

## **Obesity in primary school children in Accra Metropolis**

**This dissertation is submitted to the School of Public Health,  
University of Ghana, Legon in partial fulfillment of the requirement for  
the award of Master of Public Health Degree**



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**Declaration.**

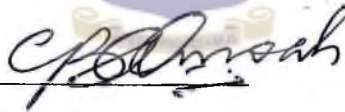
I do hereby declare that except for duly acknowledged citation and ideas, this dissertation is an original work produced by me from a study personally undertaken and was not submitted for any degree elsewhere.

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**Academic Supervisors:**

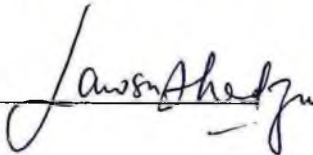
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**Abstract**

*Objectives:* To determine the prevalence and socio-demographic aspects of obesity in primary school children in Accra Metropolis.

*Design:* A descriptive cross-sectional survey was conducted on sample of 1123 children aged 6-10 years attending primary schools who were selected by multistage sampling using school registers and listings of primary schools by Accra Metropolitan Education Service.

*Setting:* Four public and four private primary schools in Accra Metropolis.

*Subjects and Methods:* In total, 1123 subjects (584 females and 539 males) participated. There was however 912 questionnaires available for further analysis. Socio-demographic data were obtained by self-administered questionnaire and measurements were made of weight, height and triceps skin fold thickness.

*Results:* The mean age for males was 8.43 years and that for females 8.41 years ( $p<0.001$ ). The mean weight for males was 26.8kg and that for females 27.8kg ( $p<0.001$ ). The mean BMI for males was  $16.1\text{kg/m}^2$  and that for females  $16.5\text{kg/m}^2$  ( $p<0.001$ ). The mean skin fold thickness for males was 6.8mm and that for females 9.6mm ( $p<0.001$ ). Crude prevalence of obesity (above 95 percentile) was 5% (by CDC criteria 3.4%), prevalence of risk of overweight (above 85 and below 95 percentile) was 10.2% (by CDC criteria 7%) and prevalence of underweight (below 5 percentile) was 4.8% (by CDC criteria 3.7%). The crude prevalence of obesity by skin fold thickness distribution was 5.3%. The rates of obesity (7% vs 2.8%) and at risk of overweight (12.3% vs 7.8%) were higher in females than males. There were more obese and at risk of overweight subjects in

the private schools 9.6% and 14.1% than that in public schools 1.1% and 6.8%, respectively. Obesity and risk of overweight were highest among Akan and Ewe tribes. Subjects of parents with tertiary education were more obese and at risk of overweight than their counterparts of parents with lower educational level.

*Conclusion:* Obesity does not yet appear to be a major problem in primary school children in Accra. A significant number, a tenth of the children, were at risk of overweight category. There was co- existence of obesity and underweight.

Economic status appeared to be an important determinant of nutritional status.

Female gender, Akan ethnical group, private schools and higher school fees, tertiary education of the parents were associated with higher levels of obesity and overweight. Further work is needed to ascertain the real reasons for observed differences.



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Finally, I wish to express my profound gratitude to my family members for their understanding and support while I undertook this study.

**List of abbreviations.**

AMA	Accra Metropolitan Area
BIA	Bioelectrical Impedance
BMI	Body Mass Index
¢	Cedi (Ghanaian currency)
CAT	Computerized Axial Tomography
CDC	Centers for Diseases Control
CI	Confidence Interval
DEXA	Dual Energy X-ray Absorptiometry
IOTF	International Obesity Task Force
MRI	Magnetic Resonance Imaging
NAFLD	Non-alcoholic fatty liver disease
NASH	Non-alcoholic steatohepatitis
NHANES	National Health and Nutrition Examination Survey
NCHS	National Centre for Health Statistics USA
SD	Standard Deviation
St	Sent
WHO	World Health Organization
WHR	Waist-to-Hip Ratio
WHZ	Weight for Height Z-score

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## 1.0 Introduction.

### 1.1 Background Information

The prevalence of overweight and obesity is increasing worldwide at an alarming rate in developed and developing countries<sup>1, 4, 57</sup>. Obesity may be defined as a condition in which there is an excessive amount of body fat. Obesity is a disease of complex and multiple causes leading to an imbalance between energy intake and output and to the accumulation of large amounts of body fat. It is measured most often as excessive weight for a given height, using the body mass index (BMI)—weight in kilograms (kg) over height squared ( $m^2$ ). The World Health Organization (WHO) defines overweight as a BMI from 25.0 to 29.9  $kg/m^2$  and obesity as a BMI of 30.0  $kg/m^2$  or greater<sup>1</sup>. Excess body weight is associated with increased risk for cardiovascular disorders<sup>5</sup>, type 2 diabetes<sup>6</sup>, dislipidaemia<sup>5, 6</sup>, endocrine disorders<sup>58</sup>, osteoarthritis, some cancers and gallbladder disease<sup>59-60</sup>. Obesity rates, which are doubling every 5-10 years in many parts of the world, are placing significant additional financial burdens on health systems. Many developing nations are undergoing epidemiological transition with alterations in diet and physical activity<sup>61</sup>. Some countries with high levels of obesity also report significant rates of child-hood stunting and nutritional deficiencies<sup>62</sup>. Maintaining a dual nutrition agenda, preventing obesity and related chronic diseases while eliminating nutritional deficiencies, presents a difficult challenge to countries with limited resources.

Childhood obesity is a problem because it is an important predictor of adult obesity<sup>63</sup>. About one third of obese preschool children become obese adults, and

one-half of obese school-age children become obese adults. Childhood obesity, just like adult obesity, is caused by an imbalance between calories-in and calories-out. But this simple equation is confounded by complex social facts that influence how children eat, exercise, and play.

## **1.2 Problem statement**

WHO defined obesity as a condition where fat has accumulated to such extent that health is adversely affected. Ten percent of the world's school-age children are estimated to be carrying excess body fat, an increased risk for developing chronic diseases. Childhood obesity is an important predictor of adulthood obesity. A number of developing countries undergoing rapid socio-economic and nutrition transitions are experiencing shift from under- to over nutrition problems. Their fragile health systems may face a double burden of malnutrition and obesity. In industrialized countries it is children in lower socioeconomic groups who are at a greater risk. In contrast, developing countries show obesity to be more prevalent among higher income sectors of the population, and among urban populations rather than rural ones. An assessment of the local information on nutritional status of school age children identified the following: data are scanty, scattered and not nationally representative. In the past nutritional data was collected mostly in children under 5 years and focused on malnutrition and food security. In the face of increasing trends of overweight and obesity reliable baseline data on childhood obesity would be useful. Therefore, the research questions of this study were: What was the level of obesity in primary school

children in Accra metropolis, most urbanized area in the country? Were there any differences in obesity prevalence among private and public schools?

### **1.3 Rationale for study**

In 1995, estimated 17.6mln children in the low income countries were overweight.<sup>68</sup>

An understanding and awareness of the burden of nutritional problems among school-age children is growing although until recently there have been few surveys that document nutritional status of school-age children in Ghana.

Nationally representative data are lacking. Furthermore, there are methodological concerns, the use and interpretation of weight for height indices based on children from USA has been questioned in populations with significant level of stunting.

Prevention of obesity in developing countries is imperative, since improvements in socioeconomic conditions and rapid urbanization are causing a 'nutrition transition'. The recent study among adults in Accra revealed prevalence of overweight and obesity was 23.4 and 14.1% respectively.<sup>64</sup> Countries undergoing a 'nutrition transition' have high levels of stunting (low height-for-age), which is believed to be a risk factor for obesity.

For this reason, we should look towards prevention efforts for children, rather than focusing solely on treating the obesity that already exists. Comprehensive strategies that consider both physical activity and nutrition in home, school, and community settings are needed for remedial actions to be effective. To monitor such interventions, reliable baseline data on childhood obesity would be useful. Such data are presently not available or difficult to find.

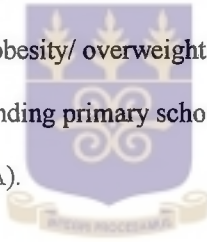
#### **1.4 Study site**

The capital Accra is the most urbanized and densely populated area in the country, with an urban population of 1.6 million (2000 Census). For administrative purposes it is divided into 6 sub-metros: Ablekuma, Ayawaso, Ashiedu-Keteke, Kpeshie, Okaikoi and Osu-Clotney. Pre-Adolescent population (5-9 years) comprises 14.67% (2000 Census). There are 386 public and number of private primary schools in Accra. Current primary school attendance in Greater Accra region is 361080 pupils (2000 Census).

#### **1.5 Study Objectives.**

##### **Main Objective of the study.**

To estimate the prevalence of obesity/ overweight and underweight among children (aged 6-10 years) attending primary schools (public and private) in the Accra Metropolitan area (AMA).



##### **Specific objectives.**

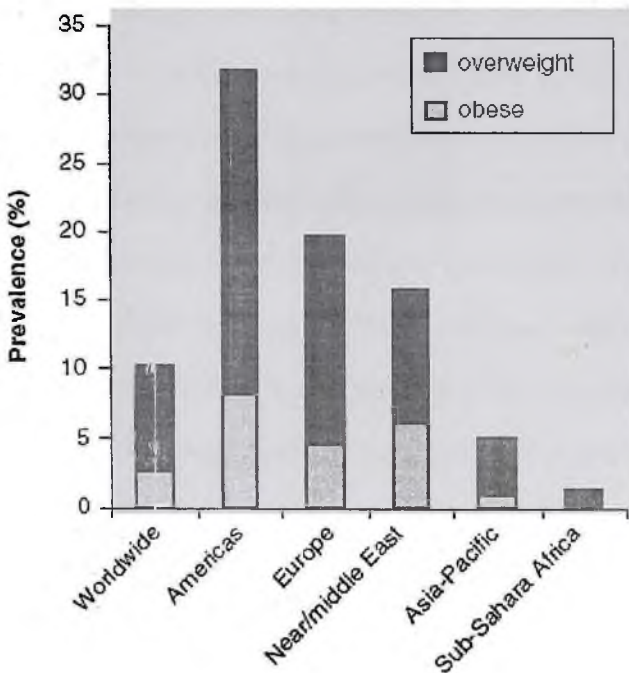
- To measure weight, height and triceps skin fold of children.
- To calculate Body Mass Index (BMI) for every participant.
- To evaluate distribution of mean BMI and skin fold thickness among children by age and sex.
- To estimate proportion of obese, at risk of overweight and underweight children..
- To determine the demographic and socioeconomic associations of obesity.
- To analyze significance of skin fold thickness as an indicator for obesity.

## 2.0 Literature review.

The success of child survival programs and expansion of basic education coverage have resulted in a greater number of children reaching school age with a higher proportion actually attending primary school.<sup>(10)</sup>

The main nutritional problems facing the school-age child include stunting, underweight, anaemia and iodine and vitamin A deficiencies. In countries experiencing the “nutrition transition, overweight and obesity are increasing problems in school-age child<sup>(2)</sup>.

Ten per cent of the world’s school-age children are estimated to be carrying excess body fat(Figure. 1), an increased risk for developing chronic diseases<sup>5,6,60</sup>.



**Figure 1.** Prevalence of overweight and obesity among school-age children in global regions. Overweight and obesity defined by International Obesity Task

Force (IOTF) criteria. Children aged 5–17 years. Based on surveys in different years after 1990. Source: IOTF <sup>(3)</sup>.

Obesity is associated with several risk factors for later heart disease and other chronic diseases including hyperlipidaemia, hyperinsulinaemia, hypertension, and early atherosclerosis.<sup>4-6</sup>

The burden of obesity upon the health services cannot yet be estimated. Although childhood obesity brings a number of additional problems in its train – hyperinsulinaemia, poor glucose tolerance and a raised risk of type 2 diabetes, hypertension, sleep apnoea, social exclusion and depression– the greatest health problems will be seen in the next generation of adults as the present childhood obesity epidemic passes through to adulthood. Greatly increased rates of heart disease, diabetes, certain cancers, gall bladder disease, osteoarthritis, endocrine disorders and other obesity related conditions will be found in young adult populations, and their need for medical treatment may last for their remaining life-times. For example, 10% of young people with type 2 diabetes are likely to develop renal failure by the time they enter adulthood, requiring hospitalization followed by life-long dialysis treatment.<sup>7</sup> Health services, especially in developing countries, may not easily bear these cost, and the result could be a significant fall in life expectancy.

### **2.1 Assessment of obesity: which child is fat?**

Power *et al.* suggest that ‘an ideal measure of body fat should be accurate in its estimate of body fat; precise, with small measurement error; accessible, in terms

of simplicity, cost and ease of use; acceptable to the subject; and well documented, with published reference values' <sup>8</sup> They further comment that 'no existing measure satisfies all these criteria.

Measurement of adiposity in children and adolescents occurs in a range of settings, using a range of direct and indirect methods. Direct measures of body composition provide an estimation of total body fat mass and various components of fat-free mass. Such techniques include underwater weighing, magnetic resonance imaging (MRI), bioelectrical impedance analysis (BIA), computerized axial tomography (CT or CAT) and dual energy X-ray absorptiometry (DEXA). These methods are used predominantly for research and in tertiary care settings, but may be used as a 'gold standard' to validate anthropometric measures of body fatness<sup>8</sup>. Among the anthropometric measures of relative adiposity or fatness are waist, hip and other girth measurements, skin fold thickness and indices derived from measured height and weight such as Quetelet's index ( $BMI$  or  $W H^{-2}$ ), the ponderal index ( $W H^{-3}$ ) and similar formulae. All anthropometric measurements rely to some extent on the skill of the measurer, and their relative accuracy as a measure of adiposity must be validated against a 'gold standard' measure of adiposity.

**Procedure: Weight and weight-for-height**

**Description:**

Total body weight can be recorded and compared with reference standards based on a child's age. Low weight-for-age is a widely used marker of malnutrition for younger children. However, weight is correlated with height, and reference

standards based on weight-for-height provide a more accurate measure of under- or overweight, and take account of possible confounding from inadequate linear growth (stunting) when assessing nutritional status.

Validation:

Growth charts are based on standard reference populations (usually the US National Center for Health Statistics reference population) Weight-for-height charts are inaccurate beyond the age of around 10–11 years and the measure is not useful in older children and adolescents<sup>9</sup>

Comments:

Weight and height (or length) is relatively easy to obtain, although they tend to be more accurate if taken by a trained person.



Procedure: **Body mass index (BMI )**

Description:

BMI is defined as weight (kg) /height squared ( $m^2$ ), and is widely used as an index of relative adiposity among children, adolescents and adults. Among adults, the WHO recommends that a person with a BMI of  $25 \text{ kg m}^{-2}$  or above is classified overweight, while one with a BMI  $30 \text{ kg m}^{-2}$  or above is classified obese<sup>1</sup> For children, various cut-off criteria have been proposed based on reference populations and different statistical approaches.

Validation:

BMI has been compared with dual-energy X-ray absorptiometry (DEXA) in children and adolescents aged 4–20 years<sup>11</sup> BMI had a true positive rate of 0.67, and a false positive rate of 0.06 for predicting a high percentage of total body fat. Sardinha *et al.*<sup>12</sup> reported a true positive rate of 0.83 for 10–11 year olds, 0.67 for 12–13 year olds and 0.77 for 14–15 year olds, while the false positive rate ranged from 0.03 in 12–13 year olds to 0.13 in 10–11 year olds. Therefore, although some overweight children would be wrongly classified as being of normal weight when using BMI as a screening test, few children would be classified as overweight if they were not.

Comments:

BMI is more accurate when height and weight are measured by a trained person rather than self-reported. Measurement of height and weight has a high subject acceptance, which is particularly important for adolescents who may be reluctant to undress (measures are normally taken in light clothing, without shoes). There is low observer error, low measurement error and good reliability and validity. Hence two people with the same amount of body fat can have quite different BMIs<sup>12</sup> There may also be racial differences in the relationship between the true proportion of body fat and BMI<sup>14</sup>

Procedure: **Waist circumference and Waist-to-hip ratio (WHR)**

Description:

Waist circumference is an indirect measure of central adiposity. Central adiposity is strongly correlated with risk for cardiovascular disease in adults<sup>13</sup> and an

adverse lipid profile, hyperinsulinaemia in children<sup>15</sup> Waist circumference is measured at the minimum circumference between the iliac crest and the rib cage using a flexible tape measure. W-to-hip ratio has been used among adults to identify people with high central adiposity.

Validation:

In young people aged 3–19 years, the correlation between waist circumference and DEXA of trunk fat were 0.83 for girls and 0.84 for boys. Waist-to-hip ratios are less well correlated with trunk fat measures using DEXA<sup>16</sup>

Comments:

Waist and hip circumferences are easy to measure with simple, low-cost equipment, have low observer error, offer good reliability, validity and low measurement error. However, there are no accepted cutoff values for the classification of overweight and obesity based on these measures, and there have been few studies of the relation between central adiposity and the metabolic disturbances associated with excess visceral fat among children and adolescents.

Procedure: **Skin fold thickness**

Description:

Skin-fold thickness can be measured at different sites on the body (e.g. triceps, sub scapular) using skin-fold calipers. Prediction equations can then be used to estimate fat mass and percentage fat from the skin-fold measurements.

Validation:

Children's abdominal skin-fold thickness correlates well ( $r = 0.88$ ) with visceral

adipose tissue as measured by CT scan or MRI<sup>17</sup>. Triceps skin-fold thickness shows a sensitivity of 0.79 in 10–11 year olds, 0.78 in 12–13 year olds and 0.87 in 14–15 year olds when compared with DEXA in measuring obesity (=30% body fat)<sup>12</sup>

#### Comments:

Skin-fold thickness uses simple equipment and offers only a moderate respondent burden, and has the potential to determine total body fat and regional fat distribution. However, skin-fold thickness varies with age, sex and race, and the equations relating skin-fold thickness at several sites to total body fat need to be validated for each population.

Measurement requires training and intra- and inter-observer reliability is poor<sup>18</sup>

In very obese individuals the measurement of triceps skin-fold or other skin-fold thicknesses may not be possible. The relationship with metabolic problems is unclear.

#### **Definitions of ‘overweight’ and ‘obesity’ in young people**

The primary purposes for defining overweight and obesity are to predict health risks and to provide comparisons between populations. Faced with a continuous distribution, criteria need to be created that define where cut-off points should occur that best fulfill these purposes. For practical reasons, the definitions have usually been based on anthropometry, with waist circumference and BMI being the most widely used both clinically and in population studies.

As suggested in Table 1 above, BMI is significantly associated with relative fatness in childhood and adolescence, and is the most convenient way of measuring relative adiposity<sup>19</sup>.

### **BMI for age reference charts and BMI for age percentiles.**

BMI varies with age and gender. It typically rises during the first months after birth, falls after the first year and rises again around the sixth year of life: this second rise is sometimes referred to as ‘the adiposity rebound’<sup>23</sup>. A given value of BMI therefore needs to be evaluated against age- and gender-specific reference values. Several countries, including France, the UK, Singapore, Sweden, Denmark and the Netherlands, have developed their own BMI-for-age gender-specific reference charts using local data. In the USA, reference values published by Must *et al.*<sup>20</sup> derived from US survey data in the early 1970s, have been widely used and were recommended for older children (aged 9 years or more) by a WHO expert committee in 1995<sup>21</sup>. More recently, the US National Center for Health Statistics (NCHS) has produced reference charts based on data from five national health examinations from 1963–1994<sup>22</sup>, although to avoid an upward shift of the weight and BMI curves, data from the most recent survey were excluded for children over the age of six years<sup>23</sup>. The NCHS documentation<sup>22</sup> recommends that those children with a BMI greater than or equal to the 95<sup>th</sup> percentile be classified as ‘overweight’ and those children with a BMI between the 85<sup>th</sup> and 95<sup>th</sup> percentile be classified as ‘at risk of overweight’. In some papers, US children at or above the 95<sup>th</sup> centile are referred to as ‘obese’<sup>24</sup> and in others ‘obesity’ refers to US children above the 85<sup>th</sup> centile<sup>25</sup>.

**BMI for age Z-scores.** As with the use of weight-for-height measures compared with standard reference populations, BMI can be compared with a reference data set and reported as Z-scores. A BMI Z-score is calculated as follows<sup>65</sup>:

$$\frac{(\text{Observed value}) - (\text{median reference value of a population})}{\text{Standard deviation of reference population}}$$

A Z-score of 0 is equivalent to the median or 50th centile value, a Z-score of +1.00 is approximately equivalent to the 84th centile, a Z-score of +2.00 is approximately equivalent to the 98th centile and a Z-score of +2.85 is >99<sup>th</sup> centile. As with other measures, BMI Z-scores can be used to compare an individual or specified population against a reference population. BMI for age Z-scores, however, require suitable statistical skills or software programmes. Also Z-scores are associated with difficulty in choosing an appropriate reference population, and there are only arbitrary cut-off points for categorizing into non-overweight, overweight and obese.

#### **BMI based on adult cut-off points.**

An expert committee convened by the International Obesity Task Force in 1999 determined that although BMI was not ideal as a measure of adiposity, it had been validated against other, more direct measures of body fatness and may therefore be used to define overweight and obesity in children and adolescents<sup>19</sup>. As it is not clear at which BMI level adverse health risk factors increase in children, the group recommended cutoffs based on age specific values that project to the adult cut-offs of 25 kg m<sup>-2</sup> for overweight and 30 kg m<sup>-2</sup> for obesity. Using data from six different reference populations (Great Britain, Brazil, the Netherlands, Hong Kong, Singapore and the USA) Cole *et al.*<sup>23</sup> derived centile curves that passed

through the points of  $25 \text{ kg m}^{-2}$  and  $30 \text{ kg m}^{-2}$  at age 18 years. These provide age and gender specific BMI cut offs to define overweight and obesity, corresponding to the adult cut off points for overweight and obesity. The tables developed by Cole *et al.* (reproduced in Appendix 1) are useful for epidemiological research in that children and adolescents can be categorized as non-overweight, overweight or obese using a single standard tool. The cutoff points were developed using several data sets, therefore they represent an international reference that can be used to compare populations world-wide. The authors, however, acknowledge that the reference data set may not adequately represent non-Western populations.

## **2.2 Global secular trends and prevalence of obesity in children and adolescents**

Representative data for examining the problem of childhood obesity have been collected in many industrialized countries, especially in North America and Europe as well as in a number of developing countries, although for most developing countries the data are more limited, especially data on older children (>5 years) and adolescents. Nevertheless, data collected in national and local surveys from different parts of the world provide useful insights into the global obesity situation among young people (Figure 2)

### *(i) Global prevalence is unequally distributed*

Taken overall, the data available from surveys of young people aged 5–17 years, collated for the WHO Global Burden of Disease report and extrapolated to countries where no data are available, indicates the prevalence of overweight

(including obesity) to be approximately 10% in this age range, and the prevalence of obesity to be 2–3%

This global average reflects a wide range of prevalence levels, with the prevalence of overweight in Africa and Asia averaging well below 10% and in the Americas and Europe above 20 %.<sup>3</sup>

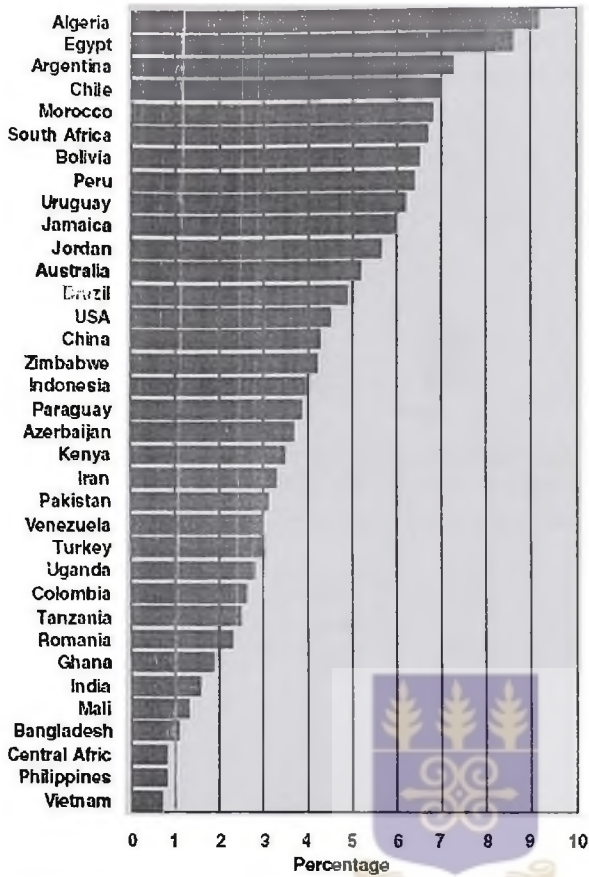
*(ii) Childhood overweight is rising rapidly*

The prevalence of excess weight among children is increasing in both developed and developing countries, but at very different speeds and in different patterns.

North America and some European countries have the highest prevalence levels, and have shown high year-on-year increases in prevalence.

*(iii) Overweight is high among the poor in rich countries, and the rich in poorer countries*

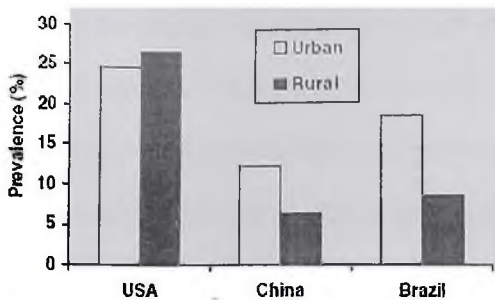
In industrialized countries it is children in lower socioeconomic groups who are at greatest risk. In contrast, developing countries show obesity to be more prevalent



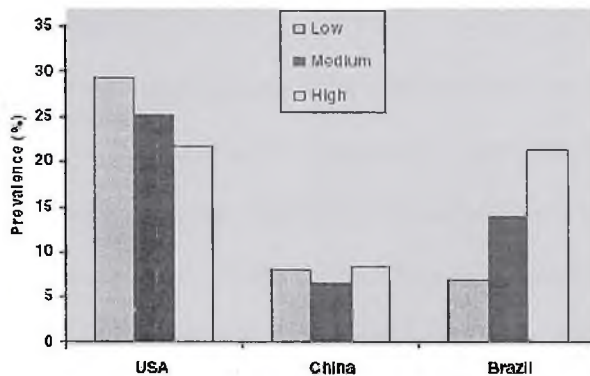
**Figure 2.** Prevalence of obesity among children aged under 5 years. Obesity in under fives according to WHO standardized cut-offs ( $Z > 2.0$ ). Based on surveys in different years. Source: de Onis & Blossner<sup>26</sup>

among higher income sectors of the population, and among urban populations rather than rural ones (Figures 3, 4).

**Figure 3.** Prevalence of overweight according to residential area. Overweight defined by IOTF criteria. Survey years 1988–1994 (USA) and 1997 (Brazil, China). Children aged 6–18 years. Source: Wang *et al.*<sup>27</sup>



**Figure 4.** Prevalence of overweight according to family income levels. Overweight defined by IOTF criteria. Survey years 1988–1994 (USA) and 1997 (Brazil, China). Children aged 6–18 years. Source: Wang *et al.*<sup>27</sup>



A number of developing countries undergoing rapid socio-economic and nutrition transitions are experiencing shift from under- to over-nutrition problems, and may experience a double burden of malnutrition and obesity. For example, in Brazil between 1974 and 1997, the prevalence of overweight and obesity (IOTF definitions) among young people aged 6–17 years more than tripled increasing from 4.1% to 13.9%), while the prevalence of underweight (<5th centile NHANES-I) decreased from 14.8% to 8.6%<sup>(27)</sup>. It is likely that many other developing countries will show similar trends as economic conditions develop.

### **2.3 Prevalence of overweight in Sub-Saharan Africa.**

There are very limited representative data available from African countries for studying the secular trends in childhood obesity, because most public health- and nutrition-related efforts have been focused on malnutrition and food safety problems. Most of the available data that do exist are collected for pre-school children and focus on malnutrition. In general, the prevalence of childhood obesity remains very low in this region, except for countries such as South Africa where obesity has become prevalent in adults, particularly among women, and where childhood obesity is also rising.

According to a recent comprehensive study conducted among pre-school children from 24 sub-Saharan countries excluding South Africa<sup>28</sup>, the prevalence of overweight including obesity (defined as a weight-for-height standardized score greater than one, i.e.  $WHZ > 1$ ) was below 10% in 18 countries, and the prevalence of obesity alone (defined as  $WHZ > 2$ ) was below 5% in all countries except one (Malawi). Overall, the prevalence of overweight (including obesity) was 8.4% while for obesity alone the prevalence was 1.9%.

### **2.4 The physical and psycho-social consequences of childhood obesity.**

#### *Physical health.*

Clinical studies of obese children have suggested a range of medical conditions for which obese children are at greater risk<sup>29</sup>

#### *1.1. Sleep-disordered breathing and asthma*

A well-established pulmonary consequence of childhood obesity is 'sleep-associated breathing disorder', most clearly seen in severe obesity. The term refers to a broad spectrum of sleep-related conditions including increased resistance to airflow through the upper airway, heavy snoring, reduction in airflow (hypopnoea) and cessation of breathing (apnoea). Obesity-linked hypoventilation syndrome, sometimes referred to as Pickwickian syndrome, is a serious condition associated with pulmonary embolism and sudden death in children <sup>30</sup>.

### *1.2. Fatty liver disease*

Non-alcoholic fatty liver disease (NAFLD) is increasingly recognized as a major health burden in obese children. NAFLD is a spectrum, ranging from fatty infiltration of the liver alone (steatosis) that is relatively benign to fatty infiltration with inflammation known as steatohepatitis or nonalcoholic steatohepatitis (NASH) and characterized by the potential to progress to fibrosis, cirrhosis and end-stage liver disease <sup>31</sup>. Current prevalence estimates indicate that NAFLD affects approximately 3% of all children in various countries and from 23% to 53% of children who are obese, with up to 70% of these having steatohepatitis, severe fibrosis or cirrhosis <sup>32</sup>. NAFLD therefore appears to be a common form of liver disease in many children, especially in developed countries where the obesity epidemic is most advanced.

### *1.3. Menstrual problems and early menarche*

Abnormalities in menstruation and early menarche represent part of the endocrine response to excess body weight in girls. Previous studies have established a

relationship between obesity and lowered fertility<sup>33</sup> but the impact of excess weight on menstrual problems in adolescence is less well established.

Oligomenorrhoea or amenorrhoea associated with obesity, insulin resistance, hirsutism, acne and acanthosis nigricans comprise a 'polycystic ovary syndrome'.

The appearance of insulin resistance in youth, associated with overweight, may foreshadow an increased prevalence of polycystic ovary syndrome in adolescence.

Menarcheal timing is influenced by weight status, with higher relative weights associated with earlier menarche<sup>34</sup>. The rise in childhood obesity seen in the last decade among younger children may result in a further lowering of the population average age of menarche.

#### *1.4. Delayed maturation linked to obesity in adolescent boys*

Overweight boys tend to show later maturation than their non-overweight counterparts. Although early sexual maturity is associated with overweight in girls, in boys the reverse appears to be the case, with the prevalence of overweight and obesity higher in late maturers than in early maturers<sup>35</sup>. The differences are also reflected in the changing body composition that occur during puberty, when girls tend to increase fat mass as a result of maturation while boys tend to increase muscle and other non-fat body mass.

#### *1.5. Type 2 diabetes*

Previously only seen in adults, the emergence of type 2 diabetes in youth represents a particularly alarming consequence of the obesity epidemic in children. The onset of diabetes in youth will increase the risk in early adulthood of the advanced complications of the disorder – cardiovascular disease, kidney

failure, visual impairment and limb amputations. A review by the American Diabetes Association suggests that as many as 45% of paediatric diabetes cases are the type 2 non-insulin dependent form <sup>36</sup>.

Although other factors are associated with type 2 diabetes in children (including family history, ethnicity and the presence of acanthosis nigricans), the most important risk factor is obesity. In a study of childhood diabetes carried out in Arkansas (USA), Scott *et al.* <sup>37</sup> found excess bodyweight among over 90% of adolescents with type 2 diabetes while among children with type 1 diabetes excess bodyweight was found in about 25% of cases.

#### *1.6. Cardiovascular risk factors*

The Bogalusa study in Louisiana (USA) has provided detailed information on cardiovascular risk factors in childhood and their persistence into adulthood <sup>38</sup>. In the study, overweight during adolescence was associated with an 8.5-fold increase in hypertension, a 2.4- fold increase in the prevalence of high total serum cholesterol values, a 3-fold increase in high LDL serum cholesterol values and an 8-fold increase in low HDL serum cholesterol levels as adults aged 27–31 years <sup>39</sup>. Several studies have shown links between weight gain in childhood and a subsequent increase in cardiovascular risk factors in urban African-Americans <sup>40</sup> and in populations in Finland <sup>41</sup>. The Finnish data suggest that the cluster of cardiovascular risk factors in adulthood – including hypertension, hypertriglyceridaemia, low HDL cholesterol and hyperinsulinaemia – sometimes referred to as the metabolic syndrome, is especially common among obese adults who were also obese as children.

### **Psychological and social consequences**

Obesity in children and adolescents may have its most immediate consequences in the psychological and social realms. Stigmatization of obese children and adolescents has long been recognized in Westernized cultures, and is well documented among the children's peers. Several studies found that obese children have greater social problems (peer rejection or stigma) or psychological problems (anxiety, depression or low self-esteem) than their non-obese peers. Not all cultures view excess weight as a negative attribute. For example, a study in Mexico noted that food treats for children are a cultural index of parental caring, and that parents value child fatness as a sign of health<sup>42</sup>. Ghanaians generally associate fatness with beauty in women and success in both sexes<sup>64</sup>.

### **2.5 Population groups at higher risk for obesity**

There are identifiable risk factors within the population of normal children that increase their risk of becoming obese.

**Ethnicity.** It is a common impression that schoolchildren from non-Caucasian backgrounds living in Westernized societies have greater propensity for developing obesity than white Caucasian children, but when socio-economic circumstances and parental education are taken into account, the differences may not be great. In the USA, for example, African-Americans and Hispanic-Americans appear to contribute more to the obesity epidemic, with more rapid rates of change in their populations, than does the white American population<sup>43</sup>.

**Parental obesity.** The risk of a child becoming overweight increases with parental overweight and obesity<sup>25</sup>. It is likely that the family association is due partly to genetic factors and partly to shared lifestyles, i.e. diets and patterns of activity. In some cases obese parents show less concern than average for their children's obesity, although in other cases the opposite may be true.

**Low birth weight.** A U-shaped relationship between birth weight and subsequent risk of obesity appears to apply, with the heaviest babies and the lightest being at risk of excess weight gain during subsequent childhood and adulthood<sup>44</sup>.

Considerable evidence now exists that obese children and obese adults who had low birth weights are more vulnerable to both coronary heart disease and type 2 diabetes than similarly obese people who had higher birth weights<sup>45</sup>.

**Stunting in childhood.** Stunting (short height for age) affects one-third of all children aged under 5 years globally (i.e. around 270 million children), most of them in less

developed or transitional economies<sup>46</sup>. Evidence from several surveys has shown the co-existence of stunting and overweight or obesity in the same child and/or among other members of the same household, in urban areas in developing countries<sup>47,48</sup> and poorer communities in developed countries<sup>49</sup>. One of the largest studies<sup>50</sup> of nutritional status of rural school children in low income countries (Ghana, Tanzania, Indonesia, Vietnam and India) found the overall prevalence of stunting to be high in all five countries, ranging from 48% to 56%

## 2.6 Environmental risk factors

The changing nature of the environment towards greater inducement of obesity has been described in WHO Technical Report <sup>10</sup> on chronic disease as follows:

‘Changes in the world food economy have contributed to shifting dietary patterns, for example, increased consumption of energy-dense diets high in fat, particularly saturated fat, and low in unrefined carbohydrates. These patterns are combined with a decline in energy expenditure that is associated with a sedentary lifestyle—motorized transport, labour-saving devices at home, the phasing out of physically demanding manual tasks in the workplace, and leisure time that is preponderantly devoted to physically undemanding pastimes.’ (pp. 1–2)

It is probable that similar factors are linked to the rise of overweight in children; for example, a decline in walking to school<sup>66</sup> and a rise in snack food consumption<sup>67</sup> and the popularity of fast-food outlets<sup>69</sup>. Within this ‘obesogenic’ environment there are a number of factors that warrant specific consideration with respect to the risk of overweight in children and adolescents. It is also important to consider, however, the micro-environment created in the home. For younger children in particular the family environment plays an important role in determining their risk of obesity, for example parental physical activity levels <sup>51</sup>, the family’s eating behaviours <sup>51</sup> and television viewing habits <sup>52</sup>.

## 2.7 Prevention- the only solution

Virtually all reviews have indicated that the prevention of obesity is not only possible but is the most realistic and cost effective approach for dealing with childhood obesity<sup>53</sup> as it is for adult obesity<sup>10</sup>. Dr D. Satcher, US Surgeon General, 2001 (foreword)<sup>54</sup>

“Many people believe that dealing with overweight and obesity is a personal responsibility. To some degree they are right, but it is also a community responsibility. When there are no safe, accessible places for children to play or adults to walk, jog or ride a bike that is a community responsibility. When school lunchrooms or office cafeterias do not provide healthy and appealing food choices that is a community responsibility. When new or expectant mothers are not educated about the benefits of breast-feeding, that is a community responsibility. When we do not require daily physical education in our schools, that is also a community responsibility . . . The challenge is to create a multi-faceted public health approach capable of delivering long-term reductions in the prevalence of overweight and obesity. This approach should focus on health rather than appearance, and empower both individuals and communities to address barriers, reduce stigmatization and move forward in addressing overweight and obesity in a positive and proactive fashion.”

### *The school approach*

In principle, schools provide an excellent setting for preventing obesity<sup>55</sup>, and are also the target of the World Health Organization’s ‘Health Promoting Schools’ programme<sup>56</sup> They offer regular contact with children during term-time and

provide opportunities for nutrition education and promotion of physical activity both within the formal curriculum, and informally via the provision of appropriate facilities within the school environment such as healthy school meals, break-time snack provision and playground equipment. Thus schools not only influence the knowledge and attitudes of children but also provide opportunities for experiential learning and the development of a sense of self-efficacy. Furthermore the school can also provide links with the family and the wider community.



### **3.0 Methodology and materials.**

#### **3.1 Study design**

A cross-sectional descriptive survey was conducted using quantitative and qualitative data in June 2004 in selected primary schools of Accra Metropolis.

#### **3.2 Variables:**

- Age
- Sex
- Weight
- Height
- BMI
- Skin fold thickness
- Socio-demographic variables: ethnicity, mother's and father's education, type of school, school fees per term, owning of a house, owning of a cooker.

#### **3.3 Sampling procedure**

A Multistage Sampling procedure was carried out in 4 stages:

1. Randomly 4 Accra sub-metros were selected from 8 sub-metros by balloting method. They were: Ablekuma South, Ayawaso, Okaikoi, Kpeshie.
2. Four public schools were randomly selected from sample frame of 56 schools in Ablekuma South sub metro, from sample frame of 71 schools in Ayawaso sub metro, from sample frame of 76 schools in

Kpeshie sub metro, from sample frame of 51 schools in Okaikoi sub metro by blind pointing on the random numbers table<sup>71</sup>, i. e. in each sampling frame ID numbers were assigned to each school (from 1 to 56 for Ablekuma South sub-metro, from 1 to 71 for Ayawaso sub-metro, from 1 to 76 for Kpeshie sub-metro, from 1-56 for Okaikoi sub-metro). Then using a table of random numbers the researcher closed her eyes and pointed with a pencil a digit on the table. That digit was used to determine the sample unit. If the selected number was not a valid number, digits were read down the column and then proceed to the upper left top until the first valid number was reached. This procedure was repeated 4 times for each of the selected sub-metro.

3. The nearest private school to the selected public school was chosen.

The aim was to enrich our sample with subjects of different (possible higher) socio-economic background living in the same area.

4. Selection of all eligible subjects in the selected schools. The following number of children was sampled per school:

Name of the sub-metro	Public schools(n)	Private schools(n)
Ablekuma South	Zion Mamprobi - 122	St Anthony - 163
Ayawaso	Kanda Estate - 152	St Paul - 164
Okaikoi	Bubiashie St Anglican- 178	New Dimension - 89
Kpeshie	Nungua AMA -162	Mandela - 93

*Sample unit:* a child of age 6-10 years attending one of the selected public or private primary school in Accra Metro.

*Study population:* Children aged 6-10 years attending primary schools in AMA.

### **3.4 Sample size determination.**

A sample size of 544 was determined based on:

Estimate of obesity prevalence among children of 3.3%,

Worst acceptable of 1.8%,

Population size of children (aged 5-9 years):  $14.6\% * 1658937 / 100\% = 243366$ ,

Confidence Interval of 95%,

In accordance with the Statcalc function of Epi Info version 3 (Centers for Diseases Control and Prevention, Atlanta, GA, USA/ WHO, Geneva, Switzerland).

This sample size was multiplied by maximum design effect for cluster sampling of 2 to give a sample of 1088.

To allow for a non-response rate of 10% and a non-participation rate of 10%, 1088 is multiplied by  $(100/100-20)$  to arrive at a sample of 1360.

### **3.5 Eligibility criteria.**

1. The child is 6-10 years old by the 01 June 2004 attending the selected primary school in Accra and is not physically deformed that it would not distort the data.

2. Obtained informed consent from one of the parents permitting their child to participate in the study.

### **3.6 Training and Pre-testing**

Two research assistants were recruited and trained using WHO recommended measurement protocols.<sup>21</sup> To standardize survey measurements and procedures, survey team was provided with a copy of the research protocol and the most relevant sections were discussed, including:

-statement of the problem;

-objectives;

-data collection technique (age, sex determination, performing height, weight, triceps skin fold thickness measurements)

-plan for data collection and handling, etc.

Before the main survey pretest study was conducted in class one of 28 pupils of Mamprobi Roman Catholic School.

The following points were assessed during the Pretest:

- Reactions of respondents to the research procedure;
- Availability of sample needed for full study;
- Whether the tools are reliable (adjustment of the questionnaire);
- Time needed for performing anthropometric measures per participant.

### **3.7 Ethical Considerations.**

Permission to proceed was obtained from Accra Metropolitan Educational Service, Head Master/Mistress of the selected schools.

The study was approved by the Ethical Review Committee of the University of Ghana Medical School and complied with the Helsinki Declaration of 1975 (revised in 1983) on human experimentation and International Ethical Guidelines for Biomedical Research Involving Human Subjects developed by the Council for International Organizations of Medical Sciences (CIOMS) in collaboration with the World Health Organization (2002)<sup>72</sup>

Following ethical issues in research design and procedures were addressed:

- Participation in the study was voluntary;
- The parents and guardians were informed about their right to refuse to take part in the study;
- There was no penalty for refusing to participate;
- Expected benefits in obtaining knowledge relevant to the health needs of children were explained.
- Procedures used in the study did not cause physical, mental, or emotional harm.
- A child refusal to participate in the research was respected.
- Subjects and their parents were informed of the findings (weight, height, BMI) and health implications were explained.
- Utmost discretion and confidentiality were exercised in handling the personal information provided.

Informed written consent was obtained from one of the parents/ guardians before the child participated in the study (Appendix 3).

### **3.8 Data Collection, Management and Analysis**

The self-administered questionnaire on demographic and socioeconomic status and the consent form were distributed to the parents through the children 1-2 days before anthropometric measurements.

Anthropometrical measures were taken in the morning in the school premises on subject in light clothing and without shoes by direct observation. Weight was measured with a Seca770 floor digital scale (Seca, Hamburg, Germany) to the nearest 0.1 kg. It was ensured that the reading was always zero before subjects stepped on the scale. Height was measured with a stadiometer to the nearest 0.5 cm. This was placed on a flat floor at each site with subjects standing on the base of the stadiometer with feet together and back of head, back of buttocks, calves and heels all touching the upright. Subjects were then instructed to look straight at spot with head high on the opposite side. Triceps skin fold thickness was measured with skin fold calipers FAT-O-METER (Health and Education Services, Chicago, III) to the nearest 0.5 mm. It was measured in the midline of the posterior aspect of the arm at a level midway between the lateral projection of the acromion at the shoulder and the olecranon process at the ulna which was determined using a tape measure. A vertical fold of skin and subcutaneous tissue was picked up gently approximately 1cm proximal to the marked level, and the tips of the calipers were applied perpendicular to the skin fold at the marked level.

Age by 01 June 2004 was determined from the school records based on the date of birth.

### **Quality control checks.**

Quality control checks were performed for completeness of entries and internal consistency by principal investigator before leaving the school. On-going supervision of research assistants was arranged. The weighing scale was checked against two reference scales each morning before commencement of weighing.

### **Data processing and analysis.**

All data forms were entered using Epi Info 6 and were checked for range and internal consistency. Body Mass Index (BMI) was determined as  $WEIGHT / HEIGHT^2$  (kg/m<sup>2</sup>).

The height, weight, triceps skin fold thickness and BMI percentiles were calculated against the international growth reference (CDC 2000 Epi Info Nutrition program). Nutritional status was classified as follow: those with BMI scores  $\geq 85^{th}$  and  $< 95^{th}$  percentile were considered at risk of overweight and those with BMI scores  $\geq 95^{th}$  percentile were considered obese, those with BMI scores  $\leq 5^{th}$  percentile were considered underweight, those with BMI  $> 5$  and  $< 85$  percentile were considered normal. Nutrition programme, Epi Info, Version 6 (CDC, Atlanta, GA, USA/WHO, Geneva Switzerland) and the statistical package SPSS 10,0 for Windows (SPSS, Inc., Chicago, IL, USA) were used for analysis. Statistical tests included the Chi square test for discrete variables and student's t-

test for normally distributed data. Results were considered statistically significant if  $p\text{-value} < 0.05$ .

### **3.9 Limitations of the study.**

As a result of limited logistics and time the survey was limited to children attending primary schools excluding out of school children which could limit generalization of results. The self-administered questionnaires which was giving out to the parents resulted in lower response rate on socio-demographic status of the children. The prevalence of obesity in the analysis was not age and sex specifically adjusted as the age range in the sample was too small.



**4.0 Results.**

In total 1123 children (584(52%) females and 539(48%) males) aged 6-10 years took part in the study from 1<sup>st</sup> to 30<sup>th</sup> June 2004 in Accra Metropolis. There were however, 912 questionnaires on socio-economic status available for further analysis.

**General characteristics of the study population.**

The survey was carried out in the 8 primary schools in Accra. Sex distribution in the schools did not differ significantly ( $p=0.057$ ).

Table1 shows the name, type, school fees per term of selected for study schools.

**Table 1. Characteristics of participated schools.**

Area	Public		Private	
	Name of the school	School fees per term (¢)	Name of the school	School fees per term (¢)
Mamprobi	Mamprobi Zion	53,000	St. Anthony	780,000
Bubiashie	St. Joseph Anglican	55,000	New Dimension	370,000
Kanda	Kanda Estate	13,500	St. Paul	800,000
Nungua	Nungua AMA	13,500	Mandela	530,000

Table 2 shows the mean  $\pm$  SD of age, weight, height, skin fold thickness and BMI for males and females. Mean weight as well as mean BMI and mean skin fold thickness in male subjects were significantly lower than that of female subjects. Also girls appear to be taller than boys.

**Table 2. Mean value  $\pm$  standard deviations of selected variables of the study population.**

Gender	Mean age (years)	Mean weight (kg $\pm$ SD)	Mean height (cm $\pm$ SD)	Mean skin fold (mm $\pm$ SD)	Mean BMI (kg m <sup>-2</sup> $\pm$ SD)
males(539)	8.43 $\pm$ 1.2*	26.8 $\pm$ 5.1*	128.3 $\pm$ 8.6*	6.76 $\pm$ 3.5*	16.1 $\pm$ 1.7*
females(584)	8.41 $\pm$ 1.2*	28.3 $\pm$ 6.7*	130.0 $\pm$ 9.1*	9.61 $\pm$ 4.9*	16.5 $\pm$ 2.2*
Total (1123)	8.42 $\pm$ 1.2*	27.6 $\pm$ 6.0*	129.2 $\pm$ 8.9*	8.24 $\pm$ 4.5*	16.3 $\pm$ 2.0*

\* p = 0.00

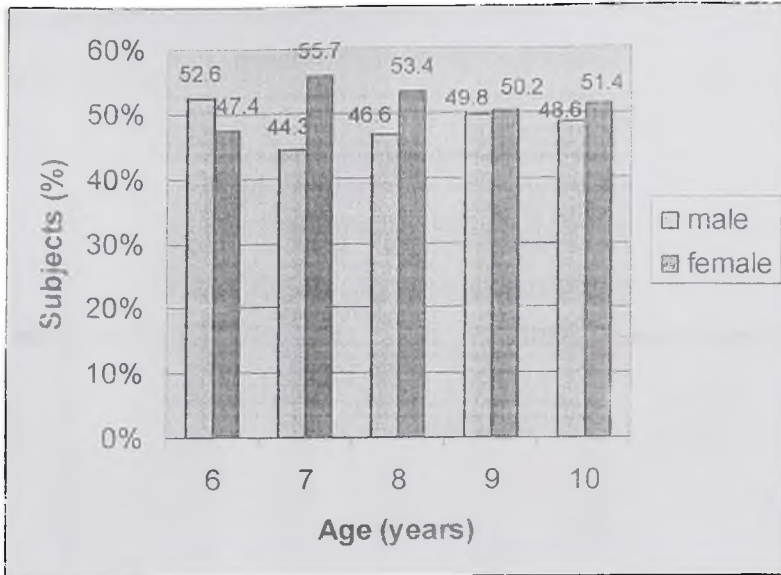


Figure1 represents gender distribution in the sample by ages. There was no statistical difference in distribution of sexes between age groups (\*p 0.681). Sex ratio female/ male in the sample was

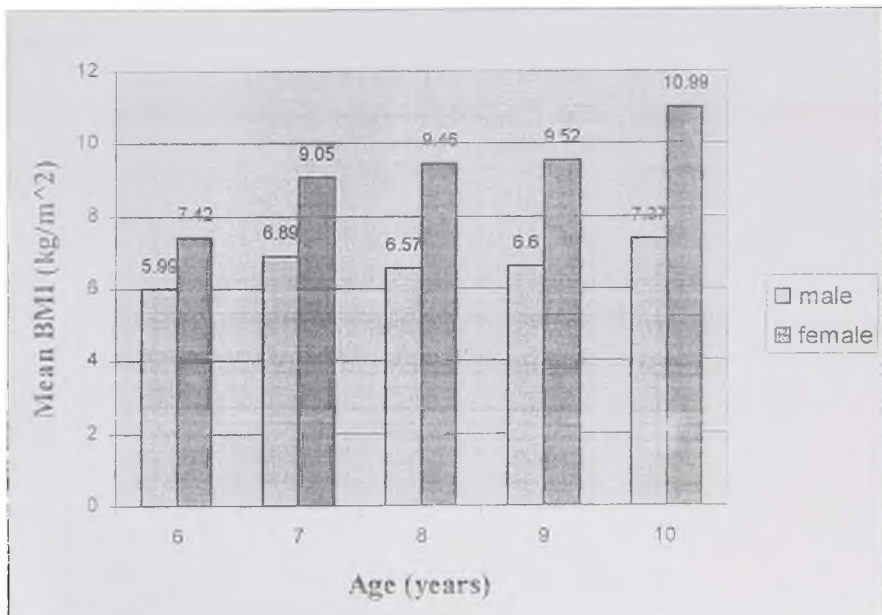
1.1 :1

Mean BMI distribution by gender and age is shown in Figure 2. Girls appear to be "heavier" in all age groups except in the 6 years group where mean BMI for males was higher. Generally, BMI increased with age.

**Figure 1. Gender distribution by age.**



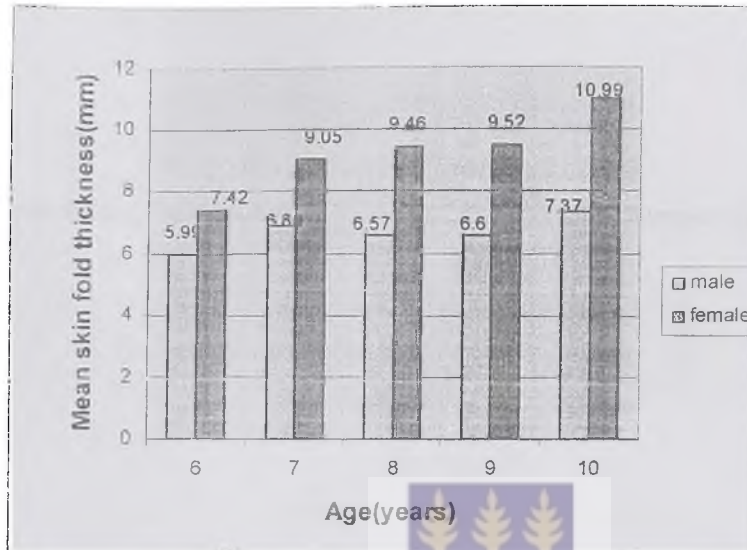
**Figure 2. Distribution of mean BMI by gender and age.\***



\*p = 0.00

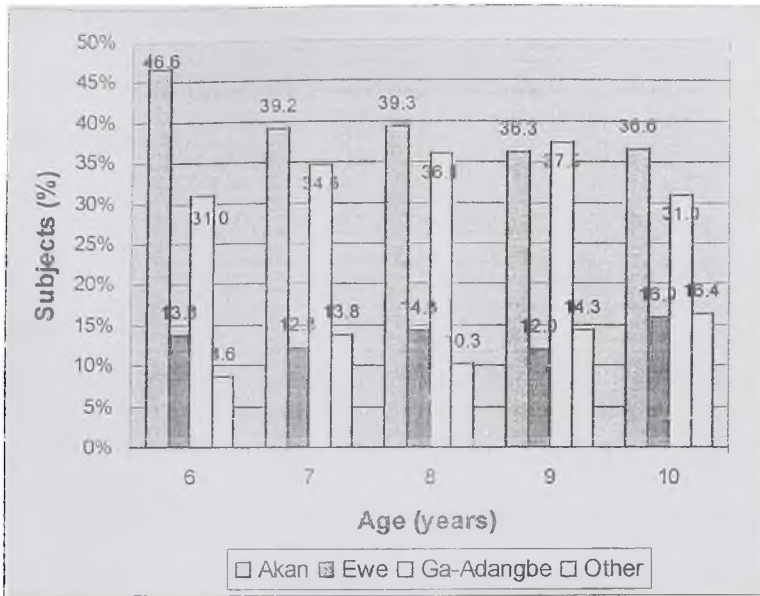
Figure 3 shows the distribution of mean skin fold of boys and girls by age group. In girls, skin fold thickness increased with age. The pattern was less clear in boys.

**Figure 3. Mean skin fold thickness distribution by gender and age\*.**



\* $p=0.00$

The age distribution by ethnic group is shown in Figure 4. Akan and Ga-Adangbe were predominant groups.

**Figure 4. Ethnic distribution by age.**

Figures 5 and 6 show weight for age on CDC curves of all females and males respectively (CDC 2000 Reference, Nutrition, Epi Info). The weight was normally distributed for both gender and ranged from 14.4 kg to 59.3 kg among girls and from 16.4kg to 50.1kg among boys. The median for females and males were 27.1 kg and 26.8kg, respectively. The respective modes for females and males were 27.2kg and 23.3kg.

Figures 7 and 8 show BMI on CDC curves of female and male subjects (CDC 2000 Reference, Nutrition, Epi Info). The BMI was normally distributed for both gender and ranged from 11.9 kg/m<sup>2</sup> to 28.6 kg/m<sup>2</sup> among girls and from 12.1kg/m<sup>2</sup>-25.0 kg/m<sup>2</sup> among boys. The median for females and males were 16.1

kg/m<sup>2</sup> and 15.9 kg/m<sup>2</sup>, respectively. The respective modes for females and males were 15.48 kg/m<sup>2</sup> and 16.6 kg/m<sup>2</sup>

Table 3 shows the distribution of ethnicity by gender. There was no significant difference in distribution of ethnic groups by gender and age groups.

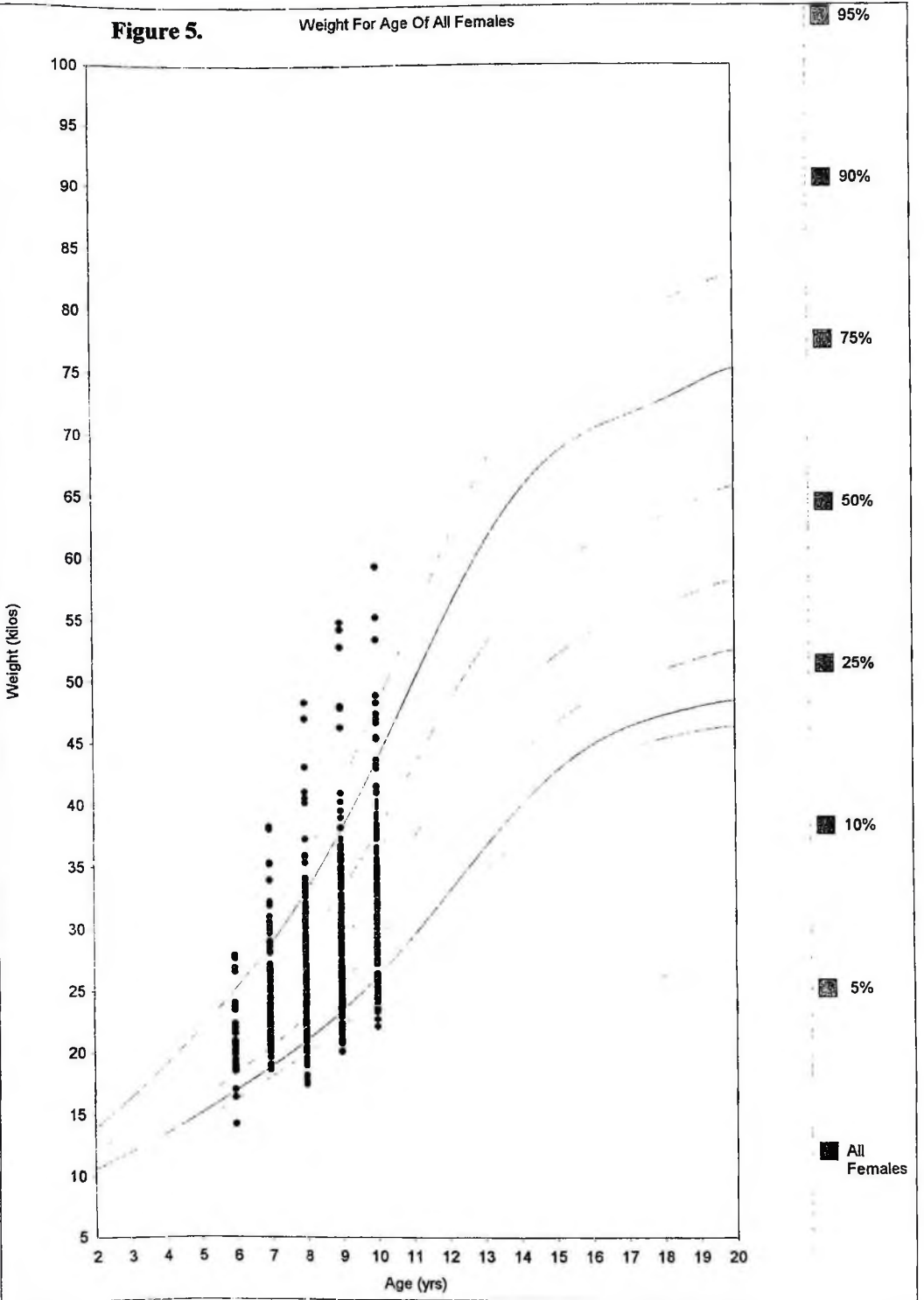
**Table 3. Distribution n (%) of ethnic groups by age and gender.**

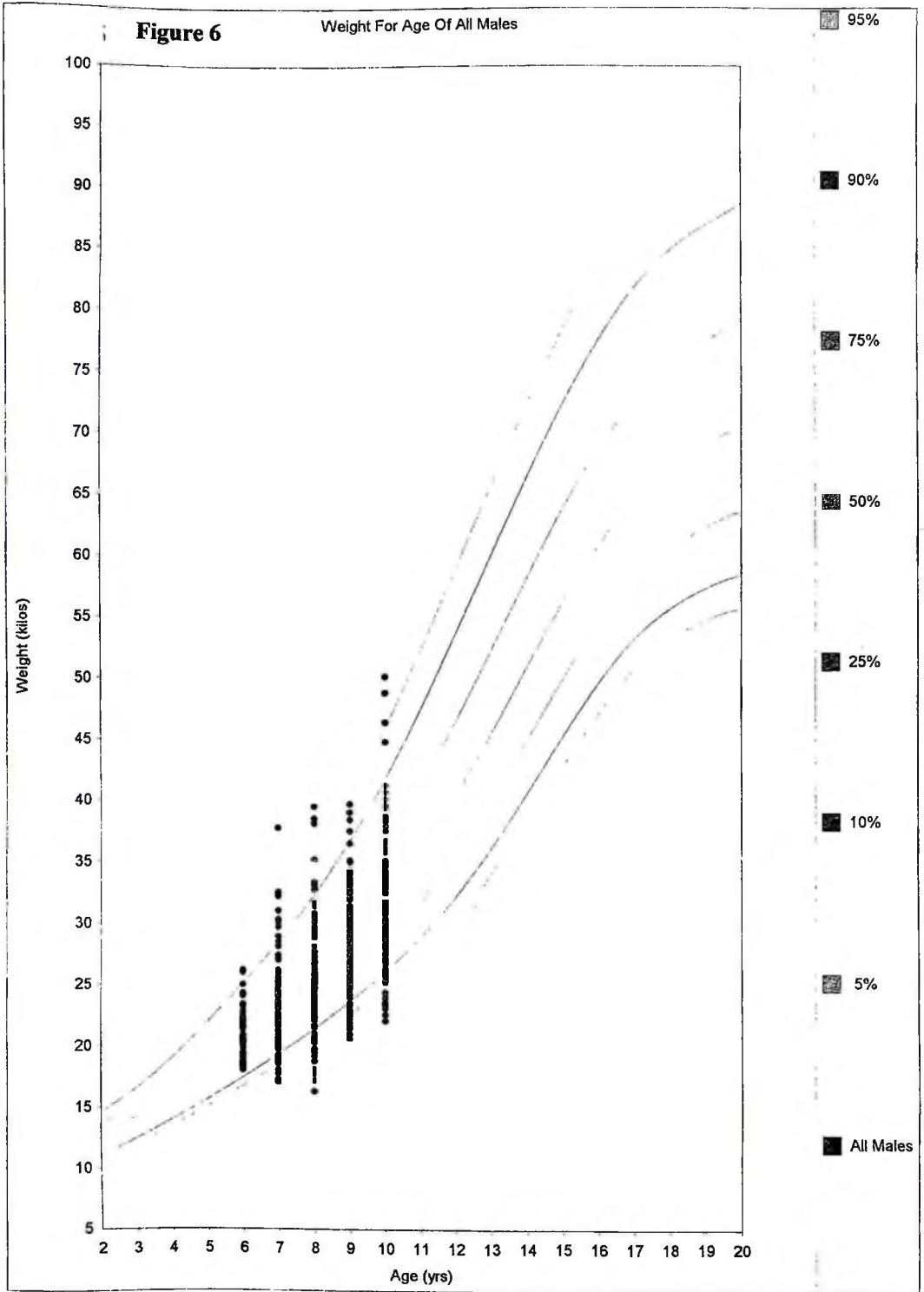
		Akan	Ewe	Ga- Adangbe	Other
Male*	Age				
	6	10(35.7)	6(21.4)	10(35.7)	2(7.1)
	7	28(47.5)	6(10.2)	20(33.9)	5(8.5)
	8	43(36.1)	15(12.6)	48(40.3)	13(10.9)
	9	46(36.2)	16(12.6)	46(36.2)	19(15.0)
	10	33(32.4)	18(17.6)	34(33.3)	17(16.7)
All males		160(36.8)	61(14.0)	158(36.3)	56(12.9)
Female**					
	6	17(56.7)	2(6.7)	8(26.7)	3(10.0)
	7	23(32.4)	10(14.1)	25(35.2)	13(18.3)
	8	56(42.1)	21(15.8)	43(32.3)	13(9.8)
	9	48(36.4)	15(11.4)	51(38.6)	18(13.6)
	10	45(40.0)	16(14.4)	32(28.8)	18(16.2)
All females		189(39.6)	64(13.4)	159(33.3)	65(13.6)

\* p 0.631 \*\*p 0.483

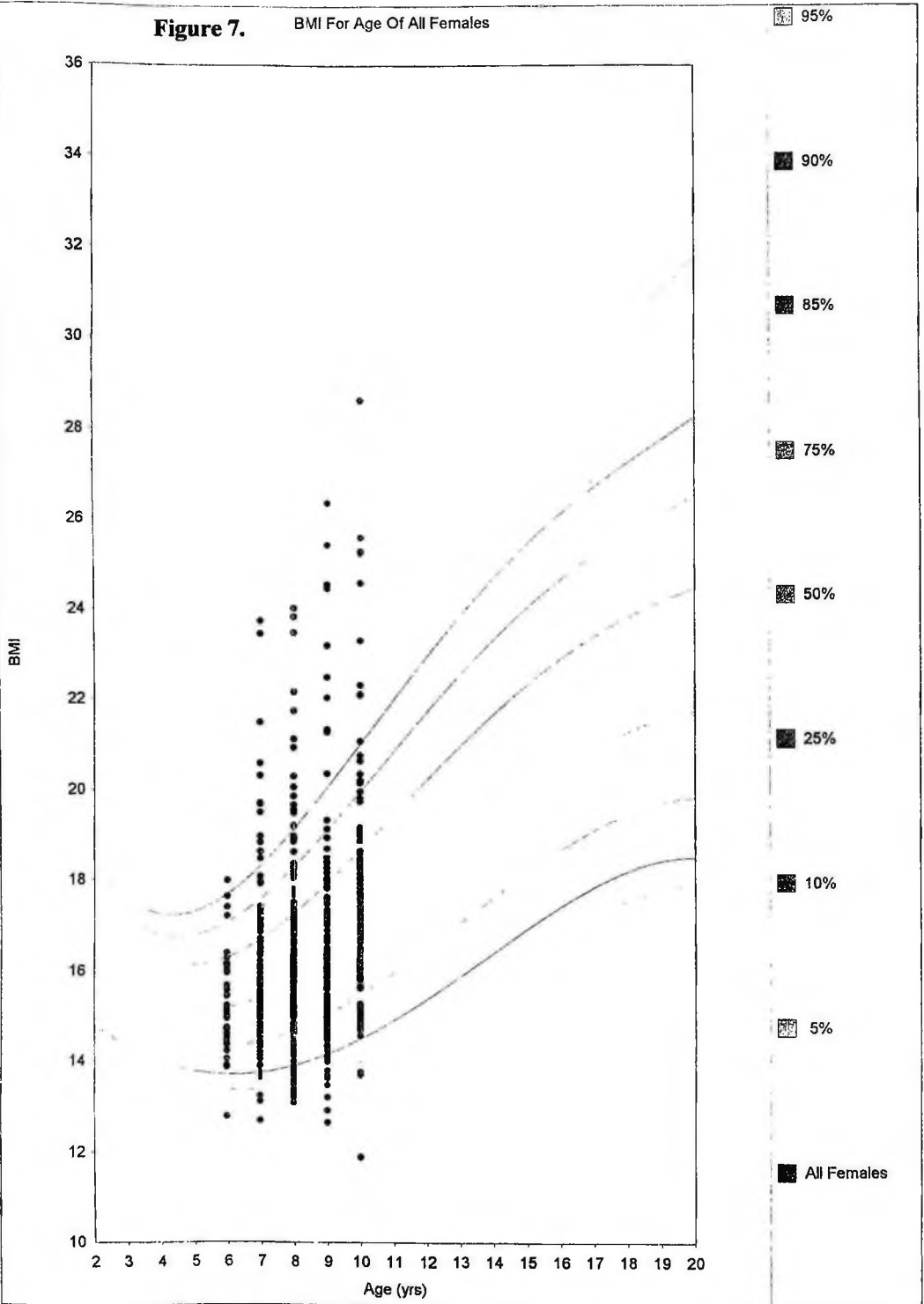
**Figure 5.**

Weight For Age Of All Females





**Figure 7.** BMI For Age Of All Females



**Figure 8.**

BMI For Age Of All Males

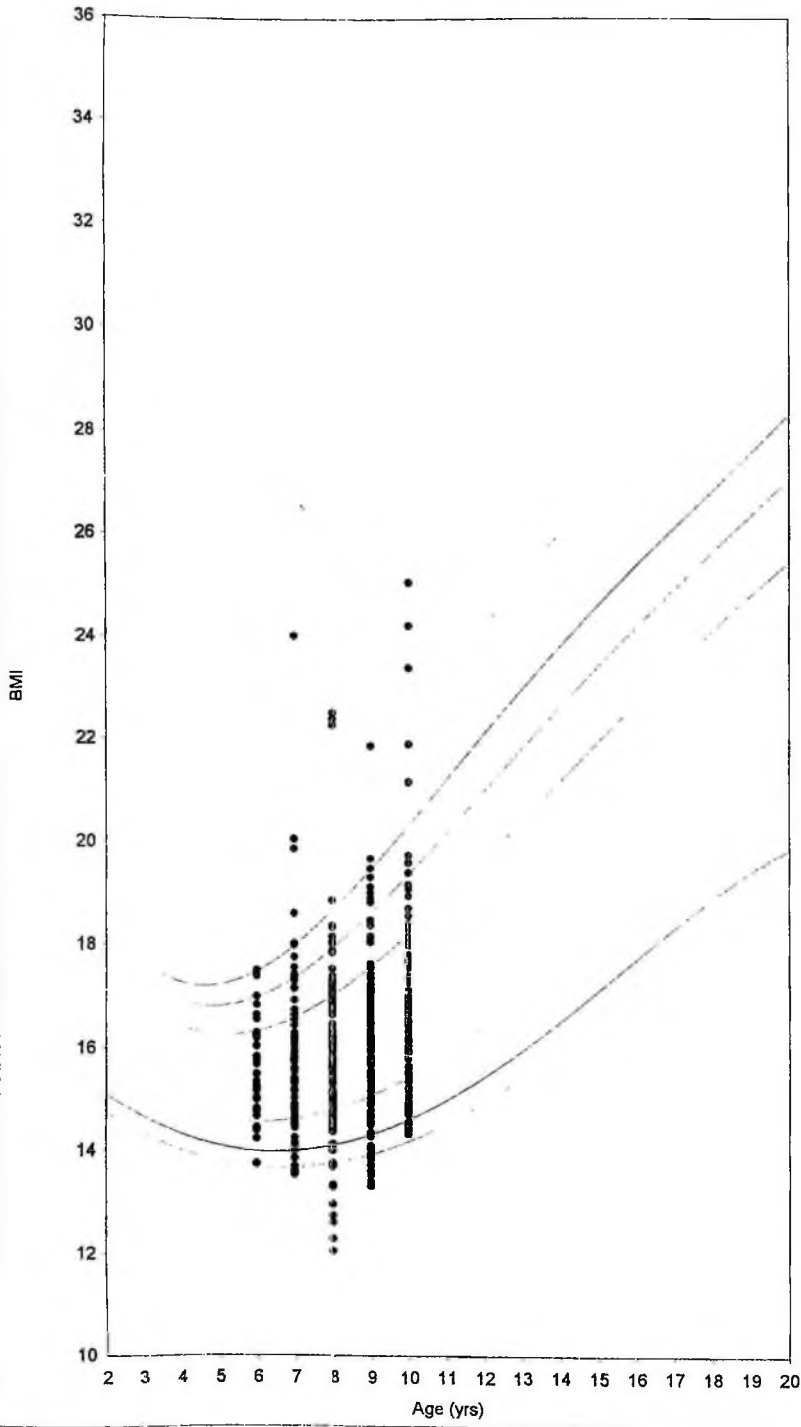
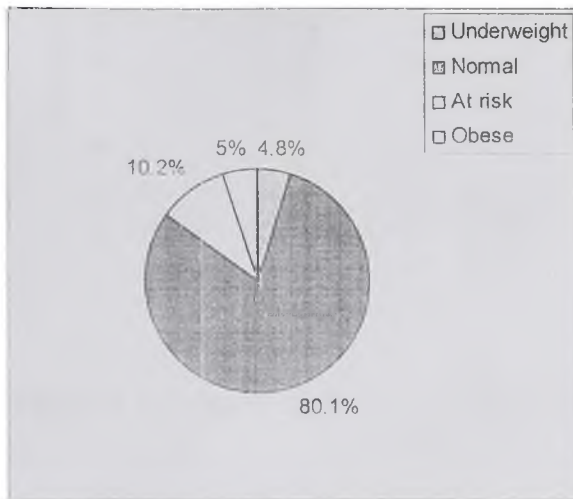


Figure 9 shows distribution of BMI categories in the study population.

The corresponding crude prevalence of obesity by CDC 2000 reference criteria was 3.4% (95%CI 2.4%- 4.7%). The corresponding crude prevalence at risk of overweight was 7% (95% CI 5.6%-8.7%). The prevalence of underweight by CDC criteria was 3.7% (95%CI 2.7%-5.1%).

**Figure 9. Nutritional status of primary school children in Accra.**

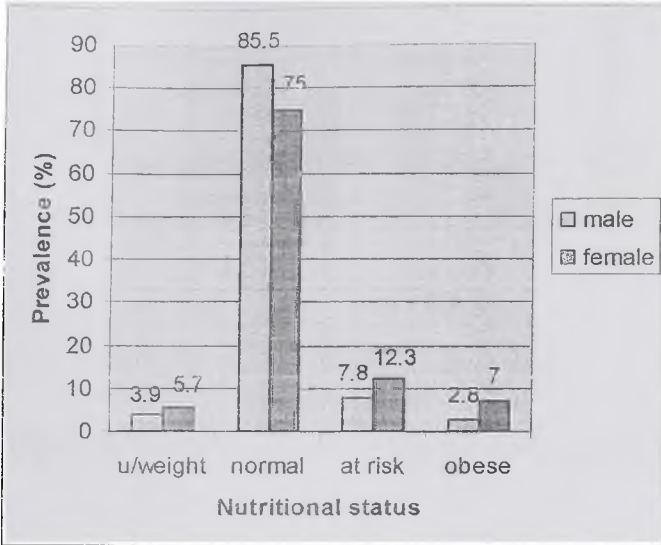


Figures 10 and 11 present gender specific distribution of BMI in the sample and by CDC 2000 reference criteria. According to these figures the rate of obesity and risk of overweight as well as underweight was higher in females than males ( $p = 0.000$ ).

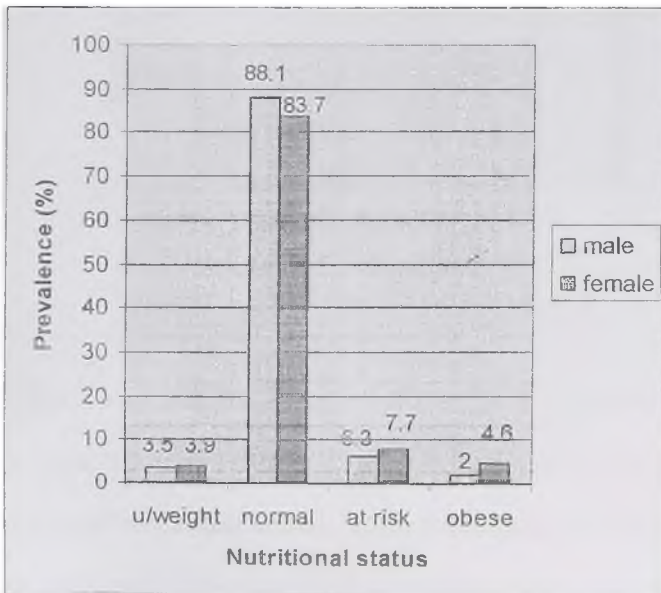
The Figures 12 and 13 show distribution of BMI categories by age in each gender. The highest prevalence of obesity and risk of overweight in females occurred in the 10 years group. In males, 7 years group had the highest prevalence of obesity and 10 years group had the highest risk of overweight. There were no obese subjects in the youngest age group in both genders. In contrast there were no

underweight boys in 10 years group Highest rates of underweight were observed in 8 years group in males and 7 years group in females.

**Figure 10. Distribution BMI categories by gender.**



**Figure 11. Distribution BMI categories by gender by CDC criteria.**



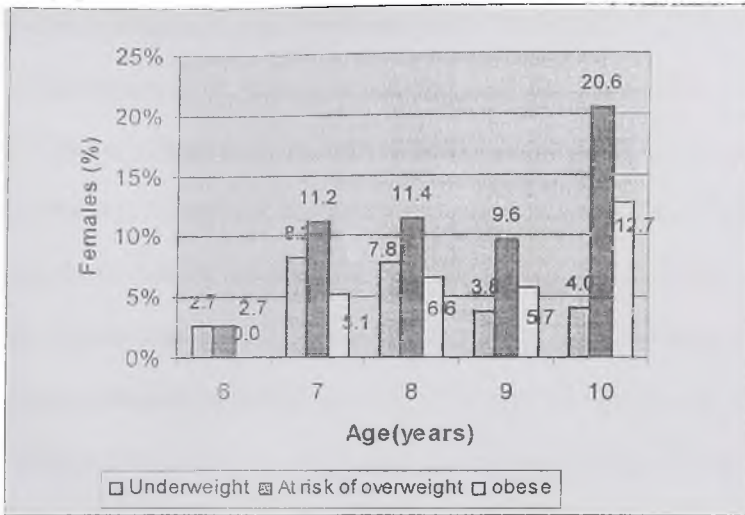
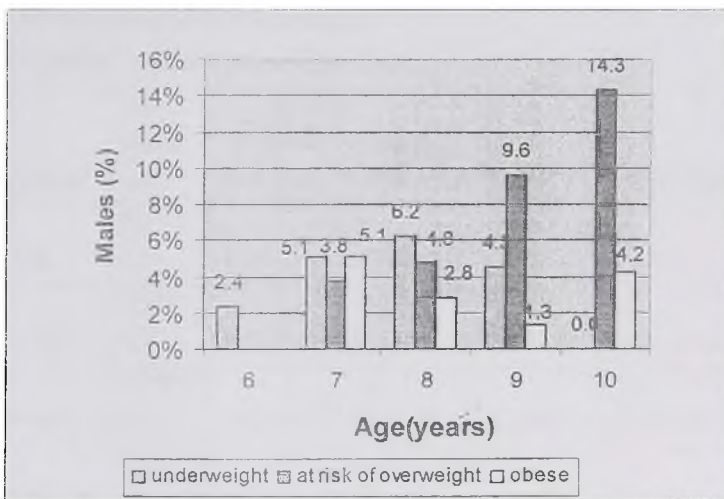
**Figure 12. Distribution of BMI categories by age in girls.****Figure 13. Distribution of BMI categories by age in boys.**

Table 4 represents distribution of means  $\pm$  SD of the selected variables by schools. The lowest number of subjects (7.9%) was in Bubuashie private school, followed by Mandela private (8.3%), among public schools the lowest proportion of participants was in Mamprobi Zion school (10.9%). Kanda Estate school had

the highest mean weight (29.8kg) and the highest mean height (134.3cm).

Subjects of Bubiashie St. Joseph school had the lowest mean BMI (15.6kg/m<sup>2</sup>)

while subjects of St. Anthony school had the highest mean BMI

(17.2kg/m<sup>2</sup>). Children of St. Anthony school also had the highest mean skin fold

thickness (17.2mm) and the lowest mean of skin fold thickness was noticed in

Mamprobi Zion school. Prevalence of obesity reflects distribution of mean BMI:

the highest proportion of obese children was at St. Anthony school (12.3 %),

closely followed by St.Paul school (12.2%) and none of the participants at

Nungua AMA school was obese followed by Bubiashie St. Joseph school where

obesity prevalence was 0.6%.

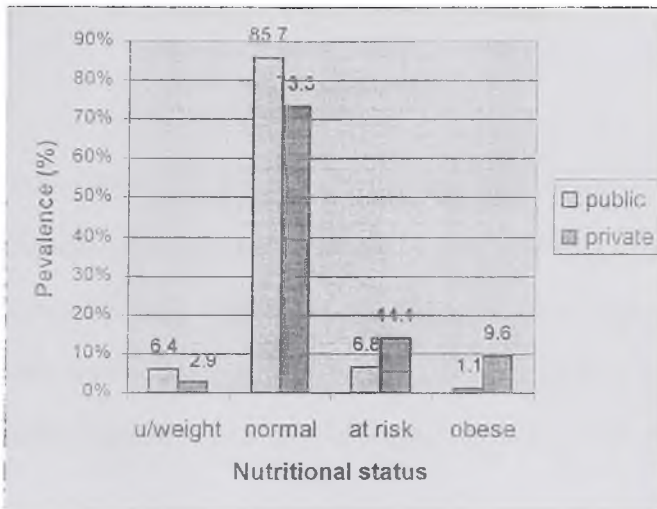
**Table 4. Distribution of means ± SD of selected variables and obesity prevalence by schools (p=0.00)**

Variables	Mean values ±SD							
School	Zion Mamp robi	Bubiashie StAnglcan	Kanda Estate	Nungua AMA	St Anthony	New dimension	St.Paul	Mandel
Age	8.5 ± 1.2	8.2 ± 1.1	8.9 ± 1.1	8.5 ± 1.2	8.5 ± 1.1	8.5 ± 1.3	8.0 ± 1.2	8.4 ± 1.1
Weight	26.5 ± 5.4	24.2 ± 4.2	29.8 ± 5.9	24.7 ± 4.1	29.6 ± 7.0	28.9 ± 7.1	28.9 ± 6.8	28.2 ± 5.4
Height	128.6 ± 9.4	125.7 ± 6.9	134.3 ± 9.8	125 ± 7.3	130.6 ± 8.3	130.7 ± 9.4	129.9 ± 8.3	130.6 ± 8.3
Skin fold	5.9 ± 2.2	7.2 ± 2.3	7.7 ± 3.3	6.1 ± 2.4	11.2 ± 5.6	8.7 ± 5.5	10.4 ± 5.8	8.6 ± 4.4
BMI	15.9 ± 1.4	15.6 ± 1.7	16.4 ± 1.6	15.7 ± 1.3	17.2 ± 2.4	16.7 ± 2.2	16.9 ± 2.7	16.4 ± 1.7
%obese	1.6	0.6	2.6	0	12.3	6.7	12.2	3.2
N(%) subjects	122 (10.9)	178(15.9)	152(13.5)	162(14.4)	163(14.5)	89(7.9)	164 (14.6)	93(8.3)

Figures 14 and 15 show the distribution of BMI by the type of school.

Prevalence of obesity and risk of overweight were higher in the private schools 9.6% (CDC 7.1%) and 14.1% (CDC 10.8%), respectively than that in the public schools where prevalence of obesity was 1.1% (CDC 0.3%) and risk of overweight was 6.8%(CDC 3.9%). Opposite pattern was noticed in distribution of underweight: the prevalence was higher in the public schools 6.4% (CDC 5%) and that for private 2.9% (CDC 2.2%).

**Figure 14. Distribution of BMI categories by the type of school**



**Figure 15. Distribution of BMI categories by the type of school by CDC criteria.**

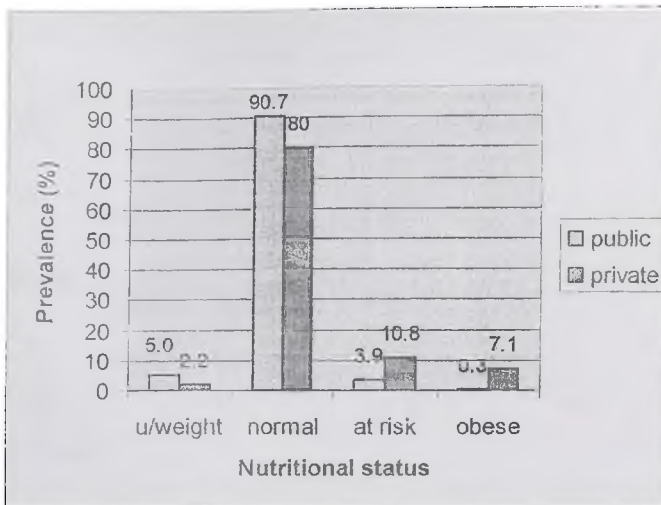


Table 5 shows distribution of BMI categories by gender and type of schools.

Females were more obese than boys in both public and private schools. There were more obese subjects in the private schools than in public schools. There were more underweight girls than boys in both type of schools and more underweight subjects in the public schools than in private schools.

**Table 5. Distribution of BMI categories by sex and type of school by CDC**

criteria\*

Gender/School	Distribution of BMI categories N (%)				Total
	u/weight	normal	at risk	obese	
Male					
Private	5(2.1)	200(84.4)	21(8.9)	11(4.6)	237(100)
Public	14(4.6)	275(91.1)	13(4.3)	0(0)	312(100)
Female					
Private	6(2.2)	207(76.1)	34(12.5)	25(9.2)	272(100)
Public	17(5.4)	282(90.4)	11(3.5)	2(0.6)	312(100)
Total	42(3.7)	964(85.9)	79(7.0)	38(3.4)	1123(100)

\*p&lt;0.001.

Table 6 represents distribution of BMI categories by paid school fees.

The highest prevalence of obesity and at risk of overweight was in the schools with the highest charge rate. Schools with the lowest charge rate had the highest underweight prevalence.

**Table 6. Distribution of BMI categories by school fees category\*.**

School fees per term	Distribution of BMI categories n (%)				Total
	u/weight	normal	at risk	obese	
≤55,000	39(6.4)	526(85.7)	42(6.8)	7(1.1)	614(100)
>55,000 - ≤ 530,000	5(2.7)	145(79.7)	23(12.6)	9(4.9)	182(100)
>530,000	10(3.1)	228(69.7)	49(15)	40(12.2)	327(100)
Total	54(4.8)	899(80.1)	114(10.2)	56(5.0)	1123(100)

\* p =0.000

Ethnicity by BMI categories are given in Table 7.

Underweight was least prevalent among Akan ethnic group. Obesity and risk of overweight prevalence were highest among Akan and Ewe tribes.

**Table 7. Distribution of BMI categories by ethnic affiliation\*.**

Ethnicity	Distribution of BMI categories N (%)				
	Underweight	Normal	At risk of overweight	Obese	Total
Akan	10(2.9)	270(77.4)	39(11.2)	30(8.6)	349
Ewe	4(3.2)	97(77.6)	17(13.6)	7(5.6)	125
Ga-Dangbe	16(5)	258(81.4)	28(8.8)	15(4.7)	317
Other	11(9.1)	94(77.7)	15(12.4)	1(0.8)	121

Pearson Chi-square test 21.666<sup>a</sup> df 9 \*p 0.01

Table 8 shows distribution BMI categories by father’s educational level. Obesity

and at risk of overweight prevalence was higher in subjects whose father had

tertiary education. Children of fathers with primary/ middle education had the

highest underweight prevalence. Obesity rates tended to increase with increase of

father’s level of education.

**Table 8. Distribution of BMI categories by level of father’s education\*.**

Father’s education	Distribution of BMI categories N (%)				
	Underweight	Normal	At risk of overweight	Obese	Total
No formal education	1(2.3)	42(95.5)	1(2.3)	0	44(100)
Primary/middle	10(5.1)	166(84.3)	18(9.1)	3(1.5)	197(100)
Secondary/ Technical	19(3.9)	384(79)	51(10.5)	32(6.6)	486(100)
Tertiary	5(3.4)	104(70.3)	25(16.9)	14(9.5)	148(100)
Total	35(4)	696(79.5)	95(10.9)	49(5.6)	875(100)

Pearson Chi-square 33.942<sup>a</sup> df 9 \*p= 0.002

Mother's educational level by BMI categories is shown in Table 9.

Children of mothers who had tertiary education had the highest obesity and at risk of overweight prevalence. The highest proportion of underweight children was among mothers with no formal education.

**Table 9. Distribution of BMI categories by level of mother's education**

Mother's education	Distribution of BMI categories N (%)				
	Underweight	Normal	At risk of overweight	Obese	Total
No formal education	5(4.7)	89(84)	9(8.5)	3(2.8)	106(100)
Primary/middle	15(4.5)	282(84.4)	28(8.4)	9(2.7)	334(100)
Secondary / Technical	16(4.2)	281(74.5)	49(13.0)	31(8.2)	377(100)
Tertiary	1(2)	36(73.5)	7(14.3)	5(10.2)	49(100)
Total	37(4.3)	688(79.4)	93(10.7)	48(5.5)	866(100)

\*Pearson Chi-square 32.220<sup>a</sup> df 9 p=0.013

Table 10 represents nutritional status of children whose parents own or not own the house, cooker. The highest prevalence of obesity was among "owners" than that among "non-owners" By contrast, "non-owners" had the highest prevalence of underweight than "owners"

**Table 10. Distribution of BMI categories by possession of the house\* and cooker\*\***

House owner	Distribution of BMI categories N (%)				Total
	Underweight	Normal	At risk of overweight	Obese	
No	44(5.7)	628(80.8)	77(9.9)	28(3.6)	777
Yes	10(2.9)	271(78.3)	37(10.7)	28(8.1)	346
<b>Possession of a cooker</b>					
No	22(6.0)	309(84.2)	28(7.6)	8(2.2)	367(100)
Yes	18(3.3)	405(75.0)	72(13.3)	45(8.3)	540(100)

\*Pearson Chi square 13.833<sup>a</sup> df 3 \*p 0.003

\*\*Pearson Chi square 26.463<sup>a</sup> df 3 \*\*p 0.000

Table 11 represents reliability of skin fold thickness in measuring of obesity: prevalence of obesity using skin fold thickness was 5.3% and that using BMI was 5%. There was good agreement between BMI and skin fold thickness (Kappa 0.636) and there was strong positive association between these two indices ( $r = 0.702$ ).

**Table 11. Agreement between BMI and skin fold thickness in diagnosing of obesity.**

<b>BMI \ Skin fold</b>	<b>Obesity present (n)</b>	<b>No obesity (n)</b>	<b>Total n (%)</b>
<b>Obesity present (n)</b>	38	18	56(5)
<b>No obesity (n)</b>	22	1045	1067(95)
<b>Total n (%)</b>	60(5.3)	1063(94.7)	1123(100)

Kappa 0.636 p = 0.000

Table 12 shows linear relationships between age, weight, height, BMI and skin fold thickness. There was also strong positive association between skin fold

thickness and weight ( $r = 0.628$ ) and positive but weak association with age ( $r = 0.118$ ) and height ( $r = 0.299$ ). BMI was also positively associated with age ( $r = 0.204$ ).

Weight and height were strongly associated with age ( $r = 0.516$  and  $r = 0.647$ ).

**Table 12. Correlation between age, BMI and skin fold thickness.**

		BMI	AGE	Skin fold thickness	WEIGHT	HEIGHT
BMI	Pearson Correlation	1	.204	.702	.793	.345
	Sig. (2-tailed)	.	.000	.000	.000	.000
AGE	Pearson Correlation	.204	1	.118	.516	.647
	Sig. (2-tailed)	.000	.	.000	.000	.000
Skin fold thickness	Pearson Correlation	.702	.118	1	.618	.299
	Sig. (2-tailed)	.000	.000	.	.000	.000
WEIGHT	Pearson Correlation	.793	.516	.618	1	.826
	Sig. (2-tailed)	.000	.000	.000	.	.000
HEIGHT	Pearson Correlation	.345	.647	.299	.826	1
	Sig. (2-tailed)	.000	.000	.000	.000	.

Tables 13 and 14 represent partial correlation between weight, height, BMI and skin fold thickness controlling for age and sex. There was also strong positive correlation between skin fold thickness and BMI, skin fold thickness and weight.

**Table 13. Partial correlation between weight, height, BMI and skin fold thickness, controlling for age.**

		Weight	Height	BMI	Skinfold thickness
Weight	Coefficient	1.0000	.7534	.8201	.6558
	Sig.(2-tailed)		P= .000	P= .000	P= .000
Height	Coefficient	.7534	1.0000	.2849	.2950
	Sig.(2-tailed)	P= .000		P= .000	P= .000
BMI	Coefficient	.8201	.2849	1.0000	.6977
	Sig.(2-tailed)	P= .000	P= .000		P= .000
Skinfold thickness	Coefficient	.6558	.2950	.6977	1.0000
	Sig.(2-tailed)	P= .000	P= .000	P= .000	

**Table 14. Partial Correlation between weight, height, BMI and skin fold thickness, controlling for sex.**

		Weight	Height	BMI	Skinfold thickness
Weight	Coefficient	1.0000	.8246	.7903	.6142
	Sig.(2-tailed)		P= .000	P= .000	P= .000
Height	Coefficient	.8246	1.0000	.3383	.2862
	Sig.(2-tailed)	P= .000		P= .000	P= .000
BMI	Coefficient	.7903	.3383	1.0000	.7097
	Sig.(2-tailed)	P= .000	P= .000		P= .000
Skinfold thickness	Coefficient	.6142	.2862	.7097	1.0000
	Sig.(2-tailed)	P= .000	P= .000	P= .000	

## 5. Discussion.

In the present descriptive cross-sectional survey data is presented on burden of overweight and underweight in primary school children in Accra the most urbanized area in the country. The study also provides useful baseline data on socio-demographic aspects of obesity in older children (5-10 years). Most of the available data that do exist are collected for pre-school children and focus on malnutrition. It is notable that over nutrition and nutrition-related chronic diseases are on the increase in developing countries due to changes in life style with altered diet and diminished physical activity. The study in Accra found growing problem of obesity and overweight in adults.<sup>64</sup> Overall crude prevalence of obesity and overweight was 14.1% and 23.4%, respectively. Obesity generally tracks from childhood into adulthood<sup>39, 41</sup>. It is probable that similar factors are linked to the risk of overweight in children; for example, a decline in walking to school and a rise in snack food consumption and the popularity of fast foods outlets.

The present study revealed that overall crude prevalence of obesity and at risk of overweight in primary school children in Accra was 5% and 10.2%, respectively. That corresponds with findings of recent study conducted among pre-school children from 24 Sub Saharan countries.<sup>28</sup> The prevalence of obesity was below 5% in all countries, except Malawi. It is interesting to notice that prevalence of underweight was almost the same as obesity 4.8%. The proportions of obese and at risk of overweight children by CDC criteria<sup>22</sup> was less than ones derived from the sample percentiles 3.4% and 7%, respectively. This discrepancy may be

attributed to the fact that curves come from more affluent American population with a high prevalence of obesity (15%)<sup>54</sup>.

Despite growing concern about weight related problems among children no universally accepted classification system for childhood obesity exist, although the choice of BMI as a measure is fairly established<sup>19</sup>. But number of problems associated with BMI as a measure of adiposity in childhood. In children BMI varies with age and sex, maturation patterns also influence these variations. In addition, increases in BMI during childhood growth seem to be attributable mainly to muscular gains, unlike in adults where adiposity gains dominate<sup>70</sup>. It has been recommended that BMI use requires additional measures to confirm excess body fat. In this study skin fold thickness was chosen as an additional measure of fatness. Overall prevalence of obesity by skin fold thickness distribution was 5.3% and that using BMI was 5%. There was good agreement between BMI and skin fold thickness (Kappa 0.636) and there was strong positive association between these two indices ( $r$  0.702). There was also strong positive association between skin fold thickness and weight ( $r$  0.628) and positive but weak association with age ( $r$  0.118). BMI was also positively associated with age ( $r$  0.204). These two indices may be recommended for future growth monitoring programs in Ghana

From the present study the percentage of obese and at risk of overweight girls was more than twice that of boys (7% verse 2.8%). It matches with findings of the study<sup>64</sup> on adults, where female were more obese and overweight than males.

Obesity prevalence in females was higher in all age group than that in males except 6 years group.

In both genders subjects from private were more at risk of excessive weight gain than their counterparts from the public schools. Prevalence of obesity and at risk of overweight in the private schools was 9.6% and 14.1% and that for public schools was 1.1% and 6.8%. Using the type of school (private or public) and amount of school fees paid as a proxies of economic status, my findings confirm that overweight is high among the rich in lower income countries<sup>27</sup>. This is contrary to reports from Western world, where subjects from affluent families tend to have lowest rates of obesity than do have subjects from less affluent families. In contrast, underweight was relatively higher in the public schools compared to private schools (6.4% verse 2.9%). Among possible reasons accountable for high obesity rates in children from higher social background may be riding in cars to schools and other places, watching video games and therefore less physically active, they are more likely to afford fast food and drinks.

Looking at possible socio-demographic determinants of obesity it is interesting to note that obesity was highest in Akans (8.6%) and the risk of overweight was highest in Ewes (13.6%) and Akans (11.2%). The observed differences presumably lie in dietary and cultural pattern of people concerned. Further research is however needed to confirm these findings and to ascertain reasons for the ethnic differences. Subjects whose father had tertiary education tended to be more obese or overweight. Prevalence of obesity and at risk of overweight in this

group were 9.5% and 16.9%, respectively. Prevalence of underweight was highest in subjects whose father had only primary education (5.1%).

Similar trends were observed in distribution of BMI categories among mothers with respect of level of education. Mothers with tertiary education tended to have more obese children (10.2%) and children at risk of overweight (14.3%). In contrast, mothers without formal education had more underweight children.

## **6. Conclusion and Recommendations**

### **6.1 Conclusion**

Obesity does not appear to be a major problem in primary school children in Accra. The study however provides useful baseline information for future monitoring of trends. A significant number, a tenth of the children, were in the at risk of overweight category. There was co-existence of obesity and underweight in primary school children. Economic status appeared to be an important determinant of nutritional status. Subjects in private schools had higher rates of overweight and obesity compared to subjects from public schools. Also higher school fees and tertiary education of parents were associated with higher rates of obesity. In contrast underweight was lowest in private schools and associated with lower school fees and low parental education. Further work is needed to ascertain the real reasons for observed differences. The results of the study suggest that improved living conditions in urban areas in population adapted to chronic food shortages increase the susceptibility to obesity and nutrition related chronic

diseases. There is a need for policy shift towards organized and co-coordinated health promotion to combat an increasing trend of overweight and obesity.

## **6.2 Recommendations.**

1. Continued collection of data on nutritional status of school age children is essential for development of national reference charts to monitor their growth and development patterns.
2. Developing effective education programmes for the public, health professionals to increase awareness of the causes and consequences of obesity as well as the methods for its prevention.
3. Schools are the main institutions able to reach a large number of children and young people. They can promote health and prevent diseases through healthy eating and exercise.
4. Urban planners can support increased physical activity by building recreational facilities, such as parks and play grounds.
5. Further research into determinants of obesity and metabolic risk profile at younger ages should be undertaken.

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**Questionnaire on socioeconomic status of the primary school children.****Explanatory Note:**

The purpose of this questionnaire is to collect information on effect of demographic and socioeconomic factors on nutritional status of children attending primary schools in Accra. Utmost discretion and confidentiality will be exercised in handling the information provided.

We thank you in advance for your participation.

Questions 1,2,4,7 fill appropriate and the rest of the questions tick appropriate.

1. Full name of the child: \_\_\_\_\_
2. Date of birth of the child: \_\_\_\_\_
3. Sex of the child: M \_\_\_\_\_ / F \_\_\_\_\_ /
4. Residential area: \_\_\_\_\_
5. Ethnicity: Akan \_\_\_\_\_ / Ewe \_\_\_\_\_ / Ga-Adangbe \_\_\_\_\_ /  
Other \_\_\_\_\_ /
6. Type of school: Public \_\_\_\_\_ / Private \_\_\_\_\_ /
7. School fees per term (cedi): \_\_\_\_\_ /
8. What was the highest level of education your father completed:
  - None \_\_\_\_\_ /
  - Primary/ \_\_\_\_\_ /
  - Secondary/Technical \_\_\_\_\_ /
  - University /Polytechnic/ \_\_\_\_\_ /
  - Not known \_\_\_\_\_ /
9. What was the highest level of education your mother completed:
  - None \_\_\_\_\_ /
  - Primary/ middle \_\_\_\_\_ /
  - Secondary/ Technical \_\_\_\_\_ /
  - University/Polytechnic \_\_\_\_\_ /
  - Not known \_\_\_\_\_ /
10. Father's employment:
  - Employed at present \_\_\_\_\_ /
  - Unemployed \_\_\_\_\_ /

Not known \_\_\_\_\_/

11. Mother's employment:

Employed at present \_\_\_\_\_/

Unemployed \_\_\_\_\_/

Not known \_\_\_\_\_/

12. Number of sisters and brothers living in the same house: \_\_\_\_\_/

13. Parents living at home:

Mother only \_\_\_\_\_/

Father only \_\_\_\_\_/

Mother and father \_\_\_\_\_/

Neither parent \_\_\_\_\_/

14. Grandparents living at home:

One grandmother \_\_\_\_\_/

One grandfather \_\_\_\_\_/

Both of them \_\_\_\_\_/

None of them \_\_\_\_\_/

15. Do the parents own a house: Yes \_\_\_/ No \_\_\_/

16. Do the parents rent a house: Yes \_\_\_/ No \_\_\_/

17. How much do they pay for the rent: Less 200,000 cedi/month \_\_\_\_\_/

200,000-500,000 cedi/month \_\_\_\_\_/

More 500,000 cedi/ month \_\_\_\_\_/

18. Do the parents possess a car: Yes \_\_\_/ No \_\_\_/

19. Do you have a TV set in your house: Yes \_\_\_/ No \_\_\_/

20. Do you subscribe to any TV programme(M-Net, Multichoice):

Yes \_\_\_/No \_\_\_/

22. Do the parents possess a refrigerator: Yes \_\_\_/ No \_\_\_/

23. Do you have a cooker in the house: Yes \_\_\_/ No \_\_\_/

**INFORMED CONSENT FOR STUDY ON NUTRITIONAL STATUS OF THE  
SCHOOL-AGE CHILDREN.**

**PARENT'S NAME:** .....

**DATE:** .....

**WARD' S NAME:** .....

**INTRODUCTION**

Your ward has been invited to participate in the survey on nutritional status of the school-age children. This study is being conducted by the School of Public Health, University of Ghana in collaboration with National Diabetes Management and Research Center, Korle-Bu. The aim of this study is to assess the extent of the most common nutritional problems such as under- and overweight among school-age children. The information may assist us develop programmes to address the any problems identified. Early prevention is essential and cost-effective in order to prevent nutrition-related chronic diseases.

Participation in this study is voluntary. Your ward will not be affected by your refusal to let him/her participate in the study.

The procedures involved in the study are simple and safe and involve measuring weight, height and skin fold thickness. These procedures would not cause any physical, mental or emotional harm to your ward.

The measurements will be made available to parents. All personal information gathered in the study will be kept confidentially.

If you have any problems or questions about this study you should contact principal investigator Dr. S. Aduama, p.o. box 77, Korle- Bu, tel.027-7512388.

**CONSENT**

I have read about this study and understood its nature. I hereby consent to permit my ward to take part in this study.

SIGNATURE / THUMB PRINT OF THE PARENT .....

DATE .....

SIGNATURE OF INVESTIGATOR .....

DATE.....