Consortium for Research on Educational Access, Transitions and Equity

The Impact of Malnutrition on Access to Primary Education: Case Studies from Ghana

Christiana Buxton

CREATE PATHWAYS TO ACCESS
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List of Acronyms

BMI	Body Mass Index
BMIZ	Body Mass Index-for-Age z- score
CREATE	Consortium for Research on Educational Access, Transitions and Equity
EFA	Education for All
GDHS	Ghana Demographic Health Survey
HAZ	Height-for- Age z-score
JHS	Junior High School
MDG	Millennium Development Goals
UPE	Universal Primary Education
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund (formerly United Nations International Children's Emergency Fund)
WAZ	Weight-for-Age z-score
WHO	World Health Organisation

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Preface

In the past, the majority of interventions aimed at improving accessibility to education focused on school-related factors such as location, provision of infrastructure and other facilities, teacher quality and institutional management. Until recently, nutritional factors were rarely considered as relevant. This monograph makes a case for policy and action aimed at increasing access to primary education to consider nutrition as a key component of efforts at achieving the Education for All goal.

The Community and School Study (ComSS), conducted in two districts in Ghana, investigated how the nutritional status of children could affect access to primary education, focusing on such indicators as age at enrolment, effective participation or school attendance, drop-out cases and academic performance. The results of the study reveal that short stature or stunting is positively correlated with delayed enrolment in both southern and northern Ghana and is a potential barrier to access to education, particularly when, as other studies have shown, parents determine whether their children are ready to enrol in school, not only on the basis of their ages but also their physical appearance (height and weight). Such a finding, confirms reports that poor nutritional status of school children, mainly as a result of poverty, contributes largely to educational exclusion with most children finding themselves within zones 2 and 3 of the CREATE zones of Access Model.

Recommendations include:

• The need for deliberate and well-targeted attention to be given to the health and nutrition of preschool children to particularly address growth defects.
• The need for policies and interventions in education to be linked to Health and Agriculture, to ensure that nutritional and health issues directly affecting education would be tackled as part of efforts to increase access to basic education.
• The need for most of the interventions aimed at improving the nutritional status of children and promoting optimal growth in them to be targeted at the period before conception, through pregnancy to the first two years of a child's life.

The last recommendation is particularly important as most growth defects resulting from nutritional deprivation occur during this period, with negative effects on the age at which children enrol in school.

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Summary

Access to basic education lies at the heart of any developmental progress made in any nation. Consequently, the Government of Ghana's commitment to achieving the second Millennium Development Goal (MDG) is reflected in several policy frameworks. Some of the measures taken include the institution of the capitation grant (school fee abolition) to all public basic schools, inclusion of pre-school education (4 to 5 years old) as part of compulsory basic education, special programs to bridge the gender gap in access to education, targeted programs to improve access in deprived areas and the introduction of a school feeding programme. All these efforts have resulted in good progress in the education sector. However, the Government of Ghana itself concedes that: "although enrolment is increasing at all levels of education in Ghana, enrolment at the primary level has not been increasing sufficiently to meet the goal of Universal Primary Education by 2015 (Ministry of Education, Science and Sports, 2006).

It appears that the majority of the interventions aimed at improving accessibility to schooling have focused on school-related factors such as location, provision of infrastructure and facilities, teacher quality, and institutional management. In most cases, health and nutritional factors are relegated to the background and are rarely considered as underlying factors of accessibility to education. However, international organisations such as the WHO, UNICEF and UNESCO have emphasised that good health, especially nutrition, water and sanitation, are key components as part of efforts to achieve the Education for All goal.

This report therefore presents findings of a study that sought to assess the relationship between the nutritional status and access to primary education in two districts – Savelugu-Nanton and Mfantseman districts - in Ghana. In both districts, findings of the study showed that a greater proportion of undernourished children (stunted and low Body Mass Index) were found among children in lower classes, children attending rural schools and among the overage population (children above 6 years) of children in primary one. Children living in rural areas and those who were overage in grade as a result of their poor nutritional status are more likely to be predisposed to problems of delayed school enrolment, dropping out of school and the inability to complete primary education. Furthermore the study revealed that short stature or stunting is positively correlated with delayed enrolment in both southern and northern Ghana and could act as a potential barrier to access to primary education, particularly when, as other studies have shown, parents determine whether their children are ready to enrol in school, not only on the basis of their ages but also their physical appearance (height and weight). These findings reveal that early childhood malnutrition (decrease in growth in stature and weight) is likely to be a potential cause of delayed enrolment into primary school and therefore is an endemic problem in Ghanaian education.

The Impact of Malnutrition on Access to Primary Education: Case Studies from Ghana

1. Introduction

Education lies at the heart of attempts made by governments in developing countries to ensure that their people obtain the basic necessities of life - food, shelter, livelihood, and a secured future. In this regard, initiatives such as the Millennium Development Goal two (MDG 2) which advocates for Universal Primary Education for All by the year 2015 and the Education for All (EFA) agendas are targets of most governments. In the past, nutrition was relegated to the background and was rarely considered by policy makers when designing and implementing educational programmes aimed at improving participation and high performance of school children. However, in recent years, many countries, development partners and other international organisations now recognise the importance and role of health and nutrition as a key component for the achievement of globally set goals such as the MDG 2 and the EFA campaign. In this regard, international organisations such as UNESCO, WHO, UNICEF, Education International and the World Bank at the launch of a framework, 'Focus Resources on Effective School Health' (FRESH) at the World Education Forum held in Dakar, Senegal in 2000 emphatically stressed that good school health, especially water, sanitation and nutrition, are key components as part of efforts to achieve the EFA goals (Pridmore, 2007).

Research indicates that undernutrition has adverse effects on mental development and educational achievement of school children (Pollitt, 1990; Grantham-McGregor, 1995; Abadzi 2006). Evidence from most studies indicates that the first two years of childhood nutrition have long-lasting effects on the growth, cognitive development and function of children (Gale et al., 2003; Wilson et al., 1986). In addition, some studies report that short stature or stunting is associated with delayed enrolment in school (Jamison, 1986; Moock and Leslie, 1986; Glewwe and Jacoby, 1995). Furthermore, it has been indicated in some studies that children who suffer from poor nutrition during the brain's most formative years score much lower on tests of reading comprehension, arithmetic, and general knowledge (Brown and Pollitt, 1996).

An estimated 200 million children below five years old, the majority of whom live in Africa, fail to reach their potential cognitive development as a result of poverty, poor health and undernutrition (Grantham-McGregor et al., 2007). Consequently, these disadvantaged children are prone to perform poorly in school, they subsequently earn lower incomes and are unable to adequately take care of their children; thereby continuing the vicious cycle of poverty which confronts many people in Africa.

A considerable number of studies have been conducted to assess the relationship between educational performance and health (Cherian, 1992, 1994). However, what seems to be lacking, is research on how nutrition, a component of health, is related to educational access and attainment among school children (Themane *et al.*, 2003). Improving the nutrition of school children may help to address educational problems associated with mental development, delayed school enrolment, learning, school performance and achievement.

Recently, the relationship between nutrition, health and educational achievement of children in less developed countries has been of interest to many researchers due to the frequent observation that many children do not enrol on time, and in most cases do not complete primary school. In addition, the mechanism by which health and nutrition influence educational achievement is not well established (Galal and Hulett, 2003) although it has been indicted that under-nutrition especially in the early childhood stages of life and poor health affects a child's ability to learn from an early age (Popkin & Lim-Ybanez, 1982; Moock & Leslie, 1986; Pollitt et al, 1993), consequently affecting educational achievement (Shariff et. al, 2000).

Children who are affected by physical growth retardation are likely to find themselves in zones 1, 2 and 3 of the CREATE zones of exclusion model, where they either never enrol in school, drop out before completing primary education or are in school but not learning and at a higher risk of dropping out. Rates of delayed school enrolment, high rates of absenteeism, early dropout, and low school attainment are linked to children’s health status and malnutrition rates (World Bank, 1993). In addition some studies report that school children who are over age for their grade usually attend school irregularly, are low-achievers at the primary level and therefore become ‘silently excluded’ as they are at a higher risk of dropping out before completing primary school (Ananga, 2010).

In Ghana, where delayed enrolment (Partnership for Child Development, 1997), poor school performance, high dropout occurrence (Odaga and Heneveld, 1995; Fentiman et. al, 1999) and absenteeism are extremely common, few studies have examined the relationship between these educational indicators and malnutrition.

This paper examines the relationship between nutritional status and some educational indicators using a sample of school-age children drawn from 29 schools in two districts- Mfantseman and Savelugu-Nanton- in Ghana. The paper will be presented in different sections. The first section will give an account of the prevalence of stunted growth and Body Mass Index (BMI) status, also described as body thinness-for-age of the two different populations of children sampled from Mfantseman district (located in southern Ghana) and Savelugu-Nanton district (located in northern Ghana). Comparisons will be made between sexes, classes and location (rural/urban) of school.

For the second section, results assessing whether a significant difference exists between the two districts with regards to the prevalence of stunting, underweight and body mass index will be presented. The third section will discuss the relationship between the nutritional status of a child and the age of enrolment into primary school for the districts separately. A comparison will also be made between the two districts to assess for any significant differences with respect to the relationship between the nutritional status of children and the age of enrolment into primary school. The fourth section will discuss the relationship between the nutritional status of the children and school achievement (test scores) in mathematics and English. The fifth section discusses findings on an assessment to find out whether a significant difference exists between the nutritional status of school dropouts and non-dropouts. The next session will be a discussion on results assessing whether a significant relationship exists between the nutritional status of children and the frequency of school attendance. The last session discusses results comparing the nutritional status of children in 2007 to that of 2009 to assess whether any differences exist between the two years.

The findings of this study will provide an understanding and evidence linking the nutritional status of children of school going age and their ability to access basic education particularly at the expected age of enrolment into primary school. This can be considered as a first step in helping to meet laudable initiatives of the EFA campaign and the MDG of achieving universal primary education for all by the year 2015.

Based on the findings of the study, some recommendations on how education policies and practices can be transformed and linked to nutrition and health policies to ensure meaningful access to primary education and improve school performance will be presented.

2. Research Questions

The research was conducted to answer the following main research question and sub-questions:

1. What are the differences in the prevalence of stunting and BMI-for-age between sexes, classes and primary school children located in rural and urban areas?

2. What is the relationship between the age at enrolment into primary school and the nutritional status of basic school children in Ghana?

3. Methodology

3.1 Study Areas

This section is a description of the methods employed to assess the relationship between some nutritional indicators and educational indicators among basic school children sampled from two districts - Mfantseman and Savelugu-Nanton districts - in Ghana. The two districts - Savelugu-Nanton (Northern Region) and Mfantseman (Central Region) were selected to represent the northern and southern belts of Ghana using the following criteria: (i) accessibility to education, (ii) type of district, (iii) a Gross Enrolment Rate (GER) below 60%, and (iv) occupational activities (such as farming and fishing) that have the potential to have an impact on access to education. The Northern Region is the third poorest region in Ghana and Savelugu-Nanton is ranked 4th out of 40 deprived districts in the region. It is however, easily accessible from Tamale the regional capital. The main occupational activity in the district is farming which could be one of the major causes of non-attendance to school. The Central Region is ranked the fourth poorest region in Ghana. Although Mfantseman is not a deprived district, it has characteristics that are relevant for a study of access to education. It has vibrant fishing communities, a major trading centre and is well known as a place with relatively high child labour (Akyempong et al, 2007). These distinct districts were chosen because they were seen as being representative of the cultural diversity of the country and captured the disparity between the north and south. In Mfantseman district, the majority of the people engage mainly in subsistence farming and fishing along the coastal shores. The major livelihood of the people in Savelugu-Nanton, located in the northern part of Ghana, is farming which includes the growing of crops and rearing of livestock. It is in this background that the two study areas were selected for this study.

3.2 Research Design and Study Subjects

The study was a 3-year (2007 to 2009) longitudinal cohort-based survey conducted among primary and Junior High School (JHS) children - in primary one, four, six and JHS1 - in 29 schools in the Mfantseman and Savelugu-Nanton districts in Ghana. Mfantseman district is located in the southern belt while Savelugu-Nanton district is located in the northern belt of Ghana. The study sample comprised of children and young people aged between 5 and 22 years. The sample sizes varied depending on the year and the anthropometric indicator that was assessed. Stunting and BMI growth standards are only available for children from birth to 19 years whilst underweight growth standards are available for children in the age group of 10 years and below (from the WHO 2007 Child Growth Standards). As such, in this study stunting and BMI was only assessed for children aged 19 years and below, whilst underweight was only assessed for children aged 10 years and below. The sample sizes as shown in Table 1 and 2 decreased as the years progressed because an increase by one in the ages of children year after year resulted in some children falling above 19 and 10 years where stunting/BMI for age and underweight indices respectively cannot be evaluated. Also, information on the ages of some children was not available from school records and most children did not know their ages. In addition, some children were absent on days that data was collected or dropped out of school in subsequent years. Anthropometric indicators of children are gender and age specific therefore they were not assessed for children whose ages were unknown. Complete data available for age, height and weight was analysed for the following number of children, represented in the tables below.

Table 1: Sample Sizes of School Children used for Analysis in Mfantseman District

Year	Anthropometric Indicator	Sample size
2007	BMI	749
2008	BMI	597
2009	BMI	390
2007	Stunting	749
2008	Stunting	599
2009	Stunting	421
2007	Underweight	166
2008	Underweight	101
2009	Underweight	43

Table 2: Sample Sizes of School Children used for Analysis in Savelugu-Nanton District

Year	Anthropometric Indicator	Sample Size
2007	BMI	696
2008	BMI	822
2009	BMI	552
2007	Stunting	708
2008	Stunting	824
2009	Stunting	521
2007	Underweight	159
2008	Underweight	165
2009	Underweight	99

3.3 Data Collection

A survey tracking form was designed and used to collect data on children in their various schools. Data collected included anthropometric data (height and weight measurements), information on monthly school attendance obtained from school records, and Mathematics and English achievement scores in tests administered by the Centre for Research into Quality of Primary Education in Ghana (CRIQPEG). Anthropometric measurements of height and weight were taken using standardised techniques and calibrated equipment. Age information was obtained from the child's school records. The date of birth was noted from school records and was used to determine the child's age in months. Weight was measured using a calibrated weighing scale and was recorded to the nearest 0.1 kg. Height was measured using a height meter and recorded to the nearest 0.1 cm.

3.4 Assessment of Nutritional Status of Study Subjects

The nutritional status of children was assessed using the new growth standards published by the World Health Organisation (WHO) in 2007. Each of the nutritional status indicators described below was expressed in standard deviation units from the median of the WHO Child Growth Standards. In this study, anthropometric indices of height- for- age or stunting (HAZ), weight- for- age or underweight (WAZ), and BMI-for-age (BMIZ); all expressed as a z-scores are used to quantify the nutritional and health status of the school children. Since weight-for-height or wasting (WHZ) indices are not available for children older than five years, BMI, a measure of body fat, was evaluated to assess the prevalence of thinness for the study population. The z-score compares a child's measurements with the measurements of a similar child of the same age in a reference healthy population and assess how much and in which direction the child deviates from what is expected from the growth standards. Stunting indicates slow physical growth from birth, usually due to repeated occurrences of poor nutrition and other illnesses. It presents a picture of past episodes of malnutrition, often thought of as stock measure of malnutrition (Wisniewski, 2009). Underweight, signifying a low weight for age z-score, reflects both stunting and wasting and could indicate both past and current nutritional status (Wisniewski, 2009). Body Mass Index (BMI), a measure of body weight for a specified height was also used as an indicator for assessing the weight status of the children. BMI correlates with body fat and a high level of body fat may increase the risk of developing diseases (Zhang, et al., 2008).

Studies that have been conducted to assess the impact of child nutrition on educational outcomes use the indicator, height for age z-score, to assess poor health and/or nutrition, for several reasons. First, stunting which is caused by malnutrition usually occurs during infancy, between the ages of 3 and 36 months when the brain develops rapidly (Martorell and Habicht, 1986). Secondly, it has been established that once stunting occurs during early childhood, it becomes difficult to reverse and a child lives with its effects acquiring a short stature through to adulthood (Martorell and Habicht, 1986). The above literature suggests that from birth to approximately age three (early childhood) is the most critical period during which nutrition should not be compromised. Nutritional deficiencies during this period can cause physical damage to stature before age three which can persists through to adulthood. Findings of some studies have established that poor nutritional practices and habits during the early stages of a child's life are associated with future poor cognitive abilities and academic attainment in later childhood stages of life (Gantham-McGregor, 2005; Jukes, 2005 and Berkman et al., 2002). For these reasons this paper uses height for age z-score as an indicator of what will be referred to as early childhood/past nutritional status. Weight – for - age and BMI z-scores will be referred to as current nutritional status.

3.5 Data Analysis

The data collected was statistically analysed using SPSS. Height and weight measurements were transformed to z-scores based on ages of children and was used to assess the nutritional status of the school children. The nutritional status indicators were based on the following anthropometry indices: height-for-age z-scores (HAZ), weight-for-age z-scores (WAZ) and BMI-for-age z-scores (BMIZ). The Body Mass Index (BMI) was calculated as the weight (in kg) / height^2 (in m^2). Each child was then categorised into the following categories in relation to weight-for-age and height-for-age: severely stunted or underweight (< – 3 z-score value); stunted or underweight (– 3 to -2 z-score) and normal or in healthy range (>-2 z-score). For BMIZ, the children were categorised into the following 5 categories: severe thinness (<-3 z-score value); thinness (-3 to < -2 z-score); normal or in healthy range (>-2 to -1 z-score); overweight (> -1 to 2 z-score) and obese (> 2 z-score value).

Descriptive statistics of the anthropometric indicators were evaluated for districts, sexes, classes and schools. Kolmogorov-Smirnov analysis was used to test the normality of the data. Relationships between the nutritional indicators and educational indicators (test scores, school attendance and age of enrolment at the primary school level) were assessed by Spearman's rho or Pearson's correlation analysis depending on whether the data was normally distributed or not. A paired sample T- test was run to assess whether a significant change occurred between the years of 2007 and 2009 for stunting, BMI and underweight. To assess for any significant differences between classes with regards to the anthropometric indicators, a one way analysis of variance (ANOVA) with post-hoc tests were run. Differences between the two districts, rural and urban schools and sexes with respect to the anthropometric data were assessed by running an independent sample t-test. An error probability value of $p \leq 0.05$ was regarded as significant in the interpretation of the results.

4. Results and Discussion

In this section, results of the study and discussions of the findings are presented. In addition, some recommendations are made on how to address mainly nutritional issues that confront children of school going age and consequently have negative implications on their ability to access basic education.

4.1 Descriptive Results of Anthropometric Indicators for the Study Population

Table 3 shows means of anthropometric indicators among children. The mean z-score values of height-for-age, weight-for-age and BMI-for-age shows that on an average, children in both districts could be above the cut off point of -2 standard deviation (SD) explained as being well nourished. Although, the mean figures present an overall picture of children being well nourished in both districts, given that, in both districts, the mean stunting, BMI and underweight z-score values in each year was above -2 standard deviation. For the stunting indicator, apart from 2007, in both 2008 and 2009, the mean stunting z-score was higher in Savelugu-Nanton as compared to Mfantseman district. The overall mean value obtained over the three years was therefore higher in Savelugu-Nanton district (-1.11) than Mfantseman district (-1.21). Similarly, for BMI indicator, the overall mean z-score value was higher for Savelugu-Nanton district (0.51) than Mfantseman district (-0.39). These results may suggest that, school children in Savelugu-Nanton are well nourished as compared to children in Mfantseman district. However, these differences are not significant between the two districts. Furthermore, it is likely that sex and school location factors might have masked these average figures. Therefore, analysis of results presented will address sex and school location differences.

Table 3: Mean (SD) of Anthropometric Indicators of School Children in the Studied Districts

Anthropometric Indicator	**Mfantseman District**	**Savelugu-Nanton District**
	Mean (SD)	Mean (SD)
HAZ 2007	-1.04(1.54)	-1.44(2.06)
HAZ 2008	-1.14(1.48)	-0.95(1.24)
HAZ 2009	-1.03(1.78)	-1.02(1.24)
Average HAZ over 3 years	**-1.21(1.59)**	**-1.11(1.63)**
BMIZ 2007	-0.42(1.14)	0.17(2.43)
BMIZ 2008	-0.31(1.19)	-0.38(1.09)
BMIZ 2009	-0.09(1.60)	-0.27(1.23)
Average BMIZ over 3 years	**-0.39(1.23)**	**0.51(3.12)**
WAZ 2007	-0.27(1.73)	-0.04(1.43)
WAZ 2008	-0.34(1.54)	-0.06(0.98)
WAZ 2009	0.48(2.05)	-0.14(0.98)

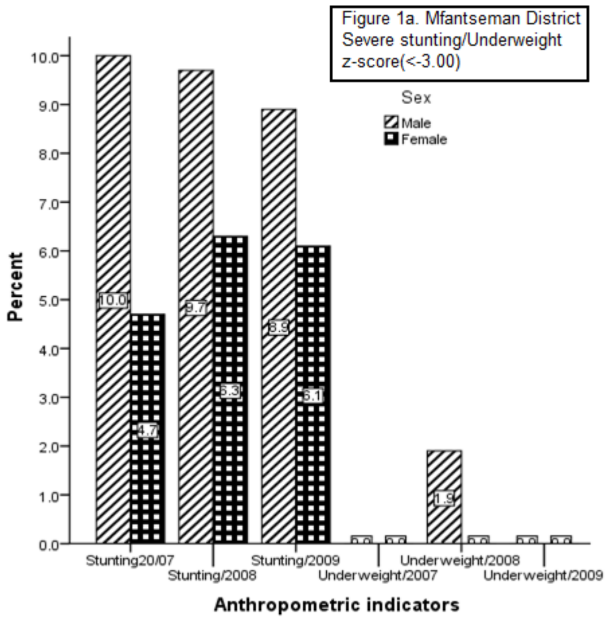
Note: HAZ (Height- for -Age z-score, Stunting); BMIZ (Body- Mass- Index for Age z-score); WAZ (Weight-for -Age z-score, Underweight)

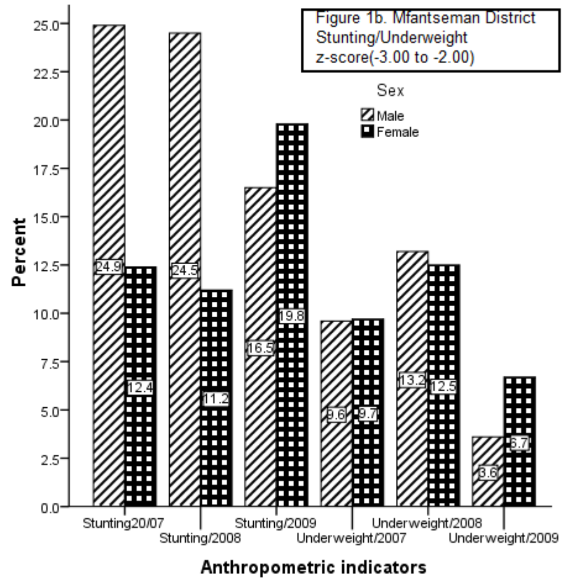
4.2 Prevalence of Anthropometric Indicators by Sex, Classes and School Location in Mfantseman District

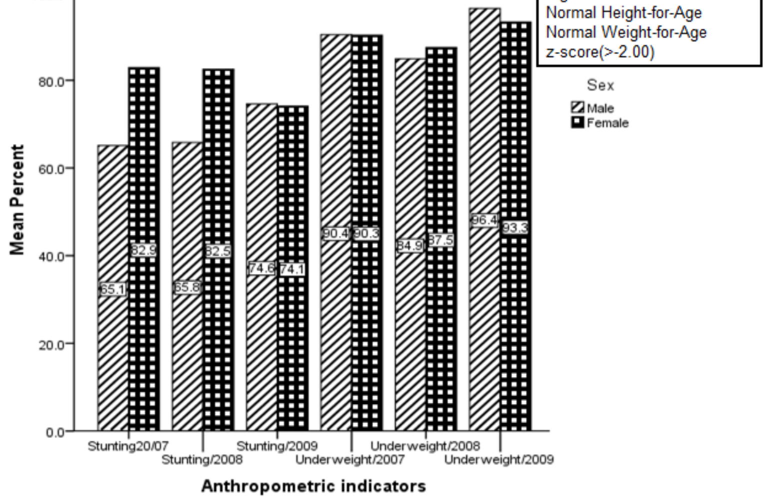
Results of the prevalence of stunting and underweight among males and females in Mfantseman district for the three years are presented in Figures 1a, 1b and 1c (*See Table 19 in the Appendix).*

Prevalence of Anthropometric Indicators by Sexes in Mfantseman District

Figures 1a, 1b and 1c: Prevalence of Stunting and Underweight Categories among School Children in Mfantseman District based on Sex. 1a) Mfantseman District, Severe stunting/underweight z-score (<-3.00); 1b) Mfantseman District, stunting/underweight z-score (-3.00 to-2.00); 1c) Mfantseman District, Normal Height-for-age, Normal weight-for-age z-score (>-2.00)

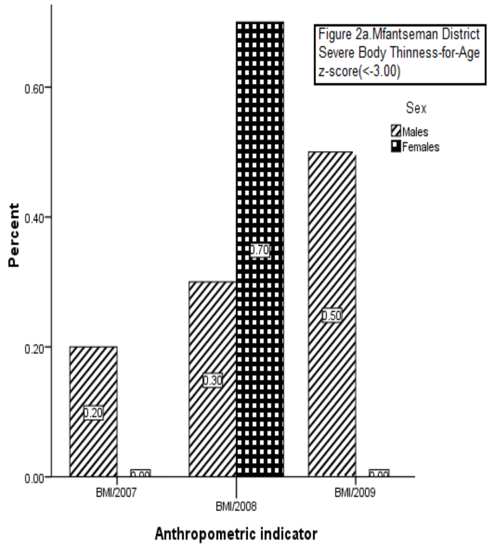


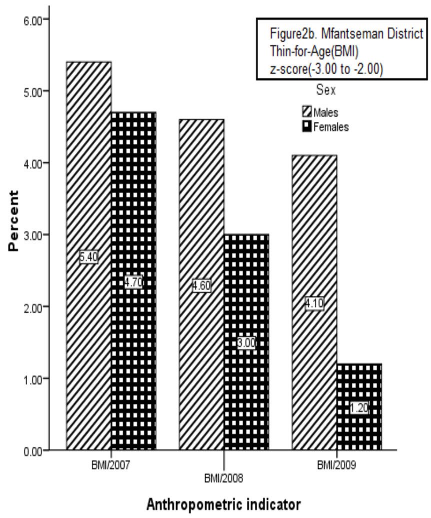


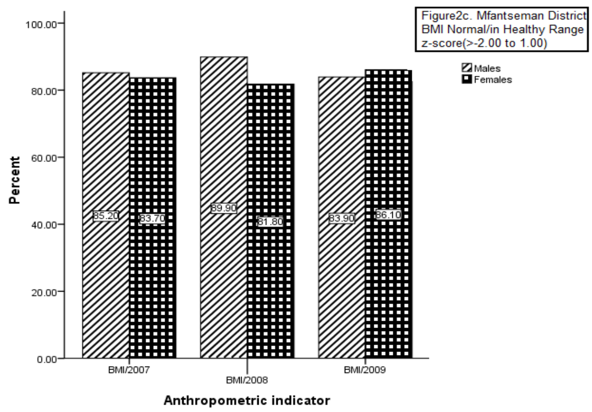


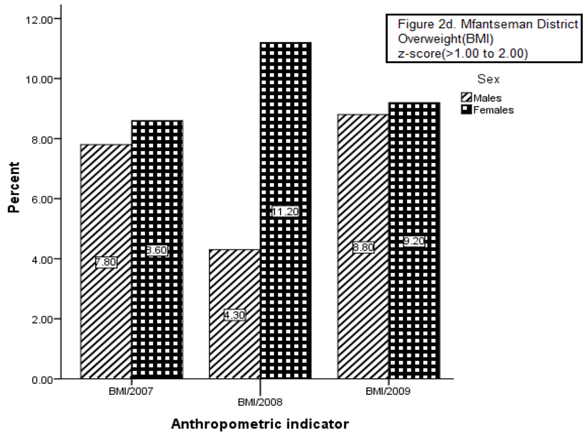
The results indicates that a statistically significant difference exist between boys and girls for both stunting and underweight indices (Table 4). The results show that in all three years (2007-2009) the prevalence of severe stunted growth and stunted growth, an indicator of severe past growth failure, were significantly higher among boys than girls, suggesting that males of school going age in Mfantseman were more likely to be stunted than their female counterparts. The findings are similar to reports of the current Ghana Demographic Health Survey report of 2008 which indicated that male children are slightly more likely to be stunted than female children in Ghana (30%, compared with 26%) (GDHS, 2008). This might suggest that boys are more vulnerable to health inequalities than their female counterparts in the same age groups. Thus, boys are more likely to be at a higher risk of being exposed to repeated occurrences of poor nutrition especially during the infancy stages of life leading to slow physical growth exhibited in being short for their ages (stunted). Even though, sex differences in anthropometry with females having an advantage over males have been previously reported in many developing countries (Wamani et al., 2004; Ukwuani and Suchindran, 2003; Ngare and Muttunga, 1999; Zere and Mclnyre, 2003; Svedberg, 1990) available studies which systematically address these sex differences assessing possible determining factors are almost non-existent. Speculations made by some researchers on the observed sex differences mainly focused on differences in behavioural patterns (Wamani et al., 2007). For instance, Svedberg (1990), on the basis of an extensive analysis of gender bias in undernutrition in sub-Saharan Africa, proposed that the slight anthropometric advantage shown by girls in many countries may be due to a pattern of preferred treatment of females due to the high value placed on women's agricultural labour (Svedberg, 1990). However, there are also studies that report greater social favouritism towards sons at the detriment of daughters (Crognier et al., 2006) including dietary discrimination (Leslie et al., 1997), thereby dispelling conclusions of a nutritionally advantaged position of female over male children. The above - mentioned speculations indicate that the underlying mechanism as to why male children are highly susceptible to malnutrition exhibited in the form of stunted growth is poorly understood. Therefore, a puzzling question that requires further research is why male children are worse off compared to female children in terms of their nutritional status.

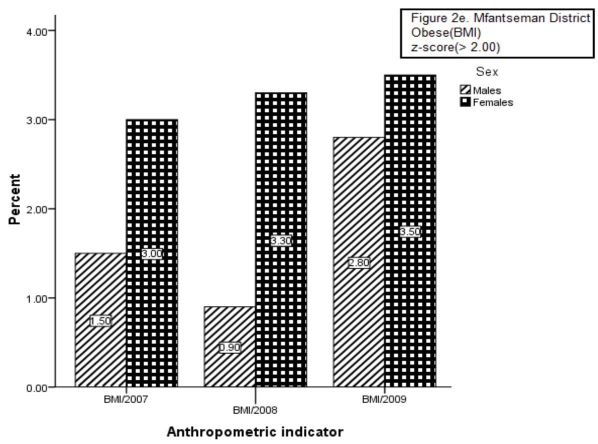
Figures 2a, 2b, 2c, 2d and 2e: Prevalence of BMI Categories among School Children in Mfantseman District based on Sex. 2a) Mfantseman District, Severe Body Thinness-for-Age, z-score (<-3.00); 2b) Mfantseman District, Body Thinness-for-Age, z-score (-3.00 to -2.00); 2c) Mfantseman District, Normal BMI/in healthy range, z-score (>-2.00 to 1.00); 2d) Mfantseman District, Overweight (BMI), z-score (>1.00 to 2.00); 2e) Mfantseman District, Obese (BMI), z-score (>2.00)











Similarly, there was a statistical significant difference between boys and girls for BMI (See Table 4), with a higher prevalence of thinness – for- age (low BMI) among boys than girls observed in all the three years (Figure 2b). Girls, on the other hand, were more likely to be overweight or obese than boys as shown in Figures 2d and 2e. (Refer to Table 18 in the Appendix).

Tables 4 and 5 show p-values of statistical tests to assess stunting and BMI status differences between, years, gender, classes and school location for Mfantseman and Savelugu-Nanton districts respectively. All values bearing an "asterix" (*) indicates that a significant difference exists between the groups/variables being compared. In Mfantseman district, there was a significant difference (p =0.001) between males and females with respect to their stunting and BMI status with a higher prevalence of stunting and low BMI among males than females. Similarly, a comparison between classes of children showed that a statistical significant difference exists between the classes with respect to stunting (p=0.001) and BMI status (p=0.002). However for the factor of school location, there was no statistical significant difference between children attending rural and urban schools with respect to their stunting (p=0.091) and BMI status (p=0.393).

As shown in Table 5, in Savelugu-Nanton district, there was a significant difference (p <0.05) for the variables gender, class and school location for stunting status but not BMI status. This indicates that unlike stunting status, BMI status of school children in Savelugu-Nanton is not influenced by the factors of gender, class and school location.

Table 4: Comparison within District by Year, Gender, Class and School Location for Stunting and BMI in Mfantseman District

Variable	***F-value***	***p-value***
Mfantseman District		
Year Comparison within District		
BMI Z-scores	2.151	0.1800.612
Stunting Z-scores	0.492	
Gender		
BMI Z-scores	16.093	0.001*
Stunting Z-scores	22.243	0.001*
Class		
BMI z-scores	4.906	0.002*
Stunting Z-scores	6.275	0.001*
School location		
BMI Z - score	2.054	0.393
Stunting Z-scores	0.023	0.091

*Difference is significant at the 0.05 level (p<0.05)

Table 5: Comparison within District by Year, Gender, Class and School Location for Stunting and BMI in Savelugu-Nanton District

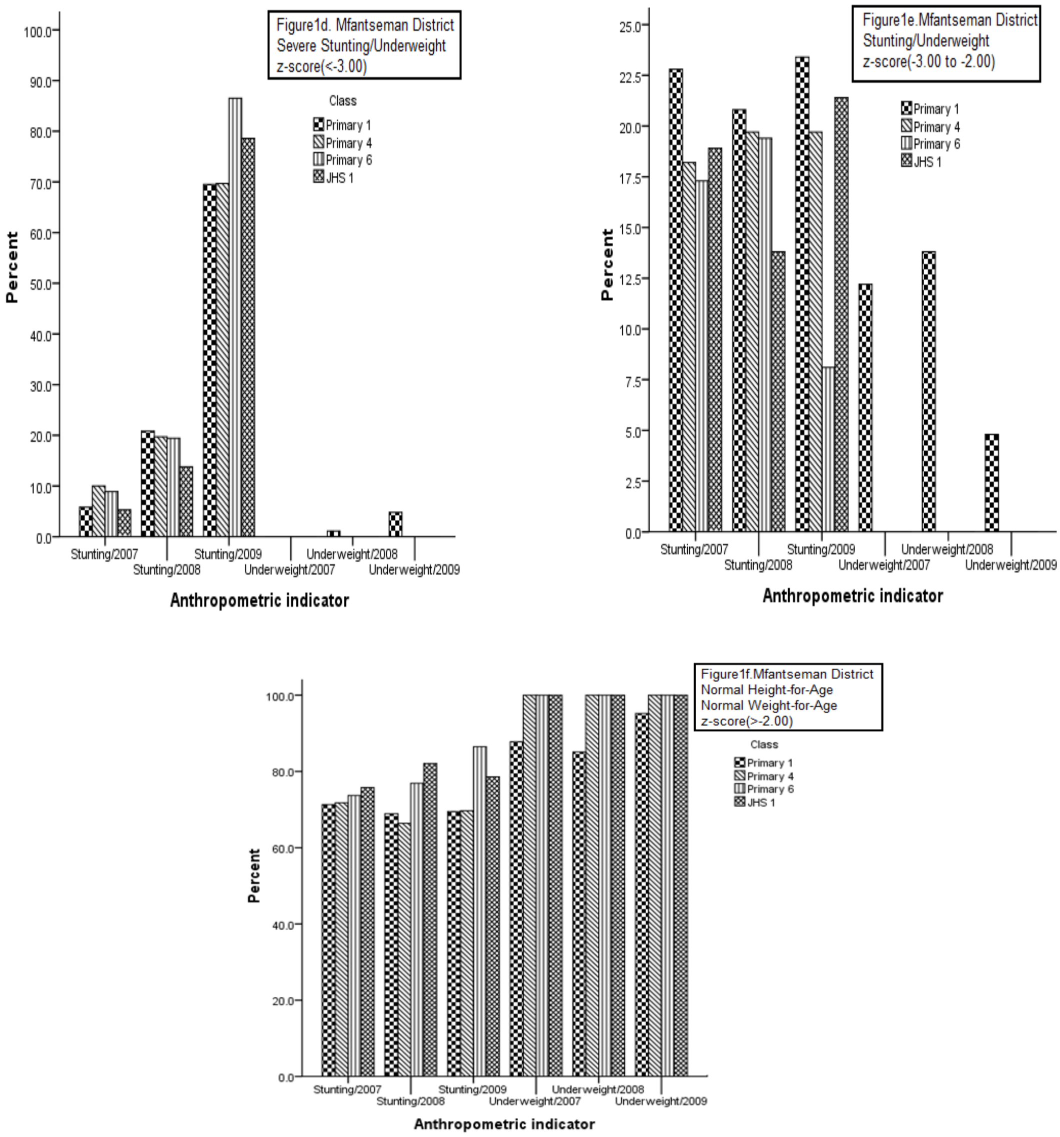
Savelugu-Nanton District		
Year Comparison within District		
BMI Z-scores	1.365	0.256
Stunting Z-scores	12.079	0.001*
Gender		
BMI Z-scores	0.419	0.518
Stunting Z-scores	17.555	0.001*
School location		
BMI Z-scores	2.054	0.393
Stunting Z-scores	7.415	0.002*
Class		
BMI Z-scores	1.144	0.330
Stunting Z-scores	17.109	0.001*

*Difference is significant at the 0.05 level ($p<0.05$)

Prevalence of Anthropometric Indicators by Classes in Mfantseman District

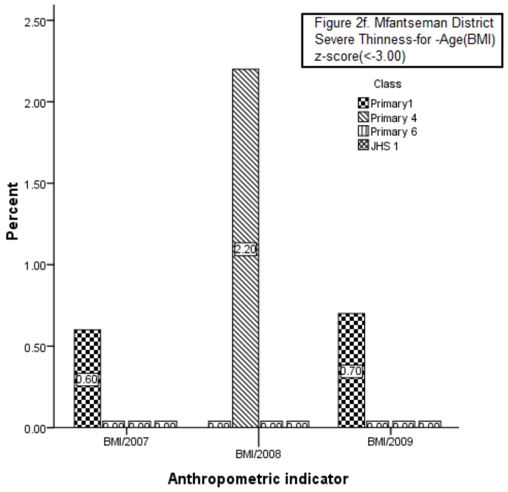
Results of the prevalence of stunting and underweight among the four classes of the school children in Mfantseman district are shown in Figures 1d, 1e and 1f. Figure 1e, indicates that a higher prevalence of stunting and underweight was observed among children in class one in each year. In Figure 1e, the graph shows that in the year 2007, prevalence of severe stunting decreased from primary 1 through to JHS 1. A comparison made with regards to differences in anthropometric indicators between the classes (See Tables 9 and 10 in the Appendix) showed that there was a significant difference between the classes with respect to stunting categories (Table 4). Children in Primary 1 were more likely to be stunted and underweight as compared to children in the upper classes as shown in Figure 1e. A reason that can be attributed to lower percentages of stunted children in the upper classes is that perhaps, stunted children perform poorly in school and as a result often ended up being repeated in their classes, dropped out of school and therefore did not have the chance to progress through primary school to JHS. This finding therefore has an implication for targeting school children in the lower classes, since majority of stunted children are more likely to be present in the lower classes and therefore are likely to drop-out preventing them from completing primary education.

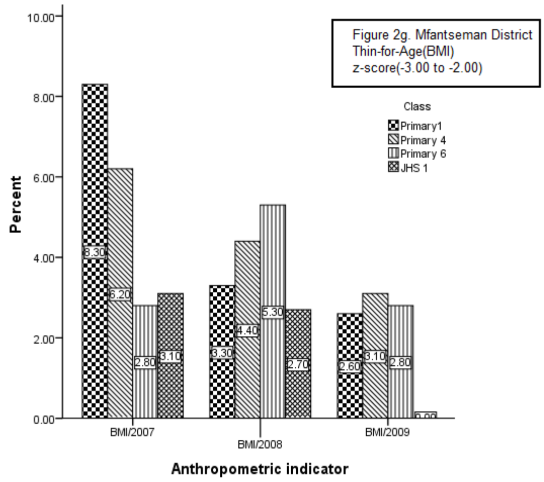
Figures 1d, 1e and 1f: Prevalence of Stunting and Underweight z-score Categories among School Children in Mfantseman District based on Classes. 1d) Mfantseman District, Severe stunting/underweight z-score (<-3.00); 1e) Mfantseman District, stunting/underweight z-score (-3.00 to-2.00); 1f) Mfantseman District, Normal Height-for-age, Normal weight-for-age z-score (>-2.00)

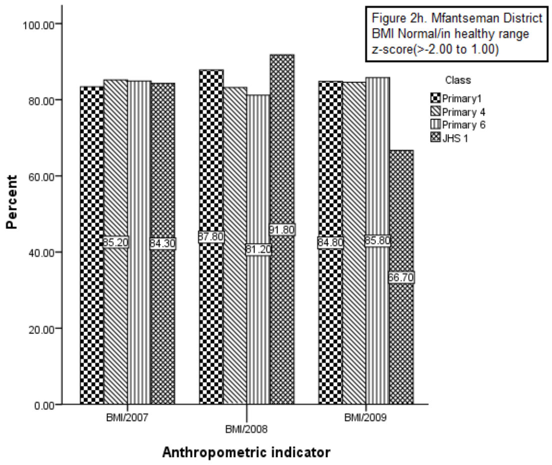


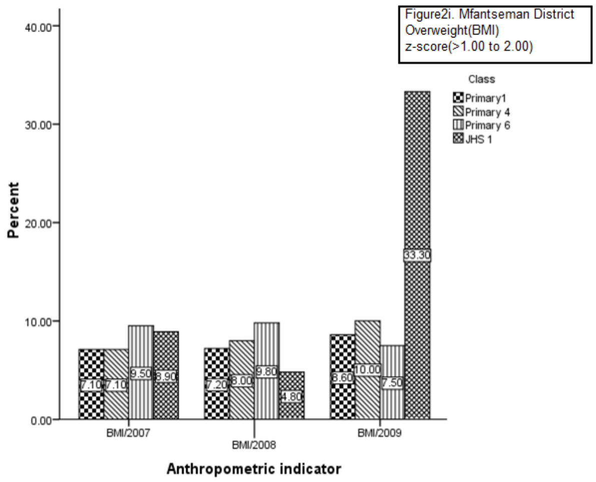
The results presented in Figure 2f shows that children in primary 1 and 4 in Mfantseman district are more likely to be severely thin-for- their ages than children in primary 6 and JHS 1. The results suggest that cases of low BMI status and severe growth retardation are likely to be pronounced in lower primary classes than in upper primary classes. This buttresses the fact that children who were physically small in body size were more likely to enrol late in school regardless of their ages.

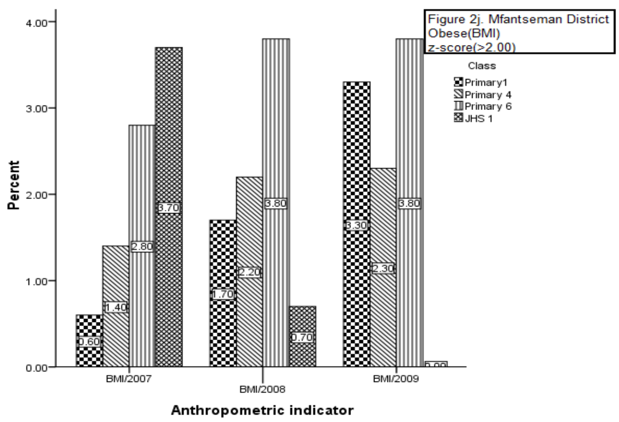
Figures 2f, 2g, 2h, 2i and 2j: Prevalence of BMI Categories among School Children in Mfantseman District based on Classes. 2f) Mfantseman District, Severe Body Thinness-for-Age, z-score (<-3.00); 2g) Mfantseman District, Body Thinness-for-Age, z-score (-3.00 to -2.00); 2h) Mfantseman District, Normal BMI/in healthy range, z-score (>-2.00 to 1.00); 2i) Mfantseman District, Overweight(BMI), z-score (>1.00 to 2.00); 2j) Mfantseman District, Obese(BMI),z-score (>2.00).







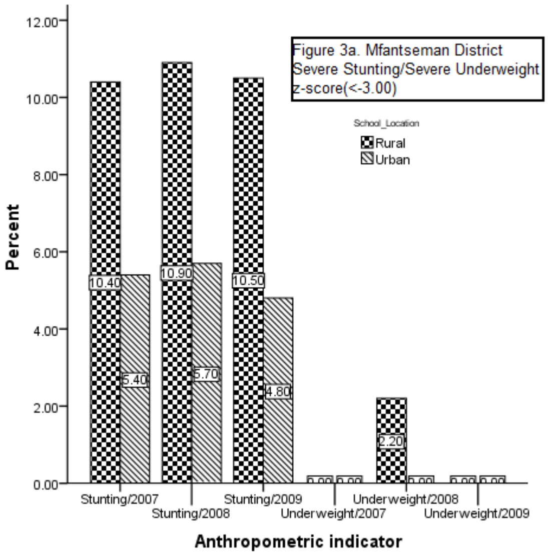


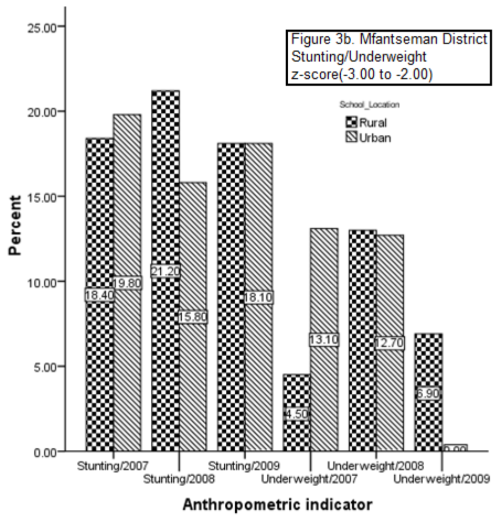


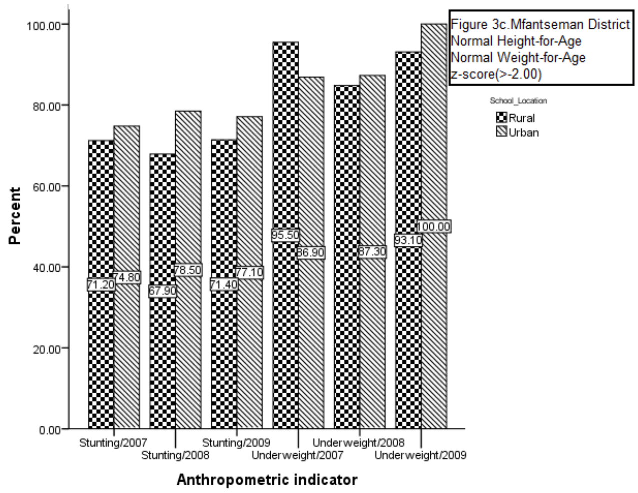
As shown in Figures 2f, 2g, 2h, 2i and 2j, there was no consistent trend during each year with respect to the proportions of children in classes within each BMI category. What these results indicate is that, BMI status of children unlike stunting can change with time depending on the nutritional intakes of an individual. However there was a significant difference with respect to the proportions of children under each BMI category between the classes. A significant finding was that children in primary 1 were more likely to be either severely or thin-for their ages as shown in Figures 2f and 2g in 2007. This could have implications on parental judgement of a child's readiness to start school at the expected age.

Prevalence of Anthropometric indicators by School Location in Mfantseman District

Figures 3a, 3b and 3c: Prevalence of Stunting and Underweight Categories among School Children in Mfantseman District based on Location (Rural/Urban). 3a) Mfantseman District, Severe stunting/underweight z-score (<-3.00); 3b) Mfantseman District, stunting/underweight z-score (-3.00 to-2.00); 3c) Mfantseman District, Normal height-for-age, Normal weight-for-age z-score (>-2.00)



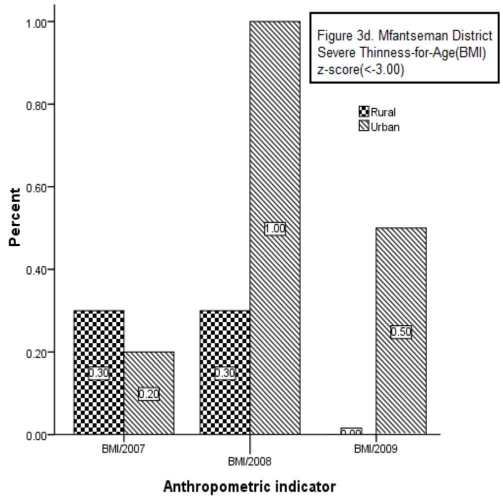


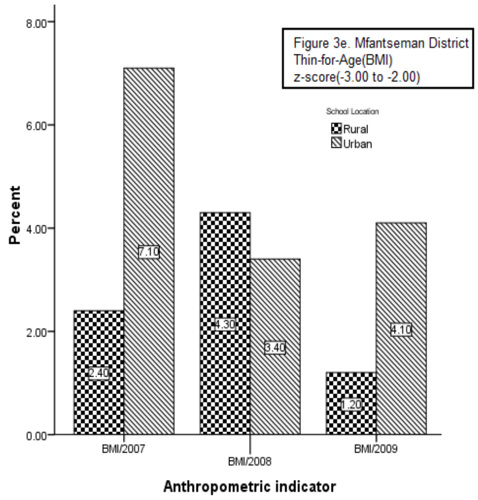


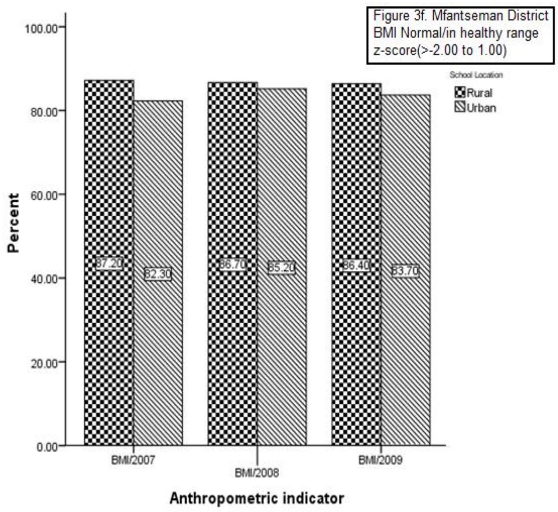
Results comparing the stunting and underweight status of children in rural and urban schools are shown in Figures 3a, 3b and 3c. As shown in Figure 3a even though there was a higher prevalence of severe stunted growth among children in rural schools than those in urban schools, the difference between rural and urban schools was not statistically significant (Table 4). In all years (2007, 2008 and 2009), more children who attended schools located in rural areas exhibited the severe forms of stunted growth than those attending schools situated in urban areas. This finding reaffirms findings of the current GDHS report that the level of stunting is higher in the rural areas (32%) than in the urban areas (21%). A further explanation given was that stunting decreases as mother's level of education and wealth quintile increase. This indicates that as a result of the low educational background of caregivers and poverty confronting most rural population, children living in rural areas are likely to be more susceptible to poor growth and development. However, even though a greater proportion of urban children than their rural counterparts had normal heights and weights for their ages except for underweight status in 2007, the differences between these two groups of children were not statistically significant (Table 4).

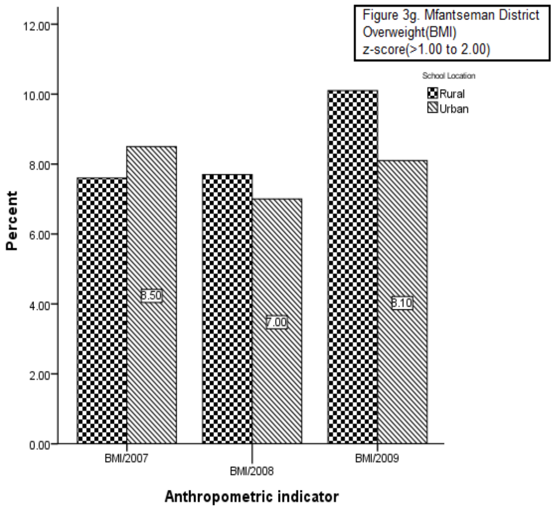
This finding suggests that, even though a greater proportion of rural children are stunted than their urban counterparts in Mfantseman district, school children regardless of the factor of school location (rural or urban) are likely to be affected in similar ways with regards to factors that can affect their nutritional and health status, consequently resulting in poor growth rates.

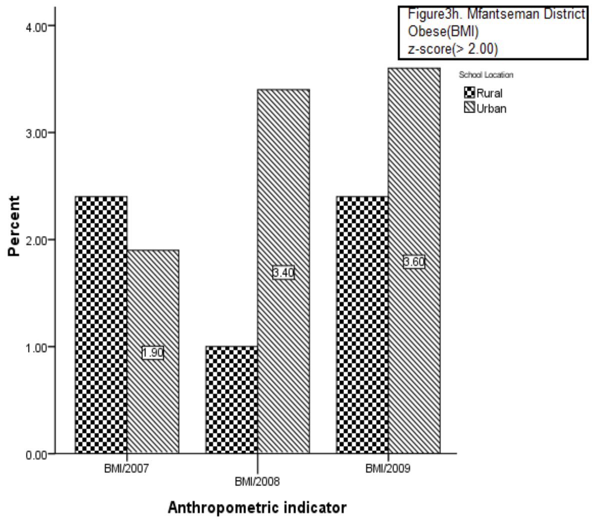
Figures 3d, 3e, 3f, 3g and 3h: Prevalence of BMI Categories among School Children in Mfantseman District based on Location (Rural/Urban). 3d) Mfantseman District, Severe Body Thinness-for-Age, z-score (<-3.00); 3e) Mfantseman District, Body Thinness-for-Age, z-score (-3.00 to -2.00); 3f) Mfantseman District, Normal BMI/in healthy range, z-score (>-2.00 to 1.00); 3g) Mfantseman District, Overweight (BMI), z-score (>1.00 to 2.00); 3h) Mfantseman District, Obese (BMI), z-score (>2.00)











The prevalence values for overweight in the years 2007 and 2009 for children living in rural areas were 7.6% and 10.1% respectively (see Table 16 in the Appendix). For children living in urban areas the prevalence values were between 8.1% and 8.5% in 2007 and 2009 respectively (see Table 16 in the Appendix). These results indicate that in both rural and urban areas there has been an increase in the prevalence of overweight cases among school children as the years progress. The increase in overweight prevalence values comparing 2007 and 2009 supports reports in the current GHDS report that the prevalence of overweight children has been increasing over the years (GDHS, 2008).

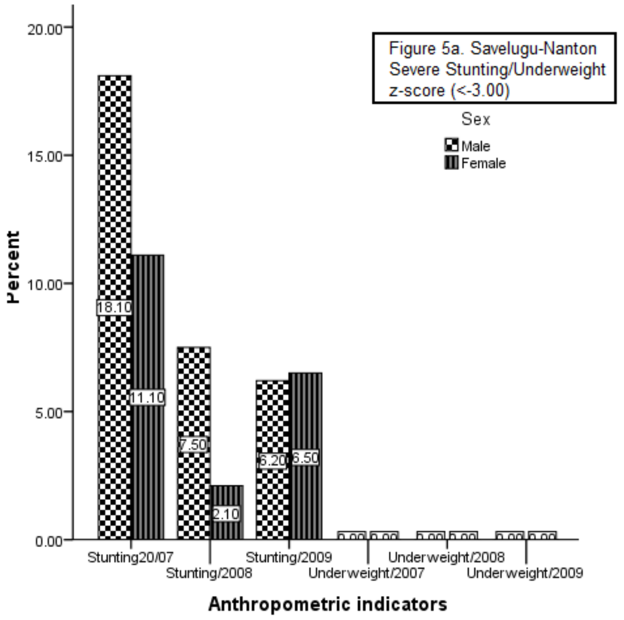
From our findings, it appears that more children living in rural areas are overweight (see Figure 3i) as compared to their counterparts in urban areas. On the other hand, children in urban areas are more likely to be obese (higher grade of overweight as shown in Figure 3h. It has been suggested by some studies that rural children are likely to be more overweight and obese than urban children because rural populations are more likely to be less educated and have lower incomes than urban populations, and all of these factors are related to higher obesity levels (Patterson et al., 2004). Unhealthy diet has been identified as one culprit in the rural obesity problem Specifically contributing factors include low consumption of dietary fibre, have limited diversity in their dietary than populations in urban areas. Most often rural populations tend to consume more high energy dense foods which are carbohydrate and fatty based and are less likely to afford expensive food items such as fruits and vegetables, which help in reducing blood cholesterol levels. Another risk factor indicated in most recent studies as a major cause of overweight, is that some rural areas are undergoing a transition from rural to urban lifestyles, which particularly affects both their physical activity levels and dietary habits (Kruger et al. 2006). In addition, there is evidence that experiences with under-nutrition during the early stages of the lives of children can cause permanent changes in their physiological make-up, which may later predispose them to certain health conditions associated with overweight and obesity (Lobstein et al.,2004; Martins et al.,2004; Monteiro et al.,2005 and Sawaya et al.,2005). This finding further indicates that children who are affected by stunted growth during the early stages of their life (an effect of under-nutrition) are likely to be have permanent changes in their physiological make-up, which subsequently predisposes them to heath conditions such as overweight and obesity later in life, particularly when they consume more energy dense foods (carbohydrate and fatty-based foods).

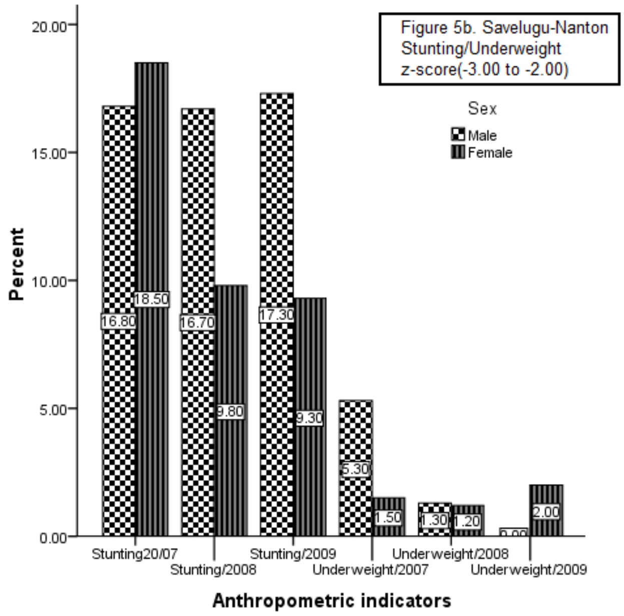
4.3 Prevalence of Anthropometric Indicators by Sex, Classes and School Location of School Children in Savelugu-Nanton District

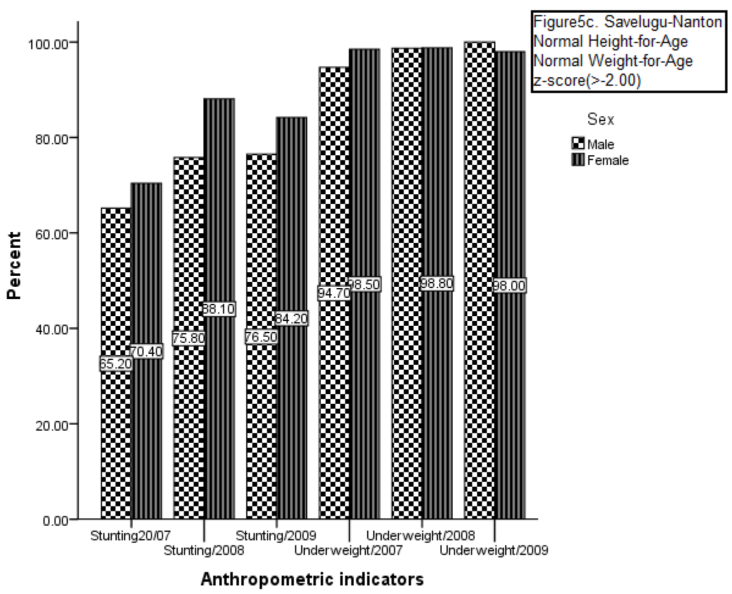
The Prevalence of stunting and BMI- for-age of sexes and classes of school children in Savelugu-Nanton district for the three years are presented in (Tables 9 and 10 in the Appendix).

Prevalence of Anthropometric indicators by Sex in Savelugu-Nanton District

Figures 5a, 5b and 5c: Prevalence of Stunting and Underweight Categories among School Children in Savelugu-Nanton District based on Sex. 5a) Savelugu-Nanton District, Severe stunting/underweight z-score (<-3.00); 5b) Savelugu-Nanton District, stunting/underweight z-score (-3.00 to-2.00); 5c) Savelugu-Nanton District, Normal Height-for-age, Normal weight-for-age z-score (>-2.00)



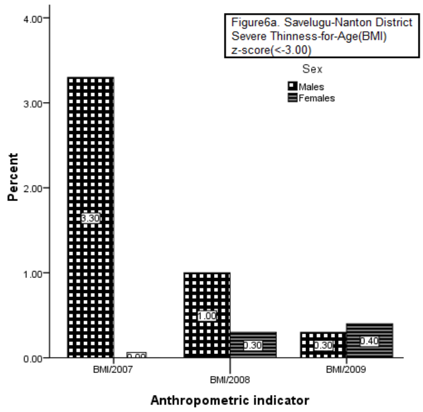


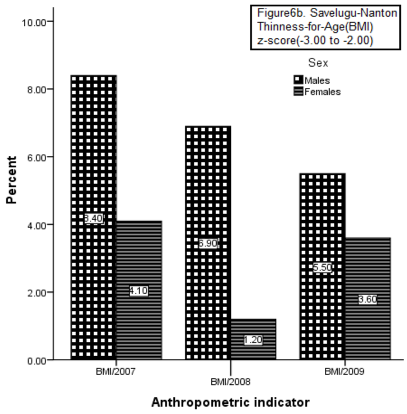


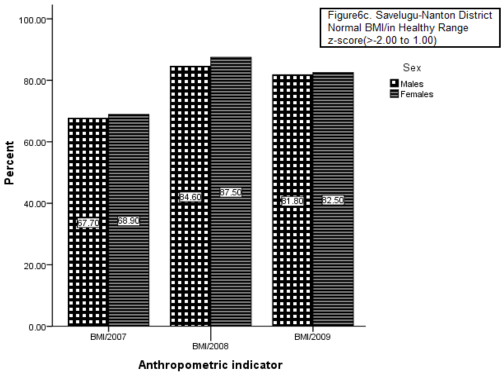
Similarly to Mfantseman district, the results indicates that a statistically significant difference exist between boys and girls for both stunting and BMI indices (Table 5).

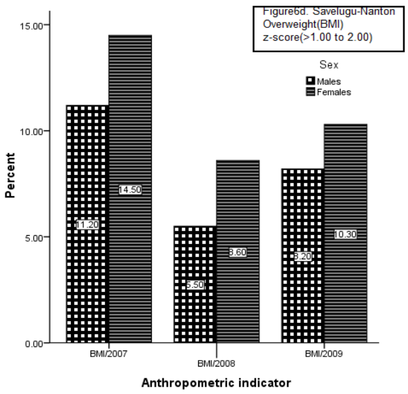
As indicated in Figures 5a and 5b in almost all the years the prevalence of severe stunted growth and stunted growth, which reflects failure to receive adequate nutrition over a long period in the past, was significantly higher among boys than girls. These results similar to that reported in Mfantseman district and suggest that there is a higher likelihood that boys in Savelugu-Nanton might have had experiences of poor nutrition and frequent infections during their early childhood stages of life. As already indicated, the question about why boys are particularly affected than girls is not clearly understood and as such requires further studies which will provide perhaps biological explanations as to why male children are more likely to be stunted than female children (Wamani et al., 2007).

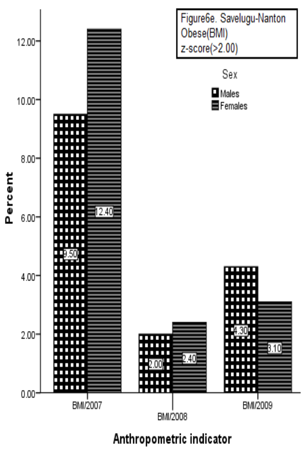
Figures 6a, 6b, 6c, 6d and 6e: Prevalence of BMI Categories among School Children in Savelugu-Nanton District based on Sex. 6a) Savelugu-Nanton District, Severe Body Thinness-for-Age, z-score (<-3.00); 6b) Savelugu-Nanton District, Body Thinness-for-Age, z-score (-3.00 to -2.00); 6c) Savelugu-Nanton District, Normal BMI/in healthy range, z-score (>-2.00 to 1.00); 6d) Savelugu-Nanton District, Overweight (BMI), z-score (>1.00 to 2.00); 6e) Savelugu-Nanton District, Obese (BMI), z-score (>2.00)





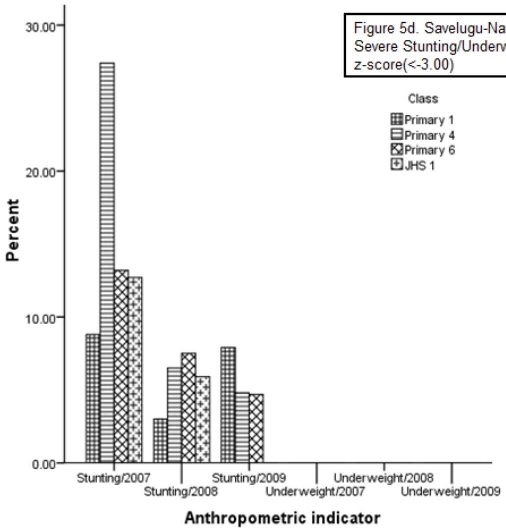


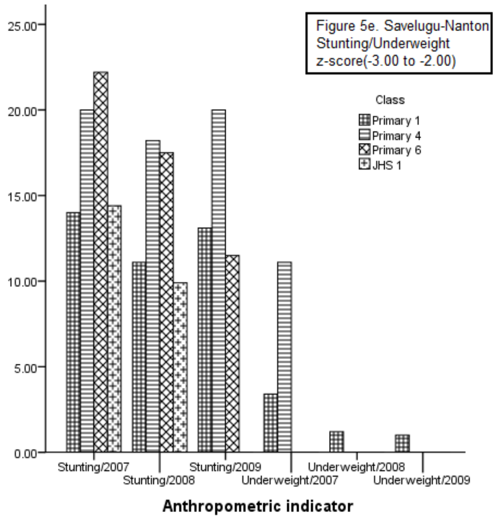


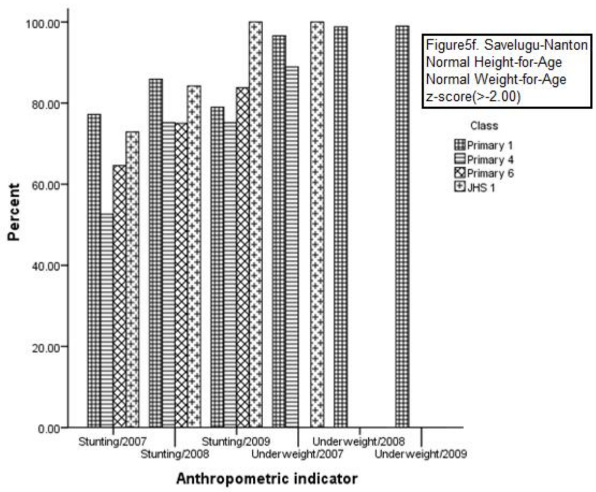


Prevalence of Anthropometric Indicators by Classes in Savelugu-Nanton District

Figures 5d, 5e and 5f: Prevalence of Stunting and Underweight Categories among School Children in Savelugu-Nanton District based on Classes. 5d) Savelugu-Nanton District, Severe stunting/underweight z-score (<-3.00); 5e) Savelugu-Nanton District, stunting/underweight z-score (-3.00 to-2.00); 5f) Savelugu-Nanton District, Normal Height-for-age, Normal weight-for-age z-score (>-2.00)







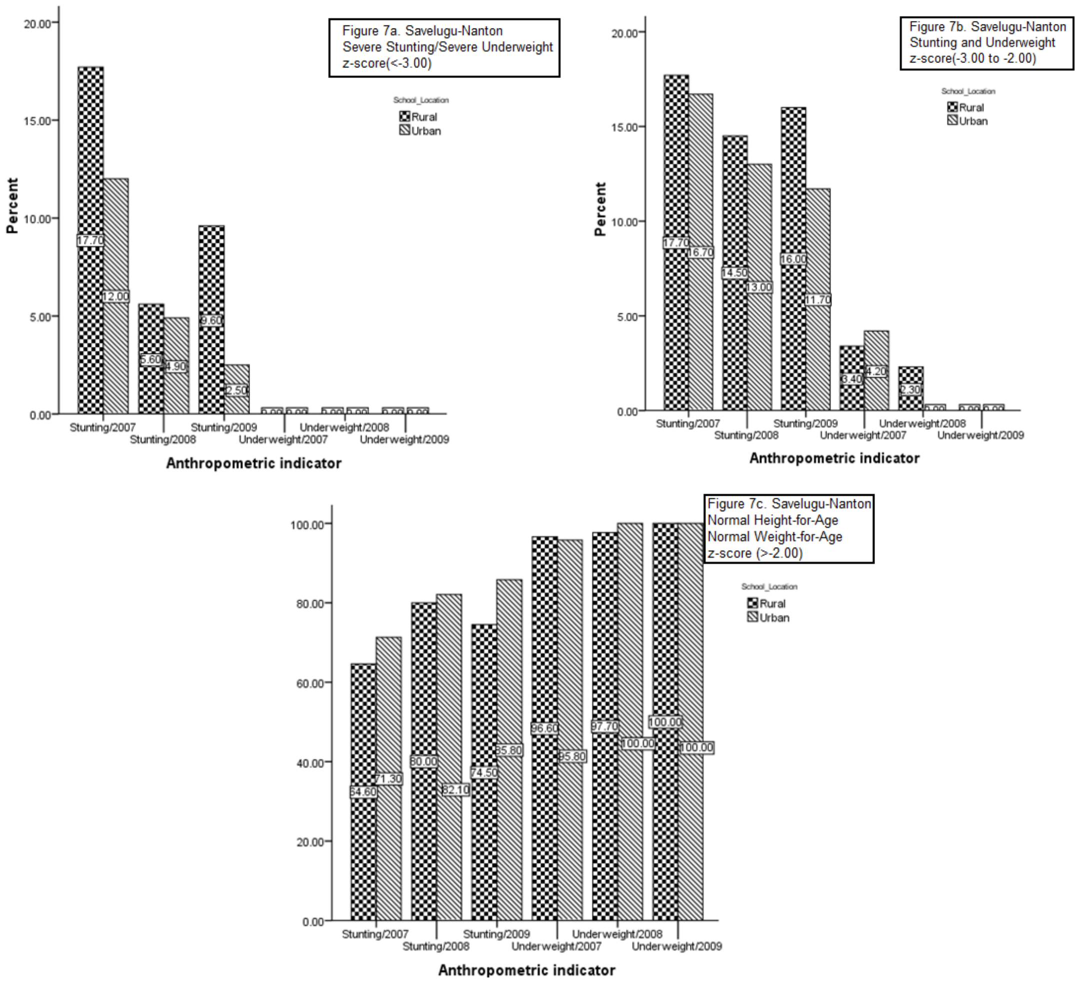
For BMI, a comparison between boys and girls indicted that a higher prevalence of body thinness- for- age was likely to be observed among boys as compared to girls (Figures 6a and 6b). On the other hand, a higher prevalence of overweight and obesity was observed more among girls than boys (Figures 6d and 6e). Reasons that can be attributed to these findings are that perhaps girls as compared to boys in Savelugu-Nanton district were less physically active in addition to the fact that girls tend to accumulate more body fat than boys as they grow.

Stunting prevalence figures were significantly different between classes of children (Table 5). The highest prevalence of severe stunted growth was observed among class 4 pupils in 2007 (27.4%) above the northern regional prevalence value of 15.4% (GDHS, 2008).

Results comparing prevalence of body thinness - for- age between classes of school children in 2007 revealed that the prevalence tends to decrease as children progress from lower classes to upper classes [primary1 (10.5%) > primary 4 (9.3%) > primary 6 (4.9%) > JHS1 (2.2%)] (See Table 18 in the Appendix). This finding similar to Mfantseman district indicates that children in primary 1 were more likely to be either severely or thin-for their ages and therefore appeared smaller in size, an occurrence likely to influence parent's decision with regards to a child's readiness to enrol in school. In addition, the decrease in proportions of thin-for-age children in the upper classes could suggest that some children who might have enrolled malnourished (appearing physically smaller or thin than expected for their age) might have dropped out as they progressed from one class to other either because they were ridiculed or felt inferior to children who appeared to have "normal" body sizes. Eventually, it is likely that only small proportions of such malnourished children remained and were able to complete primary and subsequently progress to the Junior High School (JHS) level.

Prevalence of Anthropometric Indicators by School Location in Savelugu-Nanton District

Figures 7a, 7b and 7c: Prevalence of Stunting and Underweight Categories among School Children in Savelugu-Nanton District based on Location (Rural/Urban). 7a) Savelugu-Nanton District, Severe stunting/underweight z-score (<-3.00); 7b) Savelugu-Nanton District, stunting/underweight z-score (-3.00 to-2.00); 7c) Savelugu-Nanton District, Normal Height-for-age, Normal weight-for-age z-score (>-2.00)



The distributions of children attending rural and urban schools in the Savelugu-Nanton district in each stunting and underweight category are illustrated in Figures 7a, 7b and 7c.

There was a significant difference with respect to stunting when a comparison between children attending rural and urban schools was made for Savelugu-Nanton district (Table 5). In all three years (2007, 2008 and 2009) severe stunting and stunting were observed to be significantly higher among children attending rural schools as compared to children attending urban schools in Savelugu-Nanton district, as illustrated in Figures 7a and 7b. This is consistent with findings of some studies such as the Ghana Demographic Health Survey conducted in 2008, which indicated that the level of stunting among children was higher in rural areas than in urban areas mainly as a result of low educational levels of mothers, hunger and poverty, which confront many households living in rural areas. The results show how food deprivation and health conditions from birth or even before conception can result in linear growth retardation particularly among children living in rural areas in Savelugu-Nanton district. As reported in some studies stunting cases are usually associated with non-enrolment, late enrolment, poorer school attendance and poorer school performances (Mosley et al, 1990; Galal and Hulett, 2003). The above-mentioned negative effects can contribute to educational exclusion among school-age children particularly in rural areas in northern Ghana.

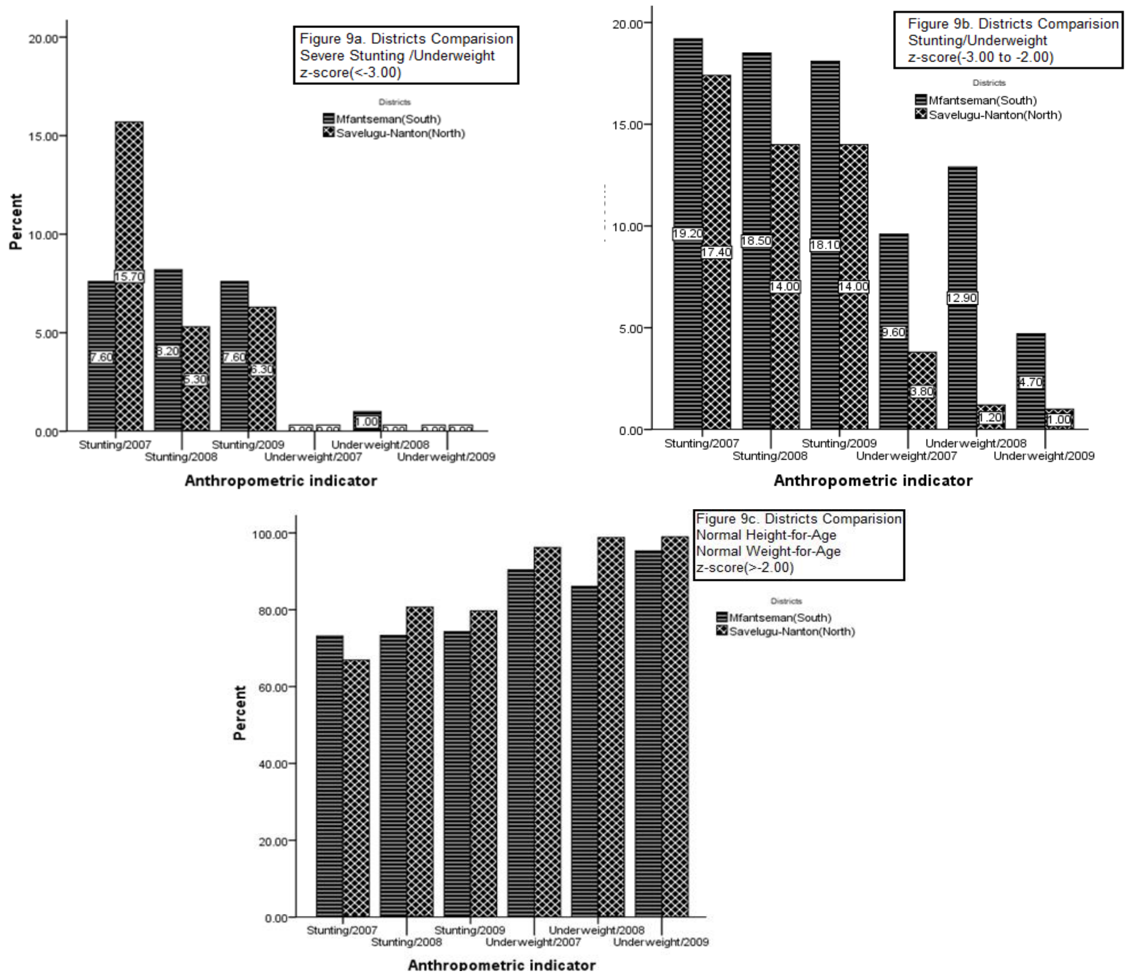
For the indicator BMI – for- age, results shown in (Figures 7d and 7e in Appendix M) indicate that children attending rural schools were more likely to be either severely thin or thin for their ages as compared to children enrolled in urban schools.

For BMI status, there was a significant higher prevalence of severe body thinness-for-age (BMI-for-age below -3SD) and thinness- for- age (BMI-for-age below -2SD) among children living in rural areas compared to those living in urban areas in Savelugu-Nanton district. Surprisingly, a higher proportion of the children living in rural areas were overweight and obese as compared to children living in urban areas. An explanation of this observation can be attributed to the emergence of the issue of “Nutrition transition” facing many developing countries where there has been evidence that experiences with under- nutrition during the childhood stages of life causes permanent changes in the physiological make-up of children. This may predispose them to certain health conditions associated with overweight and obesity (Lobstein et al., 2004; Martins et al., 2004; Monteiro et al., 2005 and Sawaya et al., 2005). The emergence of this has now led to a transition in diet and physical activity patterns, leading to intakes of high energy-dense and fatty foods in addition to sedentary lifestyles among poor populations.

4.4 Comparison of Prevalence of Anthropometric Indicators between Districts

Descriptive results based on stunting status for the two districts are presented in Figures 9a, 9b and 9c. Results assessing the differences between the two districts at the gender and class levels are shown in Table 18 in the Appendix.

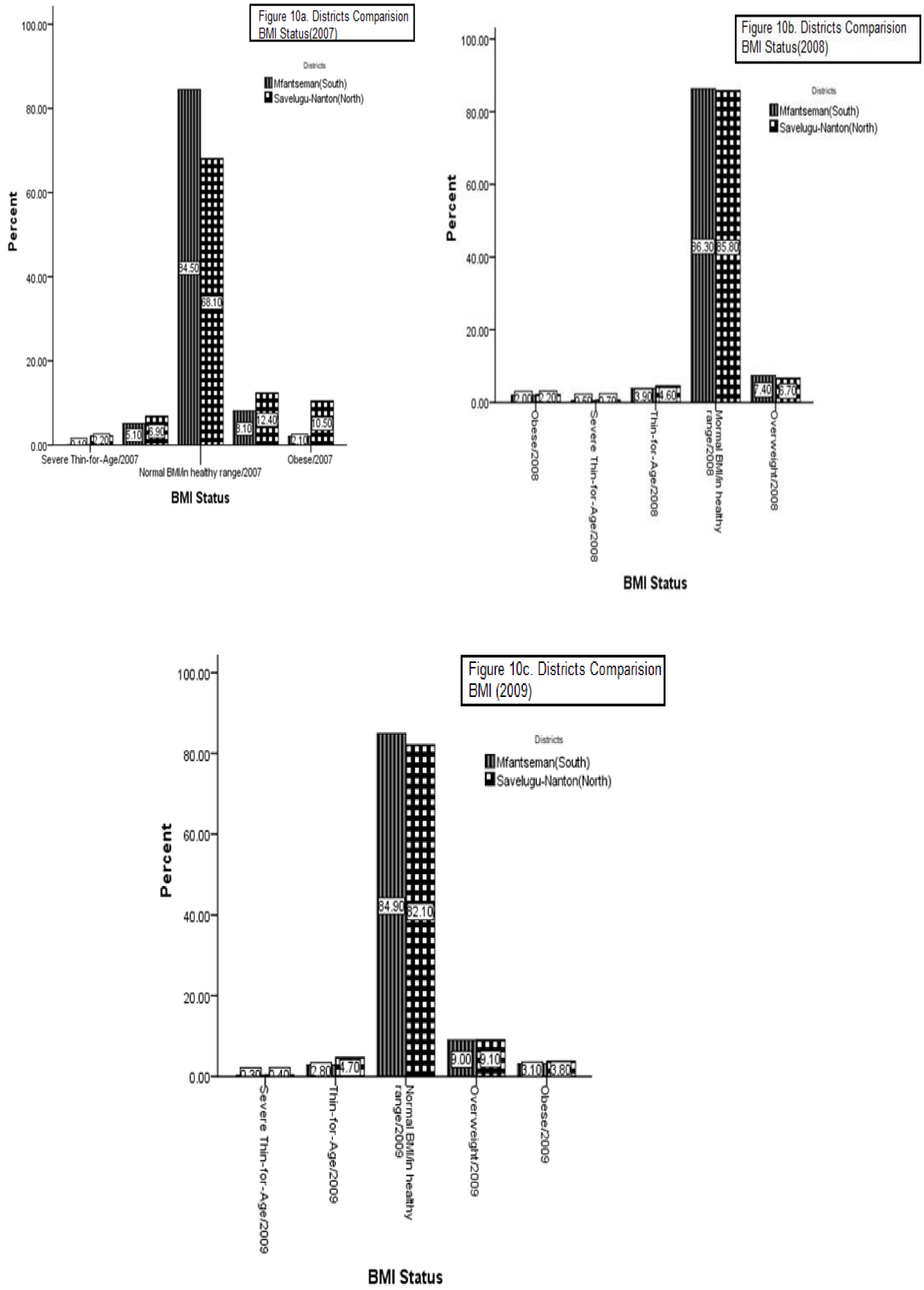
Figures 9a, 9b and 9c: Comparison of Prevalence of stunting/Underweight between Districts. 9a) District comparisons, Severe stunting/underweight, z-score (< -3.00); 9b) District comparisons, stunting/underweight, z-score (-3.00 to -2.00); 9c) District comparisons, Normal height-for-age, Normal weight-for-age, z-score (< -3.00)



The mean value of stunting (HAZ) was approximately -1.0 across the three years for both districts indicating that generally, the population of school children in both districts could be described as exhibiting a mild form of stunting based on the WHO malnutrition classification system (Cogill, 2002). Results from Table 3 indicate that generally children in both districts are likely to fall below the median BMI reference value within their age group.

There was a significant difference with regards to stunting categories when the years were compared between the two districts (Table 6). The results illustrated in Figure 9a indicate that generally children in Savelugu-Nanton district are affected by severe stunted growth (z- score < -3) more than children in Mfantseman district. However with regards to the stunting and underweight (z-score -3.00 to -2.00), a higher prevalence were observed among children in Mfantseman than Savelugu-Nanton district in all the three years. A comparison of the prevalence of stunting between the districts (Table 13) showed a significantly higher prevalence of severe stunted growth among children in Savelugu-Nanton as compared to Mfantseman in both 2007 and 2009. A possible reason that can be attributed to this observation is that the northern part of Ghana experiences a unimodal wet season, and therefore, only one rainy season from July to September, making the population more susceptible to seasonal food shortages than the people in the southern part who experience a bimodal rainfall and two harvesting periods. As a result of this, food insecurity persists in the northern part of Ghana affecting vulnerable groups such as children mainly due to unstable food production, insufficient purchasing power and problems of physical access due to a lack of road infrastructure in the northern part of the country. (Agble et al., 2009) It is therefore likely that households in Savelugu-Nanton district are confronted with annual periods of drought, famine and food shortages that affect the nutritional status of children. As a result of poverty and the food insecurity status of populations in northern Ghana, it is likely that dietary intakes are less diversified particularly with a reduced intake of animal-based foods and other protein rich foods such as meat, fish, and poultry products among children in Savelugu-Nanton district. Other risk factors that may lead to poor growth among children include persistent intestinal infection and frequent malaria attacks (Ministry of Health, 1998; Asibey-Berko et al., 1999; Grantham-McGregor and Ani, 2001). Some of the above-mentioned factors might have contributed to the high prevalence of stunted growth among this population as reported in some studies conducted in other districts in Ghana (Anderson et. al, 2010). Studies which have assessed the effects of stunting from an educational perspective indicate that stunting is associated with non-enrolment or delayed-enrolment (Beasley et.al, 2000), poorer cognitive function, poor school attendance and school performance (Mosley et al, 1990; Galal and Hulett, 2003). Children in Savelugu-Nanton, because of the higher prevalence of severe stunted growth, are more likely to be predisposed to the above-mentioned problems than their counterparts in Mfantseman district.

Figures 10a, 10b and 10c: Comparison of BMI Status by year between Districts. 10a) District comparisons, BMI status (2007); 10b) District comparisons, BMI status (2008); 10c) District comparisons, BMI status (2009)



Results presented in Figures 10a, 10b and 10c indicate that there was a significantly higher prevalence of both severe thinness and thinness- for- age among children in Savelugu-Nanton as compared to Mfantseman district. Similarly, a significantly higher prevalence of overweight and obesity was observed among the Savelugu-Nanton population as compared to the Mfantseman population. The results suggest that more school children in Savelugu-Nanton are likely to be affected by malnutrition. Therefore, children in Savelugu-Nanton are more susceptible to stunted growth than children in Mfantseman.

Table 6: Difference in BMI and Stunting between Districts: Year, Gender and Class levels

Variable	***p-value***
Year Comparison between District	
BMI Z-scores	0.230
BMI Categories	0.004*
Stunting Z-scores	0.001*
Stunting Categories	0.001*
Gender	
BMI Z-scores	0.517
BMI Categories	0.015*
Stunting Z-scores	0.001*
Stunting Categories	0.001*
Class	
BMI z-scores	0.354
BMI Categories	0.011*
Stunting Z-scores	0.001*
Stunting Categories	0.001*

*Difference is significant at the 0.05 level

4.5 Nutritional Status and Age at Enrolment into Primary School

Data collected on the ages at which children enrolled in Primary 1 was used to investigate the extent to which children enrolled late in school, an index for the purpose of this study categorised into two groups and termed as overage by 2 to 3 years or overage by 4 or more years. The relationship between age of enrolment (categorised into age brackets) and anthropometric indicators were assessed. In analysing the data it was assumed that the index overage refers mainly to delayed enrolment and not class repetition.

As shown in Figure 11, the majority of the children in both districts fell within the overage categories presenting an overall picture of delayed primary school enrolment in both districts.

Figure 11: District Comparison -Age Brackets of Primary 1 School Children

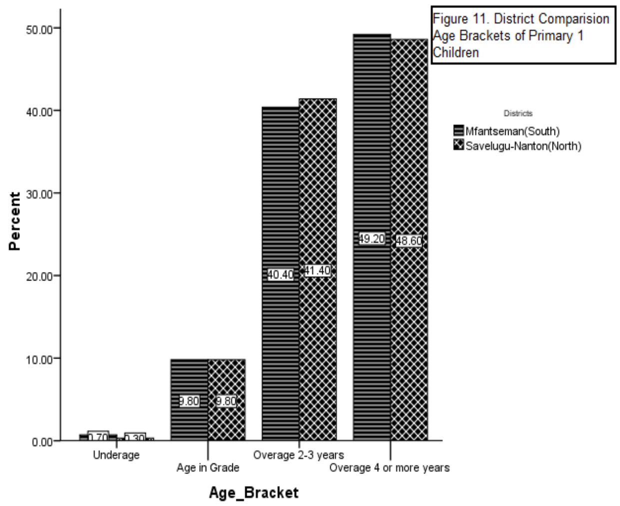
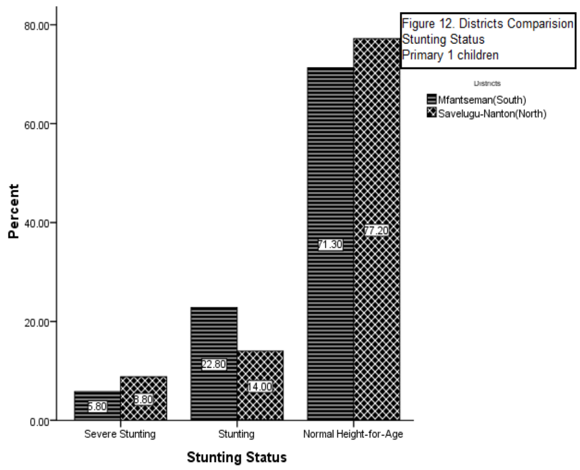


Figure 12: District Comparisons - Stunting Status of Primary 1 School Children



Data were analysed for (HAZ-171, WAZ-131, and BMIZ-169) indices of Class 1 children from 7 primary schools in Mfantseman district and for (HAZ-193, WAZ-149 and BMIZ-191) children from 6 primary schools in the Savelugu-Nanton district.

Table 7 shows means of HAZ, WAZ and BMIZ for the age bracket categories of the children. The results presented in Table 7, indicate that generally, the mean z-score values for each indicator decreased with an increase in age (from underage through to the overage categories) for all districts except for BMIZ within the age bracket categories of the Savelugu-Nanton class one population. The mean z-score values were significantly different between the age categories for all indicators except for BMIZ within the Mfantseman population (Table 7). The results also indicate that, in both districts among the Primary 1 population, a high negative deviation from the median value for stunting and underweight z-scores are likely to be found among older pupils (overage by 2 or more years) than younger pupils (underage for their grade). This corroborates the idea that overage children tend to enrol late, if households are judging readiness for school purely on the basis of height.

Table 7: Mean comparison of Anthropometric indicators between age brackets of class 1 pupils within districts

District	Age Bracket	N (%)	HAZ Mean (SD)	BMIZ Mean(SD)	WAZ Mean(SD)
Mfantseman	Underage	1(0.6)	3.56	1.492	4.32
	Age in Grade	24(14.1)	0.26(1.45)[a]	-0.27(0.98)	0.08(1.42)[a]
	Overage 2-3 yrs	83(48.5)	-0.82(1.46)[a]	-0.54(0.99)	-0.82(1.37)[a]
	Overage ≥ 4yrs	63(36.8)	-1.79(1.42)[a]	-0.67(1.14)	-0.93(1.05)[a]
	Total	171(100.0)	-1.00(1.63)[a]	-0.54(1.06)	-0.64(1.42)[a]
Savelugu-Nanton	Underage	-	-	-	-
	Age in Grade	21(10.9)	0.43(1.10)[a]	0.18(0.88)[a]	0.48(1.18)[a]
	Overage 2-3 yrs	88(45.6)	-0.27(1.90)[a]	0.38(1.58)[a]	0.11(1.30)[a]
	Overage ≥ 4yrs	84(43.5)	-1.53(1.91)[a]	-0.89(1.78)[a]	-0.99(1.04)[a]
	Total	193(100.0)	-0.74(1.96)[a]	-0.20(1.72)[a]	-0.13(1.33)[a]

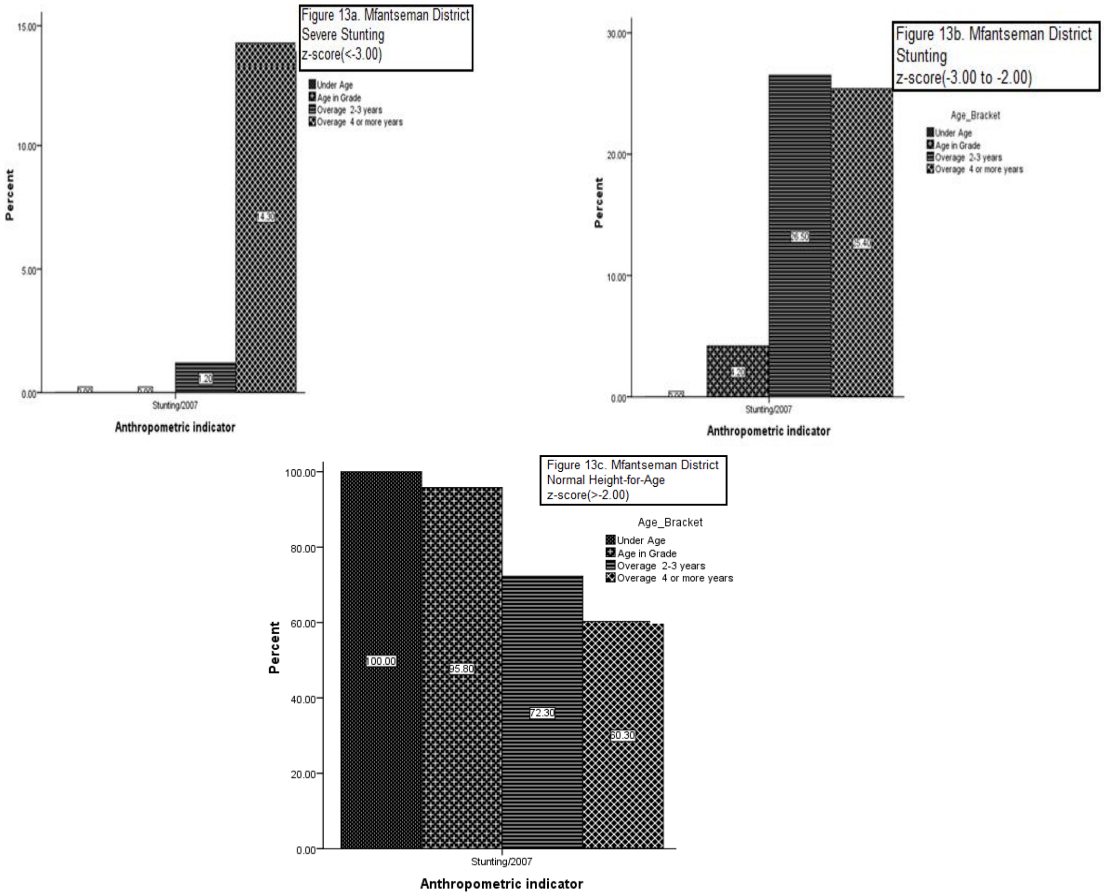
Superscripts **a** represents statistically significant differences between age brackets within a district ($p<0.05$)

The above results are supported by the results given in (Table 16 and 17 in the Appendix) where proportions of categories for anthropometric indicators by age bracket and sex are presented. In both populations in the two districts, no child was severely stunted or underweight and only one child was stunted and underweight among the age in grade group (Table 16 and 17 in the Appendix). In both districts, the majority of the children who were either severely stunted or stunted were found within the overage groups as shown in Figures 13a, 13b, 14a and 14b (see Table 16 and 17 in the Appendix). A possible explanation of this observation is that, majority of children are more likely to enrol late into primary school as a result of their poor nutritional status. It is likely that as a result of appearing physically short in height and underweight in size although older, parents' and guardians' decisions regarding a child's readiness to start school might have been influenced and therefore might have prevented majority of the children from starting school at the recommended age of 6 years. Our finding confirms Glewwe and Jacoby (1995) reports that children in Ghana were enrolling late or not enrolling at all because of their poor nutritional status measured by their short height for their age. In addition, Fentiman and Hall (1997) on the basis of studies conducted in Ghana indicated that non-enrolled children were shorter and underweight than their school going counterparts. Furthermore, findings of similar studies conducted in other developing countries revealed that poor health and nutritional status can determine to a larger extend the age that a child will start schooling (Jamison, 1986; Moock and Leslie, 1986;

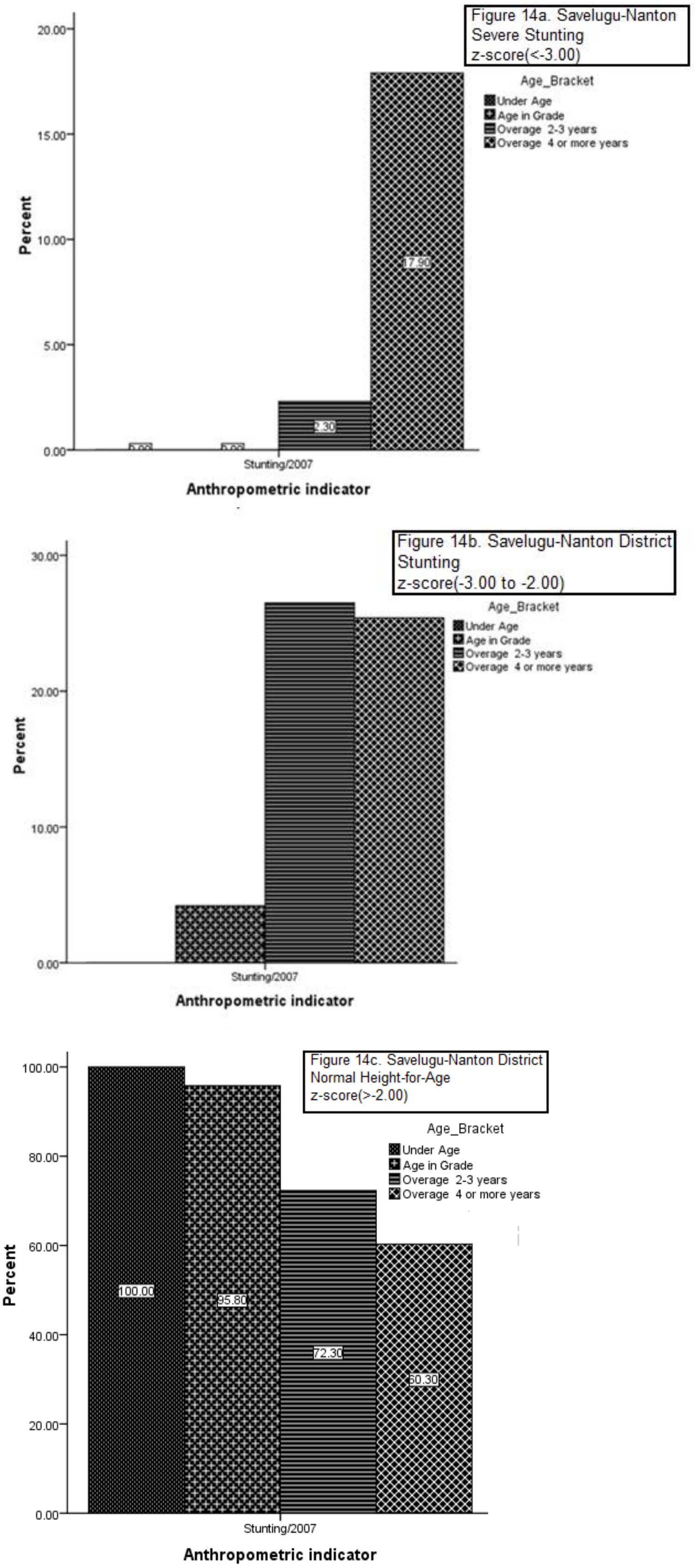
Glewwe and Jacoby, 1995; Brooker et al, 1999). Our findings therefore emphasis that children who are of normal stature are more likely to enroll in school earlier at the expected age of enrolment than those who are shorter than expected for their ages.

Other implications on the issue of late enrolment is that children who enrol late into school are at a higher risk of attending school irregularly, are low-achievers, are more likely to repeat grades and are at a higher risk of dropping out before completing primary school (Ananga, 2010; Nonoyama-Tarumi et. al, 2010 and Wils, 2004). Furthermore, at the classroom level, when students fail to enroll at the recommended age, teachers are confronted with a pedagogical challenge of teaching students of varied ages in one classroom having differing levels of maturity (Fentiman et al. 1999; Nonoyama-Tarumi et. al, 2010).

Figures 13a, 13b and 13c: Stunting Categories by Age Brackets of Primary One Children in Mfantseman District. 13a) Mfantseman District, severe stunting, z-score (< -3.00); 13b) Mfantseman District, stunting, z-score (-3.00 to -2.00); 13c) Mfantseman District, normal height-for-age, z-score (>-2.00)

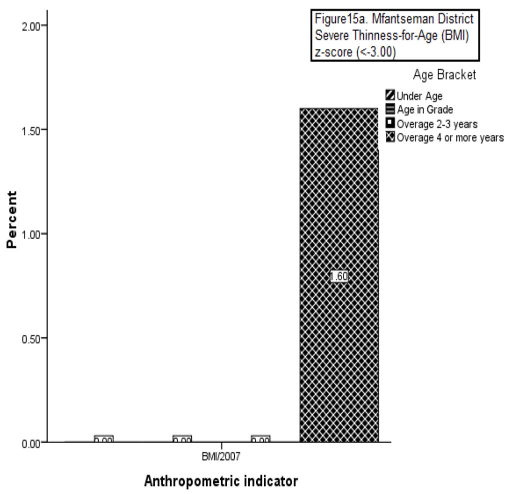


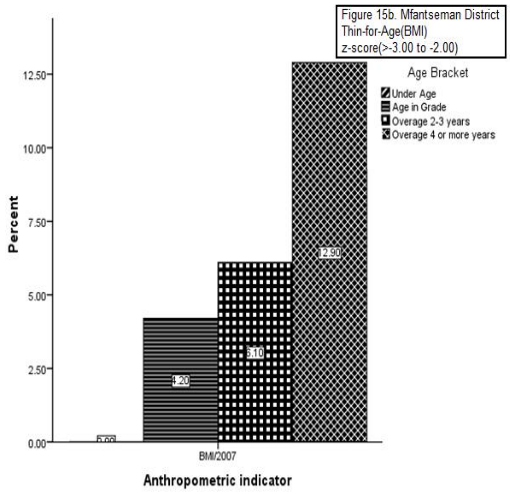
Figures 14a, 14b and 14c: Stunting Categories by Age Brackets of Primary One Children in Savelugu-Nanton District. 14a) Savelugu-Nanton District, severe stunting, z-score (< -3.00); 14b) Savelugu-Nanton District, stunting, z-score (-3.00 to -2.00); 14c) Savelugu-Nanton District, normal height-for-age, z-score (>-2.00)

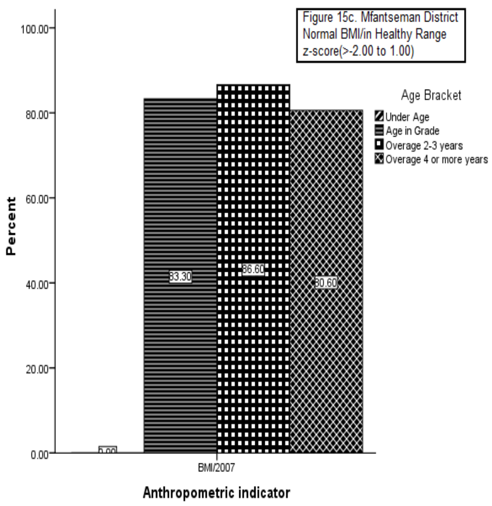


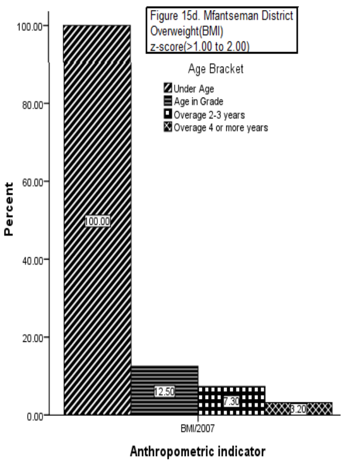
On the other hand, Figures 13c and 14c indicate that in both districts, the majority of the children who had normal heights for their ages were found among the underage and correct age in grade groups. Within the overage by 2-3 years and overage by four or more years groups a total percentage of 39.6% and 36.9% of the children in Mfantseman and Savelugu-Nanton districts were found to be either severely stunted or stunted (See Tables 16 and 17 in the Appendix). According to the WHO epidemiological criteria for assessing the severity of undernutrition in populations, these prevalence values mentioned above in both districts are described as being highly severe in these populations (Gorstein, 1994) and therefore deserve to be addressed immediately. This also highlights the relationship between poor nutrition and the problem of over age in grade pupils which CREATE research has found to be endemic in Ghanaian education.

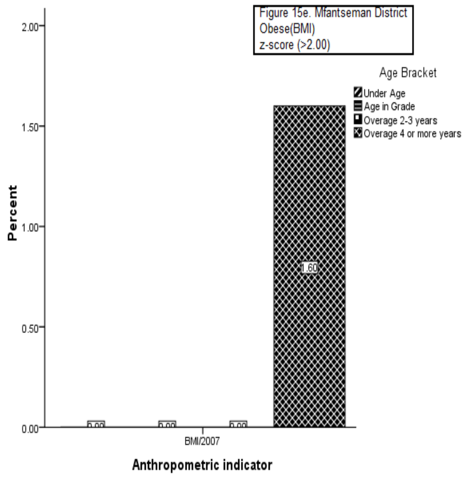
Figures 15a, 15b, 15c, 15d and 15e: BMI Categories by Age Brackets of Primary One Children in Mfantseman District. 15a)Mfantseman District, severe thinness-for-age, z-score (< -3.00); 15b) Mfantseman District, Thin-for-age, z-score (-3.00 to -2.00); 15c) Mfantseman District, normal BMI/ in healthy range z-score (>-2.00 to 1.00); 15d) Mfantseman District, overweight (BMI) z-score (>-1.00 to 2.00); 15e) Mfantseman District, Obese (BMI) z-score (>2.00)











Similarly, majority of children in both districts described as being either severely thin or thin for their ages (low BMIZ) were found among the overage group of children as presented in Figures 15a, 15b, (16a and 16b in the Appendix).

There was a significant negative correlation between stunting, underweight and BMI and the age of enrolling into primary school (Table 8), suggesting that older children were significantly more stunted, underweight and thin for their age than the younger children which can be attributed to delayed entry into primary school. These results strongly suggest that early childhood malnutrition (decrease in growth in stature and weight) is the cause of delayed enrolment and continues to affect age of enrolment into primary school in both districts. The highest correlation was observed for the stunting index. These findings are consistent with the findings of the Partnership for Child Development, (1998) and Brooker et. al, (1999) studies in Ghana and Tanzania, where they indicated that stunted children enrolled later in school and were more likely to drop out earlier. Similarly, Moock and Leslie (1986) reported that nutritional status as measured by height-for-age was a significant determinant of both school enrolment and grade attainment among primary school children in the Terai region of Nepal (Moock and Leslie, 1986). Our finding confirms those of similar studies conducted in Ghana which indicates that children were enrolling late or not enrolling at all because of their poor nutritional status indicated by their short height for their age (Glewwe and Jacoby, 1995; Fentiman and Hall, 1997).

More than a decade after these studies were conducted in Ghana, the story remains unchanged; findings of this study indicate that the problem still persists; parents continue to make decisions with regards to the readiness of their children to start school based on their stature and weight rather than their age.

Table 8: Relationship between Anthropometric Indicators and Age at Enrolment of Class 1 Pupils

Variable	**r (*p-value)***
Mfantseman District Age of Enrolment	
Stunting (HAZ) 2007	-0.523(0.001)*
BMI status 2007	-0.245(0.001)*
Underweight (WAZ) 2007	-0.401(0.001)*
Savelugu-Nanton Age of Enrolment	
Stunting (HAZ) 2007	-0.523(0.001)*
BMI Status 2007	-0.355(0.001)*
Underweight (WAZ) 2007	-0.457(0.001)*

* Correlation is significant at the 0.05 level

5. Conclusion

In this paper, findings about the relationship between the nutritional status and some educational indicators of school children and how these relationships can influence access to primary education are presented.

A comparison between classes of school children revealed that in both districts, children in Primary 1 were more likely to be stunted and underweight as compared to children in the upper classes. This has implications where stunted children in lower grades are more likely to end up repeating grades, drop out of school and therefore are more unlikely to complete primary education.

In both districts a higher proportion of children attending rural schools were more likely to be stunted than those attending schools situated in urban areas although the difference was not statistically significant. This finding suggests that children in rural areas are more likely to be confronted by problems of delayed school enrolment; higher school dropouts rates and as such are more unlikely to complete basic education as compared to children in urban areas.

A comparison between the districts showed that children in Savelugu-Nanton, because of the higher prevalence of severe stunted growth, are more likely to be predisposed to problems of delayed school enrolment, dropping out of school and inability to complete primary education than their counterparts in Mfantseman district.

In both districts, no child was severely stunted or underweight among the age in grade group. On the other hand, in both districts, the majority of the children who were stunted or underweight (low BMI) were found within the overage groups. This implies that a positive relationship exist between poor nutritional status and delayed school enrolment among children in both districts. Most children are enrolling late into school because of their poor nutritional status which affected their growth and development physically and therefore might have influences on parent's decisions regarding readiness of a child to start school. These results strongly suggest that early childhood malnutrition (decrease in growth in stature and weight) is one potential cause of delayed enrolment into primary schools in both northern and southern Ghana and as such is a potential barrier to ensuring that every child has access to basic education in Ghana. In addition findings of this study, indicates that poor nutritional status of school children is a potential contributory factor which can contribute largely to educational exclusion with most children likely to find themselves within zones 2 and 3 of the CREATE zones of Access Model.

6. Policy Recommendations

On the basis of the findings, it is evident that stunting and low BMI-for –age (body thinness) are common problems that confront primary-school children living in both the northern and southern parts of Ghana.

The evidence given is sufficient to particularly implement interventions that will address both pre-natal and nutritional deprivations during pregnancy since irreversible growth defects can start from conception. Examples of programmes include the implementation of most nutrition intervention programmes during antenatal care (ANC) visits of expecting women through to the infancy stage of the baby. These interventions will ensure that both the mother and infant leave the childbirth experience in the desired optimal physical and mental condition.

Other interventions geared toward improving the nutritional status of vulnerable/disadvantage children are known and should be intensified and projected to other poor rural communities grappling with poor nutritional and health issues. These include the distribution of nutritional supplements (such as folic acid, iron and multi-vitamin) to pregnant women through Ministry of Health approved health facilities and the intensification of nutrition education programmes during ANC visits of expecting mothers. This is necessary because based on the 2008 findings of the GDHS, malnutrition was found to be associated with the mother's level of nutritional education. Children whose mothers had some form of nutritional knowledge through education were less likely to be malnourished than children whose mothers had little or no education. Educational programmes should include the promotion of early breastfeeding and introduction of appropriate complementary foods. In addition, expecting mothers should be educated on how to combine nutritious food items in the preparation of nutritious meals to meet the nutritional demands throughout the pregnancy period and ensure optimal growth of the unborn baby. The use of highly nutritious food items that are especially locally grown should be encouraged by health care professionals (nurses and midwives).

After birth, interventions aimed at reducing malnutrition, particularly undernutrition and micronutrient deficiency diseases, must be implemented earlier, particularly in the first two years of a child's life. Furthermore, the setting up of Community Management Acute Malnutrition (CMAM) programme centres must be projected to more poor communities. Under the CMAM programme children suffering from malnutrition when identified earlier can receive the necessary attention and treatment before severe growth and developmental defects occur. Other options include the setting-up of child welfare clinics and other health facilities which can help in monitoring children suffering from malnutrition.

Policies of the Ministries of Health, Agriculture and Education when integrated can be more effective and help tackle most nutritional and health issues that directly affect education. The Ministry of Health's nutrition department can liaise with the Ministry of Agriculture in identifying communities where particularly nutritious crops grow well and can be bought directly from farmers at cheaper prices. These food items can be sold at subsidised prices to expectant mothers during ANC visits in Ministry of Health approved health facilities especially in areas where particular nutritious food items are expensive. Health facilities, therefore will serve as ready markets for farmers, boosting the agricultural sector, while the nutritional needs of mothers and their children are met, thereby improving the health care of the population.

In addition, although responses of the educational system in meeting children's health and nutrition needs is expanding, it lacks the necessary urgency needed to tackle the problems that confronts particularly disadvantaged children before damages during growth occurs and becomes in most cases impossible to reverse. In Ghana commendable intervention programmes such as the Ghana School Feeding Programme can only address short-term hunger but may not correct any growth defects such as stunted growth which might have occurred during the first 24 months of a child's life. Most of the intervention programmes remain unfocused and are still limited in scope. These programmes should be targeted at populations who actually need them. Well-targeted programmes will improve the nutritional status of children, thereby increasing accessibility to primary education. A suggestion, worth considering is implementing food for education programmes such as the Ghana School Feeding Programme particularly during the pre-school years in crèches and kindergartens and more importantly "tailoring" these interventions to disadvantaged poor communities.

Another intervention that can be considered is developing and providing fortified complementary food products to infants and pre-school children living in deprived poor communities.

In conclusion, it is important to emphasise that the above-mentioned interventions are more effective during the prenatal period through to the first two years of a child's life when growth defects can occur. Without addressing nutritional issues in early childhood Ghana will not solve the problem of overage children in school and will therefore not meet the Millennium Development Goal of Universal Primary Enrolment by 2015.

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Appendices

Appendix A

Table 9: Z scores distribution of Height- for- Age (HAZ) and Weight- for-Age (WAZ) by Sex and Classes for Mfantseman District

Variable	Z scores	HAZ/07	HAZ/08	HAZ/09	WAZ/07	WAZ/08	WAZ/09
		n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Sex	< -3.00	41(10.0)	32(9.7)	20(8.9)	**-**	1(1.9)	-
Male	-3.00 to -2.00	102(24.9)	81(24.5)	37(16.5)	9(9.6)	7(13.2)	1(3.6)
	>-2.00	267(65.1)	217(65.8)	167(74.6)	85(90.4)	45(84.9)	27(96.4)
	Total	**410(100.0)**	**330(100.0)**	**224(100.0)**	**94(100.0)**	**53(100.0)**	28(100.0)
Female	< -3.00	16(4.7)	17(6.3)	12(6.1)	**-**	0(0.0)	**-**
	-3.00 to -2.00	42(12.4)	30(11.2)	39(19.8)	7(9.7)	6(12.5)	1(6.7)
	>-2.00	281(82.9)	222(82.5)	146(74.1)	65(90.3)	42(87.5)	14(93.3)
	Total	**339(100.0)**	**269(100.0)**	**197(100.0)**	**72(100.0)**	**48(100.0)**	**15(100.0)**
Class	< -3.00	10(5.8)	19(10.4)	11(7.1)	**-**	1(1.1)	2(4.8)
	-3.00 to -2.00	39(22.8)	38(20.8)	36(23.4)	16(12.2)	13(13.8)	40(95.2)
Primary 1	>-2.00	122(71.3)	126(68.9)	107(69.5)	115(87.8)	80(85.1)	**42(100.0)**
	Total	**171(100.0)**	**183(100.0)**	**154(100.0)**	**131(100.0)**	**94(100.0)**	
Primary 4	< -3.00	21(10.0)	19(13.9)	15(10.6)	**-**	0(0.0)	**-**
	-3.00 to -2.00	38(18.2)	27(19.7)	28(19.7)	0(0.0)	0(0.0)	0(0.0)
	>-2.00	150(71.8)	91(66.4)	99(69.7)	25(100.0)	2(100.0)	1(100.0)
	Total	**209(100.0)**	**137(100.0)**	**142(100.0)**	**25(100.0)**	**2(100.0)**	**1(100.0)**
Primary 6	< -3.00	16(8.9)	5(3.7)	6(5.4)	**-**	0(0.0)	**-**
	-3.00 to -2.00	31(17.3)	26(19.4)	9(8.1)	0(0.0)	0(0.0)	**-**
	>-2.00	132(73.7)	103(76.9)	96(86.5)	8(100.0)	3(100.0)	**-**
	Total	**179(100.0)**	**134(100.0)**	**111(100.0)**	**8(100.0)**	**3(100.0)**	**-**
JHS 1	< -3.00	10(5.3)	6(4.1)	0(0.0)	-	0(0.0)	**-**
	-3.00 to -2.00	36(18.9)	20(13.8)	3(21.4)	0(0.0)	0(0.0)	**-**
	>-2.00	144(75.8)	119(82.1)	11(78.6)	2(100.0)	2(100.0)	**-**
	Total	**190(100.0)**	**145(100.0)**	**14(100.0)**	**2(100.0)**	**2(100.0)**	**-**

Note. < -3 means values moving further away from the mean (i.e. an even more deviant situation, severe/critical cases), -3.00 to -2.00 (values deviant from the mean, stunted/underweight) ; >- 2.00 means values moving towards 0 (becoming less deviant from the median value and described as being normal or within the healthy range)

Appendix B

Table 10: Z scores distribution of BMI-for- age by Sex and Classes for Mfantseman District

Variable	Z-score	BMIZ/07	BMIZ/08	BMIZ/09
		n (%)	**n (%)**	**n (%)**
Sex	**<-**3.00	1 (0.2)	1(0.3)	1(0.5)
	-3.00 to -2.00	22 (5.4)	15(4.6)	9(4.1)
Male	> -2.00 to 1.00	350 (85.2)	295(89.9)	182(83.9)
	>1.00 to 2.00	32 (7.8)	14(4.3)	19(8.8)
	> 2.00	6 (1.5)	3(0.9)	6(2.8)
	Total	**411(100.0)**	**328(100.0)**	**217(100.0)**
	<-3.00	0 (0.0)	2(0.7)	0(0.0)
	-3.00 to -2.00	16 (4.7)	8(3.0)	2(1.2)
Female	> -2.00 to 1.00	283 (83.7)	220(81.8)	149(86.1)
	>1.00 to 2.00	29 (8.6)	30(11.2)	16(9.2)
	> 2.00	10 (3.0)	9(3.30	6(3.5)
	Total	**338 (100.0)**	**269(100.0)**	**173(100.0)**
Class	**<-**3.00	1(0.6)	0(0.0)	1(0.7)
	-3.00 to -2.00	14(8.3)	6(3.3)	4(2.6)
Primary 1	> -2.00 to 1.00	141(83.4)	159(87.8)	128(84.8)
	>1.00 to 2.00	12(7.1)	13(7.2)	13(8.6)
	> 2.00	1(0.6)	3(1.7)	5(3.3)
	Total	**169(100.0)**	**181(100.0)**	**151(100.0)**
	<-3.00	0(0.0)	3(2.2)	0(0.0)
	-3.00 to -2.00	13(6.2)	6(4.4)	4(3.1)
Primary 4	> -2.00 to 1.00	179(85.2)	114(83.2)	110(84.6)
	>1.00 to 2.00	15(7.1)	11(8.0)	13(10.0)
	> 2.00	3(1.4)	3(2.2)	3(2.3)
	Total	**210(100.0)**	**137(100.0)**	**130(100.0)**
	<-3.00	0(0.0)	0(0.0)	0(0.0)
	-3.00 to -2.00	5(2.8)	7(5.3)	3(2.8)
Primary 6	> -2.00 to 1.00	152(84.9)	108(81.2)	91(85.8)
	>1.00 to 2.00	17(9.5)	13(9.8)	8(7.5)
	> 2.00	5(2.8)	5(3.8)	4(3.8)
	Total	**179(100.0)**	**133(100.0)**	**106(100.0)**
	<-3.00	0(0.0)	0(0.0)	0(0.0)
	-3.00 to -2.00	6(3.1)	4(2.7)	0(0.0)
JHS 1	> -2.00 to 1.00	161(84.3)	134(91.8)	2(66.7)
	>1.00 to 2.00	17(8.9)	7(4.8)	1(33.3)
	> 2.00	7(3.7)	1(0.7)	0(0.0)
	Total	**191(100.0)**	**146(100.0)**	**3(100.0)**

Note: < -3 means values moving further away from the mean (i.e. Severe thinness), -3.00 to -2.00 (thinness); >-2.00 to 1.00 means values moving towards 0 (normal, in healthy range); >1.00 to 2.00(overweight) and >2.00(obese)

Appendix C

Table 11: Z scores distribution of Height- for- Age (HAZ) and Weight-for-Age (WAZ) by School Location in Mfantseman District

Variable	Z scores	HAZ/07	HAZ/08	HAZ/09	WAZ/07	WAZ/08	WAZ/09
		n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
School Location Rural	< -3.00	34(10.4)	33(10.9)	22(10.5)	0(0.0)	1(2.2)	0(0.0)
	-3.00 to -2.00	60(18.4)	64(21.2)	38(18.1)	3(4.5)	6(13.0)	2(6.9)
	>-2.00	232(71.2)	205(67.9)	150(71.4)	64(95.5)	39(84.8)	27(93.1)
	Total	**326(100.0)**	**302(100.0)**	**210(100.0)**	**67(100.0)**	**46(100.0)**	**29(100.0)**
Urban	< -3.00	23(5.4)	17(5.7)	10(4.8)	0(0.0)	0(0.0)	0(0.0)
	-3.00 to -2.00	84(19.8)	47(15.8)	38(18.1)	13(13.1)	7(12.7)	0(0.0)
	>-2.00	317(74.8)	234(78.5)	162(77.1)	86(86.9)	48(87.3)	13(100.0)
	Total	**424(100.0)**	**298(100.0)**	**210(100.0)**	**99(100.0)**	**55(100.0)**	**13(100.0)**
Total	< -3.00	57(7.6)	50(8.3)	32(7.6)	0(0.0)	1(1.0)	0(0.0
	-3.00 to -2.00	144(19.2)	111(18.5)	76(18.1)	16(9.6)	13(12.9)	2(4.8)
	>-2.00	549(73.2)	439(73.2)	312(74.3)	150(90.4)	87(86.1)	40(95.2)
	Total	**750(100.0)**	**600(100.0)**	**420(100.0)**	**166(100.0)**	**101(100.0)**	**42(100.0)**

Appendix D

Table 12: Z scores distribution of BMI-for- Age by School Location for Mfantseman District

Variable	Z-score	BMIZ/07	BMIZ/08	BMIZ/09
		n (%)	**n (%)**	**n (%)**
School Location	<-3.00	1(0.3)	1(0.3)	0(0.0)
	-3.00 to -2.00	8(2.4)	13(4.3)	2(1.2)
	> -2.00 to 1.00	285(87.2)	260(86.7)	146(86.4)
Rural	>1.00 to 2.00	25(7.6)	23(7.7)	17(10.1)
	> 2.00	8(2.4)	3(1.0)	4(2.4)
	Total	**327(100.0)**	**300(100.0)**	**169(100.0)**
	<-3.00	1(0.2)	3(1.0)	1(0.5)
	-3.00 to -2.00	30(7.1)	10(3.4)	9(4.1)
Urban	> -2.00 to 1.00	348(82.3)	254(85.2)	185(83.7)
	>1.00 to 2.00	36(8.5)	21(7.0)	18(8.1)
	> 2.00	8(1.9)	10(3.4)	8(3.6)
	Total	**423(100.0)**	**298(100.0)**	**221(100.0)**
	<-3.00	2(0.3)	4(0.7)	1(0.3)
	-3.00 to -2.00	38(5.1)	23(3.8)	11(2.8)
Total	> -2.00 to 1.00	633(84.4)	514(86.0)	331(84.9)
	>1.00 to 2.00	61(8.1)	44(7.4)	35(9.0)
	> 2.00	16(2.1)	13(2.2)	12(3.1)
	Total	**750(100.0)**	**598(100.0)**	**390(100.0)**

Appendix E

Table 13: Z scores distribution of Height- for- Age (HAZ) and Weight- for-Age (WAZ) by Sex and Classes for Schools in Savelugu-Nanton District

Variable	Z scores	HAZ/07	HAZ/08	HAZ/09	WAZ/07	WAZ/08	WAZ/09
		n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Sex	< -3.00	84(18.1)	37(7.5)	19(6.2)	0(0.0)	0(0.0)	0(0.0)
Male	-3.00 to -2.00	78(16.8)	83(16.7)	53(17.3)	5(5.3)	1(1.3)	0(0.0)
	>-2.00	303(65.2)	376(75.8)	234(76.5)	89(94.7)	78(98.7)	50(100.0)
	Total	**465(100.0)**	**496(100.0)**	**306(100.0)**	**94(100.0)**	**79(100.0)**	50(100.0)
Female	< -3.00	27(11.1)	7(2.1)	14(6.5)	0(0.0)	0(0.0)	0(0.0)
	-3.00 to -2.00	45(18.5)	32(9.8)	20(9.3)	1(1.5)	1(1.2)	1(2.0)
	>-2.00	171(70.4)	289(88.1)	181(84.2)	64(98.5)	85(98.8)	48(98.0)
	Total	**243(100.0)**	**328(100.0)**	**215(100.0)**	**65(100.0)**	**86(100.0)**	**49(100.0)**
Class	< -3.00	17(8.8)	9(3.0)	21(7.9)	0(0.0)	0(0.0)	0(0.0)
	-3.00 to -2.00	27(14.0)	33(11.1)	35(13.1)	5(3.4)	2(1.2)	1(1.0)
Primary 1	>-2.00	149(77.2)	256(85.9)	211(79.0)	144(96.6)	163(98.8)	98(99.0)
	Total	**193(100.0)**	**298(100.0)**	**267(100.0)**	**149(100.0)**	**165(100.0)**	**99(100.0)**
Primary 4	< -3.00	52(27.4)	14(6.5)	5(4.8)	0(0.0)	-	-
	-3.00 to -2.00	38(20.0)	39(18.2)	21(20.0)	1(11.1)	-	-
	>-2.00	100(52.6)	161(75.2)	79(75.2)	8(88.9)	-	-
	Total	**190(100.0)**	**214(100.0)**	**105(100.0)**	**9(100.0)**	-	-
Primary 6	< -3.00	19(13.2)	12(7.5)	7(4.7)	-	-	-
	-3.00 to -2.00	32(22.2)	28(17.5)	17(11.5)	-	-	-
	>-2.00	93(64.6)	120(75.0)	124(83.8)	-	-	-
	Total	**144(100.0)**	**160(100.0)**	**148(100.0)**	-	-	-
JHS 1	< -3.00	23(12.7)	9(5.9)	0(0.0)	0(0.0)	-	-
	-3.00 to -2.00	26(14.4)	15(9.9)	0(0.0)	0(0.0)	-	-
	>-2.00	132(72.9)	128(84.2)	1(100.0)	1(100.0)	-	-
	Total	**181(100.0)**	**152(100.0)**	**1(100.0)**	**1(100.0)**	-	-

Note: < -3 means values moving further away from the mean (i.e. an even more deviant situation, severe/critical cases), -3.00 to -2.00 (values deviant from the mean, stunted/underweight) ; >- 2.00 means values moving towards 0 (becoming less deviant from the mean, normal height-for age /weight-for-age)

Appendix F

Table 14: Z scores distribution of BMI-for- age by Sex and Classes for Schools in Savelugu-Nanton District

Variable	Z-score	BMIZ/07	BMIZ/08	BMIZ/09
		n (%)	**n (%)**	**n (%)**
Sex	**<-**3.00	15(3.3)	5(1.0)	1(0.3)
	-3.00 to -2.00	38(8.4)	34(6.9)	18(5.5)
Male	> -2.00 to 1.00	308(67.7)	419(84.6)	269(81.8)
	>1.00 to 2.00	51(11.2)	27(5.5)	27(8.2)
	> 2.00	43(9.5)	10(2.0)	14(4.3)
	Total	**455(100.0)**	**495(100.0)**	**329(100.0)**
	<-3.00	0(0.0)	1(0.3)	1(0.4)
	-3.00 to -2.00	10(4.1)	4(1.2)	8(3.6)
Female	> -2.00 to 1.00	166(68.9)	286(87.5)	184(82.5)
	>1.00 to 2.00	35(14.5)	28(8.6)	23(10.3)
	> 2.00	30(12.4)	8(2.4)	7(3.1)
	Total	**241(100.0)**	**327(100.0)**	**223(100.0)**
Class	**<-**3.00	6(3.1)	0(0.0)	0(0.0)
	-3.00 to -2.00	20(10.5)	7(2.4)	16(5.6)
Primary 1	> -2.00 to 1.00	122(63.9)	253(85.8)	222(77.4)
	>1.00 to 2.00	26(13.6)	27(9.2)	33(11.5)
	> 2.00	17(8.9)	8(2.7)	16(5.6)
	Total	**191(100.0)**	**295(100.0)**	**287(100.0)**
	<-3.00	6(3.3)	2(0.9)	1(0.9)
	-3.00 to -2.00	17(9.3)	12(5.6)	4(3.6)
Primary 4	> -2.00 to 1.00	109(59.6)	179(83.6)	97(88.2)
	>1.00 to 2.00	21(11.5)	17(7.9)	6(5.5)
	> 2.00	30(16.4)	4(1.9)	2(1.8)
	Total	**183(100.0)**	**214(100.0)**	**110(100.0)**
	<-3.00	3(2.1)	1(0.6)	1(0.6)
	-3.00 to -2.00	7(4.9)	11(6.9)	6(3.9)
Primary 6	> -2.00 to 1.00	108(76.1)	137(85.6)	134(86.5)
	>1.00 to 2.00	20(14.1)	6(3.8)	11(7.1)
	> 2.00	4(2.8)	5(3.1)	3(1.9)
	Total	**142(100.0)**	**160(100.0)**	**155(100.0)**
	<-3.00	0(0.0)	3(2.0)	**-**
	-3.00 to -2.00	4(2.2)	8(5.2)	**-**
JHS 1	> -2.00 to 1.00	135(75.0)	136(88.9)	**-**
	>1.00 to 2.00	19(10.6)	5(3.3)	**-**
	> 2.00	22(12.2)	1(0.7)	**-**
	Total	**180(100.0)**	**153(100.0)**	**-**

Appendix G

Table 15: Z scores distribution of Height- for- Age (HAZ) and Weight-for-Age (WAZ) by School Location in Savelugu-Nanton District

Variable	Z scores	HAZ/07	HAZ/08	HAZ/09	WAZ/07	WAZ/08	WAZ/09
		n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
School Location Rural	< -3.00	81(17.7)	30(5.6)	27(9.6)	0(0.0)	0(0.0)	0(0.0)
	-3.00 to -2.00	81(17.7)	78(14.5)	45(16.0)	3(3.4)	2(2.3)	0(0.0)
	>-2.00	295(64.6)	431(80.0)	210(74.5)	85(96.6)	85(97.7)	32(100.0)
	Total	**457(100.0)**	**539(100.0)**	**282(100.0)**	**88(100.0)**	**87(100.0)**	**32(100.0)**
Urban	< -3.00	30(12.0)	14(4.9)	6(2.5)	0(0.0)	0(0.0)	0(0.0)
	-3.00 to -2.00	42(16.7)	37(13.0)	28(11.7)	3(4.2)	0(0.0)	0(0.0)
	>-2.00	179(71.3)	234(82.1)	205(85.8)	68(95.8)	78(100.0)	44(100.0)
	Total	**251(100.0)**	**285(100.0)**	**239(100.0)**	**71(100.0)**	**78(100.0)**	**44(100.0)**
Total	< -3.00	111(15.7)	44(5.3)	33(6.3)	0(0.0)	0(0.0)	0(0.0)
	-3.00 to -2.00	123(17.4)	115(14.0)	73(14.0)	6(3.8)	2(1.2)	0(0.0)
	>-2.00	474(66.9)	665(80.7)	415(79.7)	153(96.2)	163(98.8)	76(100.0)
	Total	**708(100.0)**	**824(100.0)**	**521(100.0)**	**159(100.0)**	**165(100.0)**	**76(100.0)**

Appendix H

Table 16: Z scores distribution of BMI-for- Age by School Location for Savelugu-Nanton District

Variable	Z-score	BMIZ/07	BMIZ/08	BMIZ/09
		n (%)	**n (%)**	**n (%)**
School	<-3.00	5(2.0)	1(0.4)	1(0.4)
Location	-3.00 to -2.00	14(5.6)	8(2.8)	11(4.3)
	> -2.00 to 1.00	187(74.5)	250(88.3)	225(87.9)
Urban	>1.00 to 2.00	35(13.9)	16(5.7)	15(5.9)
	> 2.00	10(4.0)	8(2.8)	4(1.6)
	Total	**251(100.0)**	**283(100.0)**	**256(100.0)**
	<-3.00	10(2.2)	5(0.9)	1(0.3)
	-3.00 to -2.00	34(7.6)	30(5.6)	15(5.1)
Rural	> -2.00 to 1.00	287(64.5)	455(84.4)	228(77.0)
	>1.00 to 2.00	51(11.5)	39(7.2)	35(11.8)
	> 2.00	63(14.2)	10(1.9)	17(5.7)
	Total	**445(100.0)**	**539(100.0)**	**296(100.0)**
	<-3.00	15(2.2)	6(0.7)	2(0.4)
	-3.00 to -2.00	48(6.9)	38(4.6)	26(4.7)
Total	> -2.00 to 1.00	474(68.1)	705(85.8)	453(82.1)
	>1.00 to 2.00	86(12.4)	55(6.7)	50(9.1)
	> 2.00	73(10.5)	18(2.2)	21(3.8)
	Total	**696(100.0)**	**822(100.0)**	**552(100.0)**

Appendix I

Table 17: Prevalence of Anthropometric Indicators in Mfantseman and Savelugu-Nanton Districts

District	z-scores categories for HAZ and WAZ	HAZ/07 n (%)	HAZ/08 n (%)	HAZ/09 n (%)	WAZ/07 n (%)	WAZ/08 n (%)	WAZ/09 n (%)	z-scores categories for BMIZ	BMIZ/07 n (%)	BMIZ/08 n (%)	BMIZ/09 n (%)
Mfantseman District	< -3.00 -3.00 to -2.00 >-2.00 **Total**	57(7.6) 144(19.2) 548(73.2) **749(100.0)**	49(8.2) 111(18.5) 439(73.3) **599(100.0)**	32(7.6) 76(18.1) 313(74.3) **421(100.0)**	0(0.0) 16(9.6) 150(90.4) **166(100.0)**	1(1.0) 13(12.9) 87(86.1) **101(100.0)**	0(0.0) 2(4.7) 41(95.3) **43(100.0)**	<-3.00 -3.00 to -2.00 > -2.00 to 1.00 >1.00 to 2.00 > 2.00 **Total**	1(0.1) 38(5.1) 633(84.5) 61(8.1) 16(2.1) **749(100.0)**	3(0.5) 23(3.9) 515(86.3) 44(7.4) 12(2.0) **597(100.0)**	1(0.3) 11(2.8) 331(84.9) 35(9.0) 12(3.1) **390(100.0)**
Savelugu-Nanton District	< -3.00 -3.00 to -2.00 >-2.00 **Total**	111(15.7) 123(17.4) 474(66.9) **708(100.0)**	44(5.3) 115(14.0) 665(80.7) **824(100.0)**	33(6.3) 73(14.0) 415(79.7) **521(100.0)**	0(0.0) 6(3.8) 153(96.2) **159(100.0)**	0(0.0) 2(1.2) 163(98.8) **165(100.0)**	0(0.0) 1(1.0) 98(99.0) **99(100.0)**	<-3.00 -3.00 to -2.00 > -2.00 to 1.00 >1.00 to 2.00 > 2.00 **Total**	15(2.2) 48(6.9) 474(68.1) 86(12.4) 73(10.5) **696(100.0)**	6(0.7) 38(4.6) 705(85.8) 55(6.7) 18(2.2) **822(100.0)**	2(0.4) 26(4.7) 453(82.1) 50(9.1) 21(3.8) **552(100.0)**
Total	< -3.00 -3.00 to 2.00 >-2.00 **Total**	168(11.5) 267(18.3) 1022(70.1) **1457(100.0)**	93(6.5) 226(15.9) 1104(77.6) **1423(100.0)**	65(6.9) 149(15.8) 728(77.3) **942(100.0)**	0(0.0) 22(6.8) 303(93.2) **325(100.0)**	1(0.4) 15(5.6) 250(94.0) **266(100.0)**	0(0.0) 3(2.1) 139(97.9) **142(100.0)**	<-3.00 -3.00 to -2.00 > -2.00 to 1.00 >1.00 to 2.00 > 2.00 **Total**	16(1.1) 86(6.0) 1107(76.6) 147(10.2) 89(6.2) **1445(100.0)**	9(0.6) 61(4.3) 1220(86.0) 99(7.0) 30(2.1) **1419(100.0)**	3(0.3) 37(3.9) 784(83.2) 85(9.0) 33(3.5) **942(100.0)**

Appendix J

Table 18: Prevalence of Anthropometric Indicators of Age Brackets for Class 1 pupils in Mfantseman District

Age Bracket	z-scores categories for HAZ/WAZ	HAZ/07 n (%)	WAZ/07 n (%)	z-scores categories for BMIZ	BMIZ/07 n (%)
Underage	< -3.00	0(0.0)	0(0.0)	<-3.00	0(0.0)
	-3.00 to -2.00	0(0.0)	0(0.0)	-3.00 to -2.00	0(0.0)
	>-2.00	1(100.0)	1(100.0)	> -2.00 to 1.00	0(0.0)
	Total	**1(100.0)**	**1(100.0)**	>1.00 to 2.00	1(100.0)
				> 2.00	0(0.0)
				Total	**1(100.0)**
Age in grade	< -3.00	0(0.0)	0(0.0)	<-3.00	0(0.0)
	-3.00 to -2.00	1(4.2)	1(4.2)	-3.00 to -2.00	1(4.2)
	>-2.00	23(95.8)	23(95.8)	> -2.00 to 1.00	20(83.3)
	Total	**24(100.0)**	**24(100.0)**	>1.00 to 2.00	3(12.5)
				> 2.00	0(0.0)
				Total	**24(100.0)**
Over age by 2-3 years	< -3.00	1(1.2)	0(0.0)	<-3.00	0(0.0)
	-3.00 to -2.00	22(26.5)	12(14.8)	-3.00 to -2.00	5(6.1)
	>-2.00	60(72.3)	69(85.2)	> -2.00 to 1.00	71(86.6)
	Total	**83(100.0)**	**81(100.0)**	>1.00 to 2.00	6(7.3)
				> 2.00	0(0.0)
				Total	**82(100.0)**
Overage by 4 or more years	< -3.00	9(14.3)	0(0.0)	<-3.00	1(1.6)
	-3.00 to -2.00	16(25.4)	3(12.0)	-3.00 to -2.00	8(12.9)
	>-2.00	38(60.3)	22(88.0)	> -2.00 to 1.00	50(80.6)
	Total	**63(100.0)**	**25(100.0)**	>1.00 to 2.00	2(3.2)
				> 2.00	1(1.6)
				Total	**62(100.0)**
TOTAL	< -3.00	10(5.8)	0(0.0)	<-3.00	1(0.6)
	-3.00 to -2.00	39(22.8)	16(12.2)	-3.00 to -2.00	14(8.3)
	>-2.00	122(71.3)	115(87.8)	> -2.00 to 1.00	141(83.4)
	Total	**171(100.0)**	**131(100.0)**	>1.00 to 2.00	12(7.1)
				> 2.00	1(0.6)
				Total	**169(100.0)**

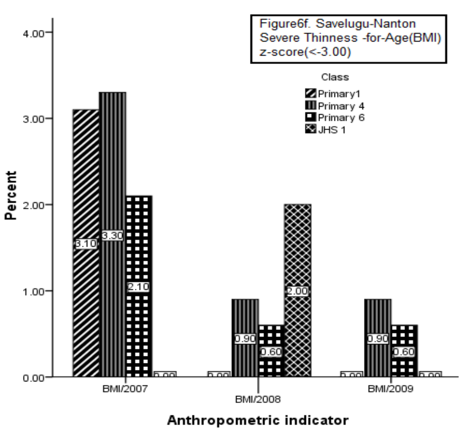
Appendix K

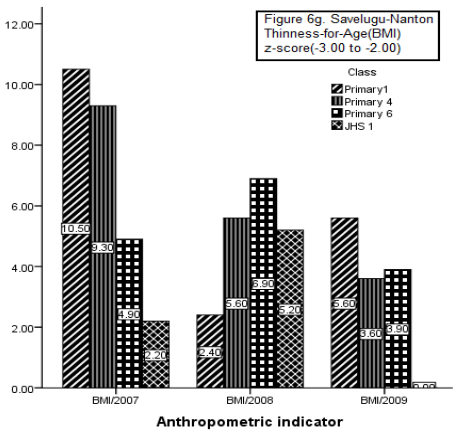
Table 19: Prevalence of Anthropometric Indicators of Age Brackets for Class 1 pupils in Savelugu-Nanton

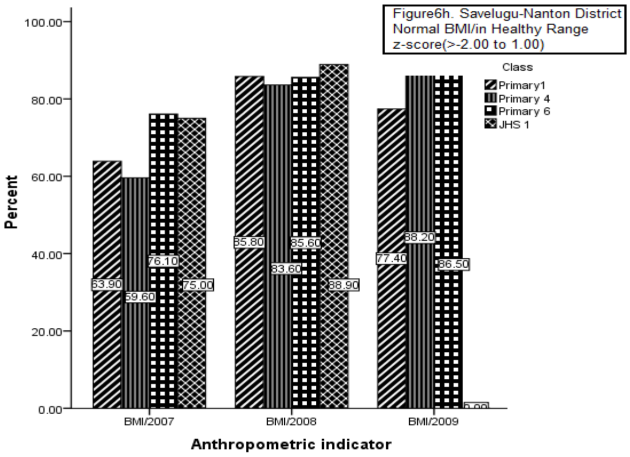
Age Bracket	**z-scores categories for HAZ/WAZ**	**HAZ/07** **n (%)**	**WAZ/07** **n (%)**	**z-scores categories for BMIZ**	**BMIZ/07** **n (%)**
Underage	< -3.00 -3.00 to -2.00 >-2.00 **Total**	- - - -	- - - -	**<**-3.00 -3.00 to -2.00 > -2.00 to 1.00 >1.00 to 2.00 > 2.00 **Total**	- - - - - -
Age in grade	< -3.00 -3.00 to -2.00 >-2.00 **Total**	0(0.0) 1(4.8) 20(95.2) **21(100.0)**	0(0.0) 0(0.0) 21(100.0) **21(100.0)**	**<**-3.00 -3.00 to -2.00 > -2.00 to 1.00 >1.00 to 2.00 > 2.00 **Total**	0(0.0) 0(0.0) 16(76.2) 5(23.8) 0(0.0) **21(100.0)**
Over age by 2-3 years	< -3.00 -3.00 to -2.00 >-2.00 **Total**	2(2.3) 10(11.4) 76(86.4) **88(100.0)**	0(0.0) 0(0.0) 89(100.0) **89(100.0)**	**<**-3.00 -3.00 to -2.00 > -2.00 to 1.00 >1.00 to 2.00 > 2.00 **Total**	2(2.3) 2(2.3) 56(63.6) 15(17.0) 13(14.8) **88(100.0)**
Overage by 4 or more years	< -3.00 -3.00 to -2.00 >-2.00 **Total**	15(17.9) 16(19.0) 53(63.1) **84(100.0)**	0(0.0) 5(12.8) 34(87.2) **39(100.0)**	**<**-3.00 -3.00 to -2.00 > -2.00 to 1.00 >1.00 to 2.00 > 2.00 **Total**	4(4.9) 18(22.0) 50(61.0) 6(7.3) 4(4.9) 82(100.0)
TOTAL	< -3.00 -3.00 to -2.00 >-2.00 **Total**	17(8.8) 27(14.0) 149(77.2) **193(100.0)**	0(0.0) 5(3.4) 144(96.6) **149(100.0)**	**<**-3.00 -3.00 to -2.00 > -2.00 to 1.00 >1.00 to 2.00 > 2.00 **Total**	6(3.1) 20(10.5) 122(63.9) 26(13.6) 17(8.9) **191(100.0)**

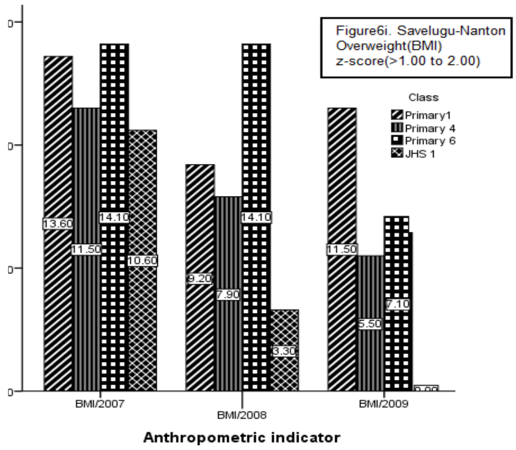
Appendix L

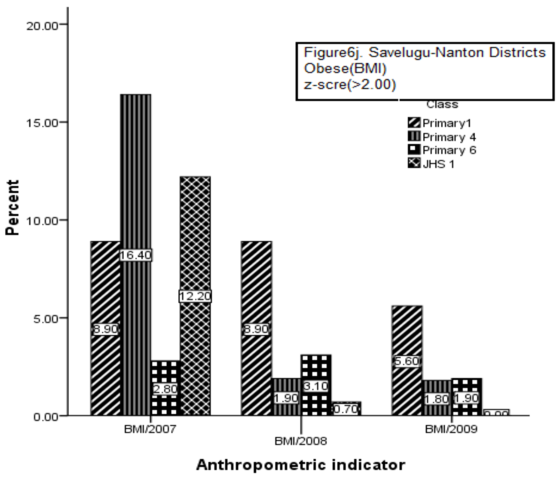
Figures 6f, 6g, 6h, 6i and 6j: Prevalence of BMI Categories among School Children in Savelugu-Nanton District based on Classes. 6f) Savelugu-Nanton District, Severe Body Thinness-for-Age, z-score (<-3.00); 6g) Savelugu-Nanton District, Body Thinness-for-Age, z-score (-3.00 to -2.00); 6h) Savelugu-Nanton District, Normal BMI/in healthy range, z-score (>-2.00 to 1.00); 6i) Savelugu-Nanton District, Overweight (BMI), z-score (>1.00 to 2.00); 6j) Savelugu-Nanton District, Obese (BMI), z-score (>2.00)





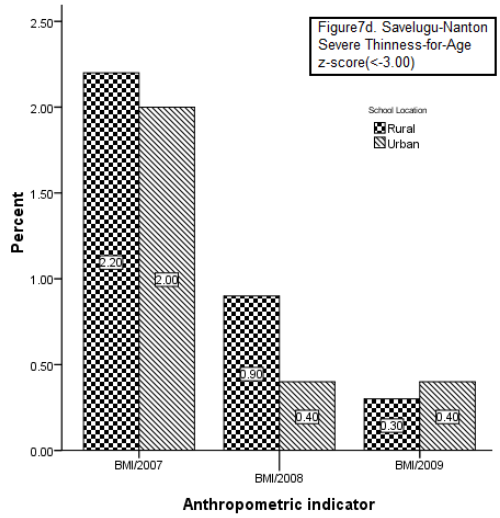


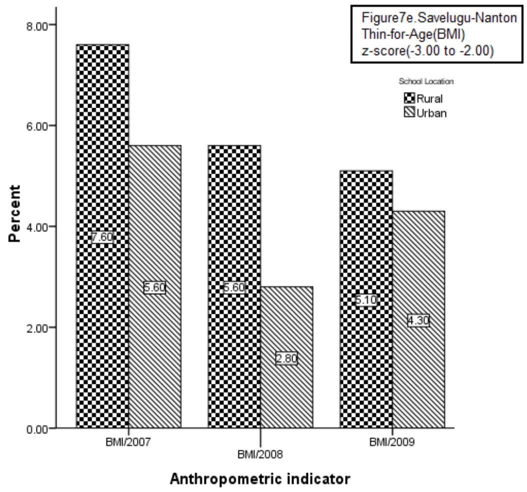


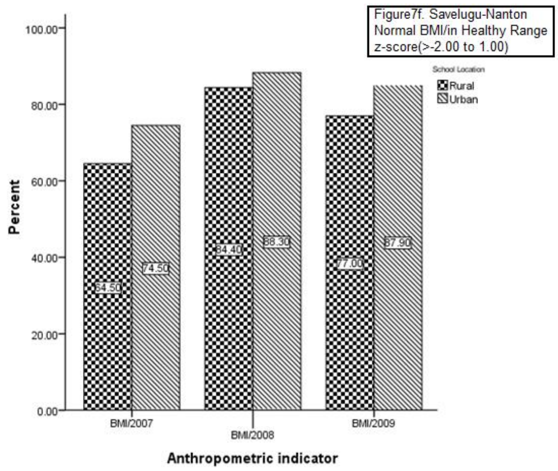


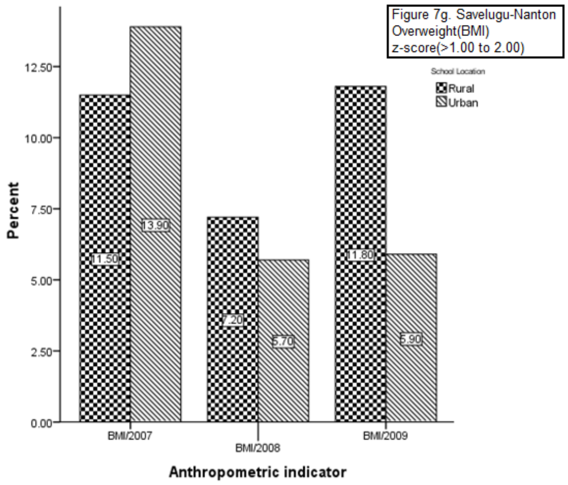
Appendix M

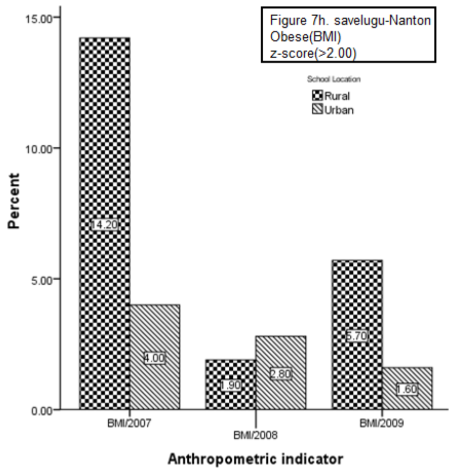
Figures 7d, 7e, 7f, 7g and 7h: Prevalence of BMI Categories among School Children in Mfantseman District based on Location (Rural/Urban). 7d) Savelugu-Nanton District, Severe Body Thinness-for-Age, z-score (<-3.00); 7e) Savelugu-Nanton District, Body Thinness-for-Age, z-score (-3.00 to -2.00); 7f) Savelugu-Nanton District, Normal BMI/in healthy range, z-score (>-2.00 to 1.00); 7g) Savelugu-Nanton District, Overweight (BMI), z-score (>1.00 to 2.00); 7h) Savelugu-Nanton District, Obese(BMI), z-score (>2.00)





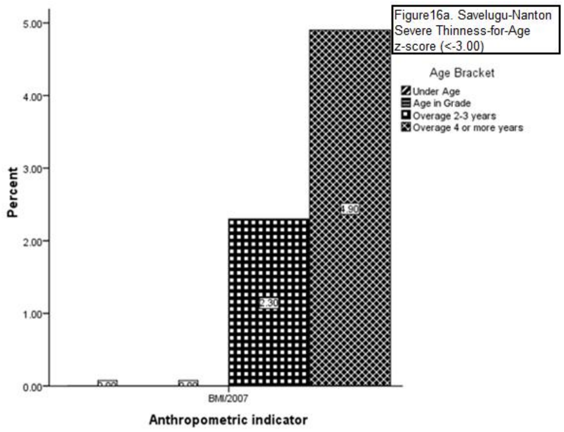


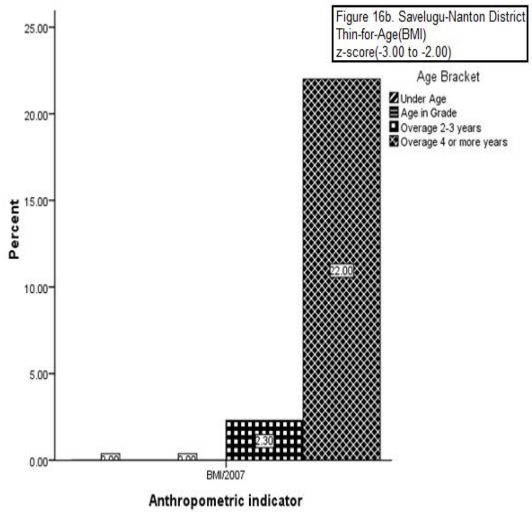


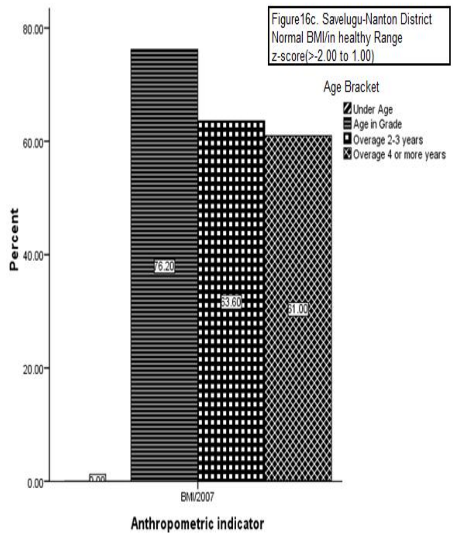


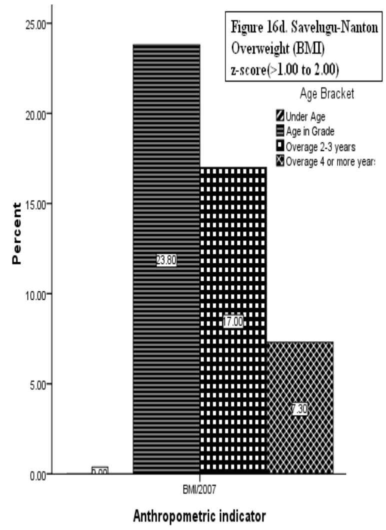
Appendix N

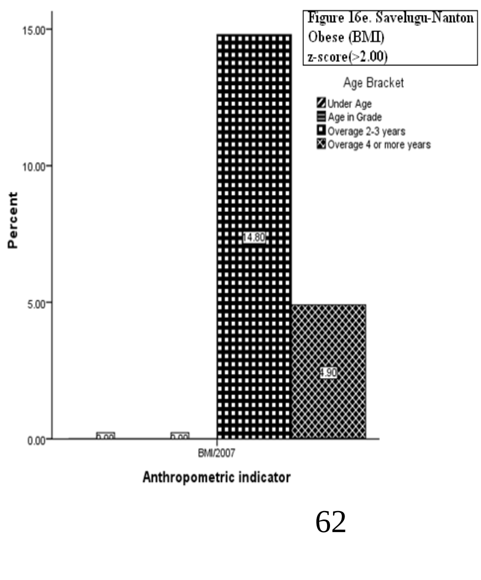
Figures 16a, 16b, 16c, 16d and 16e: **BMI Categories by Age Brackets of Primary One Children in Savelugu-Nanton District**. 16a) Savelugu-Nanton District, severe thinness-for-age, z-score (< -3.00); 16b) Savelugu-Nanton District, Thin-for-age, z-score (-3.00 to -2.00); 16c) Savelugu-Nanton District, normal BMI/ in healthy range z-score (>-2.00 to 1.00); 16d) Savelugu-Nanton District, overweight (BMI) z-score (>-1.00 to 2.00); 16e) Savelugu-Nanton District, Obese (BMI) z-score (>2.00)











Create

Consortium for Research on Educational Access, Transitions & Equity

Funded by DFID

Report summary:

Health and nutritional factors are rarely considered as underlying factors of accessibility to education even though it has been emphasised that key components as part of efforts to achieve the Education for All goal include optimal school health and nutrition. The findings reveal that early childhood malnutrition (decrease in growth in stature and weight) is likely to be a potential cause of delayed enrolment into primary school which leads to the issue of overage in grade children, an endemic problem in Ghanaian education. The findings of the study acts as a reminder that intervention programmes implemented to address the goal of Education for All should also address the nutritional and health needs of children and more importantly should be targeted at populations who actually need them.

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