5 and 6) through junior secondary (forms 1 and 2) were eligible for the study. There were a total of 5903 basic school girls estimated by the local education service in the study area.

Sample size was calculated using 95% confidence level, 50% risk of early menarcheal onset (50% was considered appropriate for the sake of having larger sample) and acceptable difference of 4%. Assuming a non response rate of 10% a total sample size was estimated at 600.

3.6 SAMPLING METHOD

The basic schools in the study area were identified and stratified into private and public from a list of schools from the local education service. Two public and two private schools were selected using simple random sampling from each group. All girls aged 9 years and

above, and in upper primary (classes 5 and 6) through junior secondary (forms 1 and 2) were eligible to participate. Six hundred (600) school girls in all were invited to participate. However seventy one (71) of the school girls refused to participate in the study.

3.7 DATA COLLECTION TECHNIQUES AND TOOLS

The data and information for the study was obtained by the use of questionnaires. The data was collected using a two part questionnaire. The first part was administered to the girls in their classrooms after their male counterparts were made to leave under the supervision of the teachers and the research team. This portion of the questionnaire had questions on date of birth, whether or not the respondent had had her first menses and the date of the first menstruation. Two visits were made to each selected school before the questionnaires were completed and the measurements taken. The first visit was made to explain the purpose of the study to the school principal and the class teachers and also set a date for the study. This was then followed by a second visit to send the written consent forms through the students for their parents' approval to enable them participate in the study.

On the day of the study, the teachers in each class explained the matter to the girls and the questionnaires were distributed to every girl. The completed questionnaires were collected from each school and in every class on the same day in order not to give the girls a chance to exchange ideas.

The Age at menarche was calculated from the date of birth to the date of the first menstrual period the participant provided. It was calculated as the difference between the reported date of menarche and the date of birth in days divided by 365. For the participants who did not provide a complete date of menarche, either the 15th day of the month (for those who provided the year and month but not the day) or the 15th day of the sixth month (for those who only provided the only the year)

For participants who did not report a date of menarche but rather the age, based on the assumption that women reporting age at menarche from recall tended to report the age at the last birthday preceding menarche, 0.5 years was added to the reported age to obtain an adjusted age at menarche (Padez 2003; Malina et al., 2004) The ages of menarche were grouped in three classes (early, medium and late).

Early menarche is considered 12 years or less, medium menarche between 13 and 14 years and delayed menarche more than 14 years (Apter and Vihko, 1983; Montero et al., 1999).

The second part which had questions concerning family characteristics, socioeconomic characteristics, birth weight and information on mother's age at menarche that the child may not be able to remember was completed at homes with the help of the parents

Parents' educational level was categorized into three levels 1—No Education; 2—basic education (Primary School, JHS or MLSC) and 3—Secondary level education or more.

Childhood stressful home environment was assessed using a check list developed by Belsky and colleagues (1991) and categorised into two; 1— stressful home environment and 2—No stressful home environment

The average household (family) size and number of siblings were reported by the respondents. The average size of the household, (family size) was categorized into three: 1— family size of ≤ 3 , 2— family size of 4-6, and 3— family size of 7-9 while the number of siblings were categorized into four ; 1— 1sibling , 2—2 siblings, 3—3 siblings and 4— 4 or more siblings .

To define birth order, four categories were used; 1—First born; 2—Second born; 3—Third; and 4- fourth or later born.

Place of residence and place of birth were also reported by the respondents and categorized into two 1—rural, 2—urban.

The birth weight of the respondents were reported by their parents from their weighing cards and categorized into three 1— <2.5kg, 2—2.5kg-4.0kg and 3—>4.0kg.

MEASUREMENTS

Body mass index (BMI) was used in the study to estimate the nutritional status and was calculated using the Quetelet index—weight/height² (i.e., kg/m²). The heights of the respondents were measured using a stadiometer and recorded to the nearest 0.1cm .The standiometer was placed on a flat floor at each site. The girls were made to stand on the base with their feet together and the back of the head, the buttocks, calves and heels all touching the upright. Subjects were instructed to look straight at a spot with head held high before the heights were taken.

The weights of the respondents were measured without shoes using a Weighing scale to the nearest 0.1kg.At every measurement it was ensured that the reading was always zero before the subjects stepped on the scale.

3.8 ETHICAL CONSIDERATIONS

Data collection was begun only after ethical approval was obtained from the Ghana Health Service ethical review committee. Permission to conduct the study was also obtained from the Director Ghana Education Service of Ga East District and the Head teachers of the participating schools. Written Informed Consent was obtained from the parents/guardian of the participating students following which the purpose of the study was explained to the students and their assent obtained regarding their agreement to participate in the study.

The information recorded was kept confidential with no one except the principal investigator only having access to it. No names were recorded in order to keep the identity of respondents anonymous. Parents / guarding were informed that they have the right to participate in the study or terminate the interview if they do not wish to and that choosing to participate or not

will not affect either their wards or the family in future. They were also informed of the fact that there were no incentives or immediate benefit attached to participation in the research.

3.9 DATA ENTRY AND QUALITY CONTROL

Data were collected by two trained research assistants. The questionnaire and instruments were pre-tested on ten respondents at a school in Madina that was excluded from the final study. The results obtained from the pre-test were used to make the necessary changes required on the survey forms. The data collected at the end of the study was cleaned to remove any inconsistencies. The completed questionnaires were serially coded before entry

3.10 DATA ANALYSIS

Household and girls characteristics were summarized using frequencies and percentages. The age at menarche was averaged for all girls who had their menses to derive a mean age at menarche. The median age was also determined.

The association between the age at menarche and parents' educational level, place of residence, birth order, birth weight, place of birth, ethnicity, socioeconomic status, body mass index, mother's age at menarche, number of siblings and average household size was carried out using a one way Analysis of variance (one way ANOVA). An ANOVA table was generated which gave a p-value for the variables studied. Where the p-value revealed a significant difference, a Post hoc (ph) evaluation using the Hochberg's GT2 test was applied to test statistical significance of differences between in-groups.

The variables that were significantly associated with age at menarche at $p < 0.05$ in the univariate analyses were included in a multivariate regression model to determine which

variables were significantly associated with age at menarche after controlling for the other variables. The main statistical package used for analyzing the data was Statistical Package for Social Sciences (SPSS) version 16

CHAPTER FOUR

4. RESULTS

4.1. SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENTS

Out of 600 questionnaires given out, 529 were completed and returned giving a response rate of 88%. The current ages of the girls included in the study ranged between 9 and 18 years, with a mean and a standard deviation of 13.9 ± 2.2 years. Approximately 43% (227) of girls were in class 5 & 6 while 57% (302) were in JHS 1 & 2. About 37% (194), were Akans, 28% (148) Ewes, 18 % (93) Northerners, and 18 % (94) were Ga -Dangbes. Majority (84%) of the respondents were Christians.

About 67 % (356) of the girls were born in urban areas although 74% (391) of them currently live in the urban/peri-urban communities. Birth weight information was unavailable for 36% of the respondents hence the observations were dropped from the analysis.

Currently, 11% of the girls had $BMI > 25 \text{kg/m}^2$ while 43% had $BMI < 18.5 \text{kg/m}^2$. Over 80% of the girls lived in households consisting of more than three persons with about 27% of them having four or more siblings. Also about 15% were “fourth born” or more with regards to parity order. Among 50% of the participants both parents had basic education.

About 10% of the girls were from the highest socioeconomic group, while 73% were from the lowest. The categorization of socioeconomic status was based on ownership of selected household assets and ownership of consumer items, ranging from television to a bicycle or car, as well as dwelling characteristics, such as source of light and fuel for cooking, sanitation facilities, and type of flooring materials. Each asset was assigned a factor score generated from the principal components analysis. The resulting asset scores were standardised in relation to a normal distribution with a mean of zero and standard deviation of one. Each household was then assigned a score for each asset, and the scores were summed for the household. Individuals were ranked according to the total score of the household in which they resided. The sample was then divided into the lowest, middle and highest socioeconomic groups.

The analysis of the data also showed that 46% of the girls lived in stressful home environments. Childhood stressful home environment was measured using a checklist of four variables developed by Belsky and colleagues (1991) in assessing stressful childhood environment. The indicators are (1) divorce (2) Not being raised by both biological parents (3) presence of a stepfather in the household and (4) the absence of biological father in child upbringing. The presence of any one of the indicators was considered to indicate a stressful environment.

Table 4.I shows details of the socio-demographic characteristics of the study respondents

Table 4-1: Socio-demographic Characteristics of School Girls in Madina Ga –East District of Greater Accra Region (n=529)

Characteristics	frequency	%	Characteristics	frequency	%
Household size			Stressful home Environment		
8≤3	102	19.3	Stressful home environment	242	45.7
4-6	256	48.4	Non-stressful home environment	287	54.3
>7	171	32.3	Place of Residence		
Mother's education			Rural	138	26.1
None	46	8.7	Urban	391	73.9
Basic education	333	62.9	Birth Order		
Secondary ⁺	150	28.4	1 st born	135	25.5
Father's education			2 nd born	171	32.3
None	20	4.7	3 rd born	146	27.6
Basic education	204	49.9	4 th born or more	77	14.6
Secondary ⁺	165	45.4	Number of siblings		
Ethnicity			1	69	13.0
Ewes	148	28.0	2	133	25.1
Ga-Dangbes	94	17.8	3	186	35.2
Akans	194	36.7	4 or more	141	26.7
Northerners	93	17.6	Body mass index		
Religion			<18.5kg/m ²	228	43.1
Christian	446	84.3	18.5-25kg/m ²	243	45.9
Muslim	83	15.7	>25kg/m ²)	58	11.0
Socioeconomic Status			Birth Weight (n=337)		
Lowest	386	73.0	<2.5kg	66	12.5
Middle	88	16.6	2.5-4.0kg	201	38.0
Highest	55	10.4	>4.0kg	70	13.2
			Place of Birth		
			Urban	367	69.4
			Rural	162	30.6

4.2. AGE AT MENARCHE

About 74% (389) of the respondent had achieved menarche at the time of the survey. The lowest age at which menarche was attained was 9 years while the highest age was 17 years. The Kolmogorov-Smirnov test for normal distribution performed on the reported age at menarche showed the distribution not to be normal ($p < 0.01$)

The mean and median age at menarche among the study population were 12.7 ± 1.2 and 13.0 respectively

About 15% of the girls had menarche before 12 years while 6% had their menarche after 14 years (Table 4-2).

The mean age of menarche for the mothers was 13.6 ± 1.1 years. Comparison of the mean age of menarche of the girls and that of their mothers was carried out using a paired t-test which showed a significant difference ($p < 0.01$) (Appendix 4).

Table 4-2: Age at Menarche among school girls in Madina, Ga East District of Greater Accra Region

Age group(years)	Frequency	Percentage
9-12	57	14.7
13-14	310	79.6
15-17	22	5.7
TOTAL	389	100

Table 4-3: Relationship between age at menarche and the characteristics of the study population (one-way ANOVA)

Characteristics	Freq	Mean \pm SD	p-value	Characteristics	Freq	Mean \pm SD	p-value
Household size			0.19	Stressful home Environment			0.16

≤3	93	12.6±1.3		Stressful home environment	175	12.8±1.1	
4-6	202	12.6±1.1		Non-stressful home environment	214	12.6±1.3	
>7	94	12.9±1.3		Place of Birth			0.22
Mother's education			0.27	Urban	267	12.8±1.3	
None	41	12.8±1.0		Rural	122	12.6±1.2	
Basic education	249	12.7±1.3		Place of Residence			0.93
Secondary ⁺	99	12.6±1.1		Rural	66	14.1±1.1	
Father's education			0.82	Urban	323	12.4±1.1	
None	20	12.7±1.0		Birth Order			<0.01
Basic education	204	12.7±1.2		1 st born		12.2±1.3	
Secondary ⁺	165	12.7±1.3		2 nd born		12.7±1.1	
Ethnicity			0.80	3 rd born		13.1±1.2	
Ewe	106	12.9±1.2		4 th born ⁺		13.0±1.1	
Ga- Dangbes	72	12.8±1.1		Number of siblings			<0.01
Akans	153	12.4±1.2		1	60	12.1±1.3	
Northerners	58	12.9±1.2		2	116	12.5±1.2	
Religion			0.89	3	136	13.0±1.1	
Christian	330	12.7±1.2		4 or more	77	13.0±1.1	
Muslim	59	12.7±1.1		Body mass index			<0.01
Socioeconomic Status			<0.01	<18.5kg/m ²	133	13.5±1.2	
Lowest	386	13.3±1.0		20-25kg/m ²	199	12.6±0.7	
Middle	88	12.0±0.8		>25kg/m ²	57	11.0±0.9	
Highest	55	11.2±0.9					

Note: freq= frequency, SD= standard deviation, p-value = Significant level

4.3. PREDICTORS OF AGE AT MENARCHE

Concerning the association of socio-demographic characteristics and age at menarche, the one-way analysis of variances (ANOVA) was used. Place of residence, parents' educational level, place of birth, religion, ethnicity, and average household size did not show any significant influence on age at menarche (Table 4-3). A statistically significant association however was shown between age at menarche and birth order, birth weight, socioeconomic status, body mass index, and number of siblings (Table 4-3).

In- group differences were analyzed using Post hoc analysis using Hochberg's GT2 test the result is as shown in (Appendix3).

Girls with BMI $>25\text{kg/m}^2$ were found to have their menarche significantly earlier compared with those with BMI between $20\text{-}25\text{kg/m}^2$ ($p<0.01$) and those with BMI $<18.5\text{kg/m}^2$ ($p<0.01$) (Appendix 3).

The age at menarche was found to be significantly earlier ($P<0.01$) in girls with one sibling (12.1 ± 1.3) compared with those three ($p<0.01$) and four or more siblings ($p<0.01$) respectively (Appendix 3).

Girls from the highest socioeconomic group were found to have significantly earlier age at menarche ($p<0.01$) compared with those from the lowest socioeconomic group ($p<0.01$) (Appendix 3).

In a multiple linear regression model that included as predictors, socioeconomic status, body mass index, birth order and number of siblings, age at menarche was found to increase with increasing birth order while it decreases with increasing level of socioeconomic status and body mass index (Table 4-4).

TABLE 4-4: Determinants of age at menarche identified using multivariate regression model

Characteristic	Standard coefficient	p-value
Birth Order	0.097	<0.04
Number of siblings	0.023	0.62
Body Mass Index (BMI)	-0.370	<0.01
Socioeconomic Status	-0.429	<0.01

CHAPTER FIVE

5. DISCUSSION

The age at onset of menarche is an important biological marker of sexual maturation in females. An assessment of the mean age at menarche is important in every population in obtaining normal references of age at menarche for clinical management of menstrual abnormalities and for planning of reproductive and adolescent health services for women.

In this study, the mean age at menarche was found to be 12.7 ± 1.2 years. This mean age is lower than the age of 13.98 years reported by Adadevoh and colleagues in a similar study among selected school girls in Kumasi, Ghana two decades ago (Adadevoh et al., 1989). Comparison of the result of this current study with that of Adadevoh and colleagues suggests

a trend towards earlier menarche at a drop of 0.65 years per decade which is comparable to the value of 0.53 years per decade quoted by Adadevoh and colleagues (Adadevoh et al., 1989) for girls between 1946 to 1955 and 1966 to 1976.

The mean age at menarche of mothers of the school girls sampled was 13.6 ± 1.1 years, about 0.9 years higher than that of their daughters (12.7 ± 1.2 years). This is a further confirmation of a downward decline in age at menarche.

This is consistent with findings from other studies that reported that the mean age of menarche has been decreasing over the years in all societies (Oduntan, et al 1976, Adadevoh, et al 1989, Cameron, et al 1991, Kaplowitz, 2006; Herman-Giddens, 2006).

The decline in age at menarche of 0.65 years per decade found in this present study, may be an indication of an improved nutrition, general health and socio-economic status of the Ghanaian girls given that the occurrence, in any population, of secular trends towards an earlier maturation is generally considered an indicator of improved sanitary, nutritional and socio-economical conditions (Wolanski and Kasprzak, 1977).

Compared with studies carried out in other African countries, the mean age at menarche was found to be earlier than those reported in Sudan 13.35 ± 0.14 (Attallal et al 1983), Cameroon 13.2 ± 1.08 (Pasquet et al., 1999), Egypt 13.3 ± 1.09 (Modebe, 1987) and Nigeria 13.48 ± 0.07 (Uche and Okafor 1979). This difference seems to suggest that Ghanaian girls experience menarche at an earlier age compared with girls of these countries. However, it is difficult to accurately compare these data since different methodologies were used and also these studies were too old and conducted during different periods.

The result of this study is consistent with findings of other studies that established a negative association between socioeconomic status and age at onset of menarche (Oduntan, 1974; Padez, 2003; Chavarro et al., 2004). In these studies earlier menarche was found to be significantly associated with higher socioeconomic status (Laska-Mierezejewska, 1995; Henneberg and Louw, 1995; Parent, 2003). It is important to mention here that the negative relationship between socioeconomic status and age at onset of menarche was observed in settings in which nutritional status is highly variable and strongly related to socioeconomic status. However studies in Africa have already shown socio-economic status of parents as a major determinant of nutritional status of children (Gans, 1963; Oduntan, 1974).

Nutritional status has an important role in the determination of age at onset of menarche. To examine the effect of nutritional status on menarche, the age at onset of menarche was tested against current nutritional status assuming it was the same at the time of attaining menarche. Although it is certainly possible that the onset of menarche might have triggered increased body fatness, however many longitudinal studies have found that body fat precedes and predicts pubertal timing (Freedman et al., 2003; Sloboda, 2007).

A positive association between age at menarche and body mass index was observed. This is consistent with the findings of a similar study carried out among Nigerian school girls where it was seen that as BMI increases, the age at menarche decreases. This association has also been reported in many studies where the influence of childhood obesity on age at menarche was shown (Anderson and Must 2005; Biro, 2006; Parent et al., 2003).

Stressful family environment was shown to have no significant effect on age of onset of menarche, which is in contrast with findings from other studies in which girls from stressful family environment were shown to have early onset of menarche (Ellis and Garber, 2000; Ellis, 1999; Kaplowitz, 2004; Moffit, 1992, Zabin, 2005, Romans, 2003, Tremblay and Frigon, 2005).

The effect of stressful family environment has always been attributed to the development of an internalizing disorder in girls that lowers their metabolism thereby inciting a weight gain that accelerates menarche (Belsky et al., 1991). It is however possible that this effect might have been reduced due to the high malnutrition among the study population or as a result of the fact that the same event that constitute stress does not have uniform effects on different people (Blair-Wheaton, 1990, Jekielek, 1998).

The number of siblings and average household size were also shown not to have significant effect on the age at onset of menarche. This is also in contrast with findings from other studies where girls with a large number of siblings or from large families were shown to be significantly associated with delayed age at menarche (Clegg 1980, Dann and Roberts 1984 Okasha et al 2001). The number of sibling and household size effect has always been attributed to the adverse feeding practices and resulting inadequate nutrition that exist in these large families.

Similar studies carried out in Italy (Carfagna et al 1972) and Australia (Jones et al., 1972) however reported no significant household or sibling size effect. On the other hand, a positive association has been found between the age at menarche and birth order. Girls with higher parity order were found to have delayed age at menarche compared with those with low parity order. This finding is consistent with other studies that have shown positive relationship between age at menarche and parity order (Matchock and Susman, 2006, Hoier,

2003). The parity effect on age at menarche may be explained by the fact that girls with low parity order tended to have favourable household environment for maturation where there is no competition with others for the limited household resources.

The other socio-demographic characteristics, namely parents' educational level, place of birth, place of residence, religion and ethnicity did not show any significant effect on age at menarche. Similar results were found in many other studies (Roberts et al. 1971, Billewicz et al. 1981, Dann and Roberts 1984, 1993, Clegg 1980, Cameron and Nadgdee 1996, Sanchez-Andre's 1997, Apraiz 1999).

CHAPTER SIX

6. CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

6.1. CONCLUSION

In conclusion, the mean age at menarche estimated for girls in Madina, Ga East district of Ghana was 12.7 ± 1.2 years. The study found age at menarche to be related significantly to body mass index, socioeconomic status and birth order. A significant association has also been found between mother's age at menarche and that of their daughters. Socioeconomic status was the strongest predictor of age at menarche

6.2. RECOMMENDATION

Many actions can be taken on the basis of what has been found in this study.

The following recommendations are made

The School Health Education Programme of the Ghana health service should consider

revising health and sex education in schools to target younger students taking into account the lower age at which girls are reaching menarche

The Curriculum Development Division of the Ghana Education Service and Ministry of Education should the inclusion of the subject of menarche in the educational curriculum early so to facilitate the easy integration of the early maturing girls into society.

Future research should focus on the more specific identification of what constitute stressful family environment during childhood that is applicable to Ghana. The findings may help to properly design robust tools needed to accurately measure stressful family environment and its effect on onset of menarche.

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APPENDICES

APPENDIX 1: QUESTIONNAIRE

QUESTIONNAIRE

Age at menarche among student girls of Madina - Ga East District of Accra

SECTION FOR PUPILS

--	--	--

Form number

Unique identifier for school

--	--	--

Date of interview

DD/MM/YY

--	--	--

PART I

SECTION A: DEMOGRAPHY

1. Date of birth? DD/MM/YY

--	--	--

2. Which class are you now?

- 1) Class5 2) Class6 3)JSS 1 4)JSS2

3. Have you had your menses/period already?

[1]. Yes [2]. No If yes, at what age?

--	--	--

SECTION B: FAMILY SIZE AND PARITY ORDER

4. How many siblings (brothers and sisters) do you have?

--

5. What is your birth order (i.e. first born, second born e.tc)?

--

PART II

MEASUREMENT

WEIGHT

--

HEIGHT

--

BODY MASS INDEX

--

Form number

School ID

--	--	--

Date

--	--	--

DD MM YY

QUESTIONNAIRE

Age at menarche among student girls of Madina - Ga East District of Accra

PART III (TO BE COMPLETED BY PUPIL WITH HELP FROM PARENTS)

SECTION A: CHILD INFORMATION

1. Date of birth

--	--	--

DD MM YY

2. Place of birth

--

3. Birth weight

--

4. Ethnic group

--

5. Religion

--

6. Current area of residence?

--

7. Have you lived somewhere else before this place?

[1]. Yes [2]. No If yes, where? And at what age?

PREVIOUS RESIDENCES (PLACES OF PRVIOUS STAY)	AGE OF CHILD AT THE TIME

8. Father's highest level of education

--

9. Mother's highest level of education

--

10. Mother's age at first menses/period

--	--	--

SECTION B: SOCIOECONOMIC STATUS (WEALTH ASSESSMENT)

Tick the ones that apply

11. Does your household own any of the following items at home?

1) Air conditioner (2) A Refrigerator (3) TV / Video Deck/DVD/CD Player? 4) Fan

(5) Radio 6) None of the above

12. What Kind Of Toilet Facilities Does Your Household Have?

- (1) Flush toilet (2) Pit toilet/latrine (3) Ventilated improved pit (VIP) latrine
- (4) Bucket/pan latrine (4) No facility/bush/field/beach (4) others specify.....

13. What type of fuel does your household mainly use for cooking?

- (1) Gas or Electric stove (2) Kerosene / Charcoal (3) Firewood/ straw /Dung (4) others specify.....

14. Do you have the following at home?

- 1) car/motorbike, 2) bicycle/horse/donkey 3) None of the above

15. What source of light do you use at home?

- 1) Electricity/solar panel, 2) gas light/kerosene lamp, 3) others.....

16) What kind of material was used in building your home?

- 1) Mud house with thatch roofing, 2) Brick building with modern roofing
- 3) Block building with aluminium roofing

SECTION C: FAMILY SIZE AND PARITY ORDER

17. What is the size of your household?

CHILDHOOD STRESS

18. Has the child always lived with both biological mother and father every time?

- [1]. Yes [2]. No

If no, indicate who

- (1) Mother (2.) Father (3.) Others (specify)

19. Has the father ever been away from home (i.e. child not living of father) for a period more than one year since she was born?

- [1]. Yes [2]. No

If yes, indicate child's age when this happened

(1) 0-5years (2.) 6years-10years (3) 10years –present age

20. Has the mother ever been away from home (i.e. child not living with mother) for a period more than one year since she was born?

[1]. Yes [2]. No

If yes, indicate child's age when this happened

(1) 0-5years (2.) 6years-10years (3) 10years –present age

21 Who do you currently live with? (Tick)

(1)Mother and father (2).Step father (3) Step mother (4) mother alone (5) father alone (6) others (specify).....

22. Are the parents of the child still married or divorced?

(1) Divorced (2) Married

APPENDIX 2: WRITTEN CONSENT

INFORMED CONSENT FORM

This informed consent form is for parents of school girls participating in the research titled, "AGE AT MENARCHE AMONG STUDENTS OF MADINA -GA EAST DISTRICT OF GREATER ACCRA"

[Name of Principle Investigator].....ANTHONY ASHINYO

[Name of Organization].....SCHOOL OF PUBLIC HEALTH, UNIVERSITY OF GHANA-LEGON.

This Informed Consent Form has two parts:

- Information Sheet (to share information about the study with you)
- Certificate of Consent (for signatures if you agree that your child may participate)

You will be given a copy of the full Informed Consent Form

Part I: Information Sheet

Introduction

I am ANTHONY ASHINYO, an MPH Resident Student. I am doing research on the age at first menses and the factors that are influencing it. In this research we will talk to your daughter and ask her a number of questions.

Whenever researchers study children, we talk to the parents or send consent forms and ask them for their permission

After you have agreed, then the next thing I will do is ask your daughter for her agreement as well. Both of you have to agree independently before I can begin.

Before you decide, you can talk to anyone you feel comfortable with. If you have questions later, you can ask them of me or of another researcher through your child if you wish

Purpose

The purpose of this study is to find out the age at which girls are starting their menses and the factors that are influencing it.

Type of Research

A questionnaire and weight and height measurement will be done.

Selection of Participants

We want to talk to and examine many school children about. We would like to ask your daughter to participate because she is student in the school we have chosen to do the research in the Madina municipality.

Voluntary Participation

You do not have to agree that your daughter can talk to us. You can choose to say no and not be punished. We know that the decision can be difficult when it involves your child.

Duration

We are asking your child to participate in an interview which will take place during normal school hours.

Risks and Discomforts

There is a slight risk that your daughter may share some personal or confidential information by chance or that she may feel uncomfortable talking about some of the topics. However, we do not wish this to happen, and she may refuse to answer any question or not take part in the interview/questionnaire if she feels the question(s) are too personal or if talking about them makes her uncomfortable. Your daughter may choose to tell you about the interview and the questionnaire but she does not have to do this. We will not be sharing with you either the questions we ask or the responses given to us by your child.

Benefits

*There will be no immediate and direct benefit to your child or to you, but your child's Participation is likely to help us find out more about the age at onset of menarche and the factors influencing it and we hope that these will help in the future. **Incentives***

Your daughter will not be provided with any payment to take part in the research.

Confidentiality:

Because something out of the ordinary is being done through research in the school, it will draw attention. We will not be sharing information about your daughter outside of the research team. The information that we collect from this research project will be kept confidential. Information about your child that will be collected from the research will be put away and no-one but the researcher will be able to see it

Right to refuse or withdraw

You may choose not to have your child participate in this study and your child does not have to take part in this research if she does not wish to do so. Choosing to participate or not will not affect either your own or your child's future in any way.

Who to Contact

If you wish to ask questions later, you may contact any of the following: your child's school teacher or ANTHONY ASHINYO on mobile phone # 0244255145 or email at aashinyo@yahoo.com

This proposal has been reviewed and approved by the Ghana Health Service Ethical Committee whose task it is to make sure that research participants are protected from harm

PART II: Certificate of Consent

Certificate of Consent

I have been asked to give consent for my daughter to participate in this research

Study which will involve her completing questionnaire and having her weight and height measured .I understand that she will also be asked to give permission and that her wishes will be respected. I have been informed that the risks are minimal. I am aware that there may be no benefit to either my child or me personally and that we will not be compensated. I have been provided with the name of the principal investigator who can be easily contacted using the number I was given for that person.

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily for my child to participate as a participant in this study and understand that I have the right to withdraw her/him from the study at any time without in any way affecting our future

Name of Parent or Guardian _____

Signature of Parent of Guardian_____

Date _____

Day/month/year

For witness

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Name of witness_____ AND Thumb print of participant

Signature of witness _____

Date _____Day/month/year

I have accurately read or witnessed the accurate reading of the consent form to the parent/guardian of the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Print name of researcher _____

Signature of researcher _____

Date _____

Day/month/year

A copy of this Informed Consent Form has been provided to the parent or guardian of the participant ____ (initialled by researcher/assistant)

APPENDIX 3: POST HOC ANALYSIS RESULTS**Table 4.4.1 Post Hoc analysis (Hochberg test); dependent variable (age at menarche)**

(I) BMI	(J) BMI	Mean Difference (I-J)	Sig.	95% Confidence Interval	
				Lower Bound	Upper Bound
<20kg/m2	20-25kg/m2	.908*	.000	.66	1.16
	>25kg/m2	2.494*	.000	2.14	2.84
20-25kg/m2	<20kg/m2	-.908*	.000	-1.16	-.66
	>25kg/m2	1.585*	.000	1.25	1.92
>25kg/m2	<20kg/m2	-2.494*	.000	-2.84	-2.14
	20-25kg/m2	-1.585*	.000	-1.92	-1.25

*. The mean difference is significant at the 0.05 level

Table 4.4.2 Post Hoc analysis (Hochberg test); dependent variable (age at menarche)

(I) BIRTHWEIGHT	(J) BIRTHWEIGHT	Mean Difference (I-J)	Sig.	95% Confidence Interval	
				Lower Bound	Upper Bound
Low (<2.5)	Normal(2.5-4.0kg)	-1.393*	.000	.66	1.16
	Big (>4.0kg)	-1.576*	.000	2.14	2.84
Normal (2.5-4.0kg)	Low (<2.5)	1.393*	.000	-1.16	-.66
	Big (>4.0kg)	-.184	.691	1.25	1.92
Big (>4.0kg)	Low (<2.5)	1.576*	.000	-2.84	-2.14
	Normal (2.5-4.0kg)	.184	.691	-1.92	-1.25

*. The mean difference is significant at the 0.05 level.

Table 4.4.3 Post Hoc analysis (Hochberg test); dependent variable (age at menarche)

(I) SES	(J) SES	Mean Difference (I-J)	Sig.	95% Confidence Interval	
				Lower Bound	Upper Bound
Lowest SES	Middle SES	1.305*	.000	1.03	1.58
	Highest SES	2.123*	.000	1.80	2.45
Middle SES	Lowest SES	-1.305*	.000	-1.58	-1.03
	Highest SES	.818*	.000	.44	1.19
Highest SES	Lowest SES	-2.123*	.000	-2.45	-1.80
	Middle SES	-.818*	.000	-1.19	-.44

*. The mean difference is significant at the 0.05 level.

Table 4.4.4 Post Hoc analysis (Hochberg test); dependent variable (age at menarche)

(I) NUMBERSIBLINGS	(J) NUMBERSIBLINGS	Mean Difference (I-J)	Sig.	95% Confidence Interval	
				Lower Bound	Upper Bound
One Sibling	Two Siblings	-.416	.149	-.91	.08
	Three Siblings	-.889*	.000	-1.37	-.41
	Four Siblings+	-.907*	.000	-1.44	-.37
Two Siblings	One Sibling	.416	.149	-.08	.91
	Three Siblings	-.473*	.009	-.87	-.08
	Four Siblings+	-.491*	.028	-.95	-.03
Three Siblings	One Sibling	.889*	.000	.41	1.37
	Two Siblings	.473*	.009	.08	.87
	Four Siblings+	-.018	1.000	-.46	.43
Four Siblings+	One Sibling	.907*	.000	.37	1.44
	Two Siblings	.491*	.028	.03	.95
	Three Siblings	.018	1.000	-.43	.46

*. The mean difference is significant at the 0.05 level.

Table 4.4.5 Post Hoc analysis (Hochberg test); dependent variable (age at menarche)

(I) BIRTHORDER	(J) BIRTHORDER	Mean Difference (I-J)	Sig.	95% Confidence Interval	
				Lower Bound	Upper Bound
First born	Second born	-.458*	.014	-.86	-.06
	Third born	-.832*	.000	-1.26	-.41
	Forth born or above	-.772*	.002	-1.34	-.20
Second born	First born	.458*	.014	.06	.86
	Third born	-.373	.097	-.79	.04
	Forth born or above	-.313	.585	-.87	.24

Third born	First born	.832*	.000	.41	1.26
	Second born	.373	.097	-.04	.79
	Forth born or above	.060	1.000	-.52	.64
Forth born or above	First born	.772*	.002	.20	1.34
	Second born	.313	.585	-.24	.87
	Third born	-.060	1.000	-.64	.52

*. The mean difference is significant at the 0.05 level.

APPENDIX 4: PAIRED T- TEST RESULT


	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 AGE AT MENARCHE OF GIRLS - MOTHERS AGE AT MENARCHE	-.927	1.708	.098	-1.121	-.734	-9.432	301	< 0.01

APPENDIX 5: ETHICAL CLEARANCE

GHANA HEALTH SERVICE ETHICAL REVIEW COMMITTEE

In case of reply the number and date of this Letter should be quoted.

*My Ref. :GHS-ERC: 3
Your Ref. No.*



GHANA HEALTH SERVICE
Your Health - Our Concern

Research and Development Division
Ghana Health Service
P. O. Box MB 190
Accra

27th May 2010

Tel: +233- 0302-681109
Fax + 233-0302 685424
Email: Hannah.Frimpong@ghsmail.org

ANTHONY ASHINYO -Principal Investigator

ETHICAL CLEARANCE - ID NO: GHS-ERC: 19/4/10

The Ghana Health Service Ethical Review Committee has reviewed and given approval for the implementation of your Study Protocol titled:

“Age at Menarche among School Girls in Madina – Ga East District of Accra”

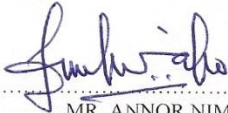
This approval requires that you submit periodic review of the protocol to the Committee and a final full review to the Ethical Review Committee (ERC) on completion of the study. The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Please note that any modification of the project must be submitted to the ERC for review and approval before its implementation.

You are also required to report all serious adverse events related to this study to the ERC within seven days verbally and fourteen days in writing.

You are requested to submit a final report on the study to assure the ERC that the project was implemented as per approved protocol. You are also to inform the ERC and your mother organization before any publication of the research findings.

Please always quote the protocol identification number in all future correspondence in relation to this protocol

SIGNED.....
MR. ANNOR NIMAKO
(GHS-ERC VICE CHAIRMAN)

Cc: The Director, Research and Development Division, GHS, Accra

APPENDIX 6: PERMISSION RECEIVED FROM GHANA EDUCATION SERVICE


GHANA EDUCATION SERVICE

*In case of reply the
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EAST MUNICIPALITY
Letter should be quoted*

number and date of this

My Ref. No. **GES/GEM/3/7/18**

Your Ref. No.


REPUBLIC OF GHANA

MUNICIPAL EDUCATION
GA

P. O. BOX AK 91.
ABOKOBI.

PHONE: +233-021-938954
E-mail. ges.abokobi@gmail.com

21ST MAY, 2010

TO THE HEADS


Dear Sir/Madam,

LETTER OF INTRODUCTION:
ANTHONY ASHINYO

The bearer of this note is a graduate student at the school of Public Health,
University of Ghana-Legon.

His research work is on "Age at Menarche among School girls in Madina -Ga
East". He is expected to present you with 'parental consent forms' which you
should ask parents of the sampled children to complete before he conducts the
interviews.

Please co-operate with him and give him the necessary assistance.


.....
CYNTHIA BOSUMTWI-SAM (MRS.)
DIRECTOR OF EDUCATION
GA EAST MUNICIPALITY
ABOKOBI.