OVERWEIGHT, OBESITY AND THINNESS AND ASSOCIATED FACTORS AMONG SCHOOL-AGED CHILDREN (5-14 YEARS) IN TAMALE, NORTHERN GHANA

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Abstract

Background: Childhood overweight and obesity has been an issue concern for both developing and developed countries. Developing countries are faced with prevalence of overweight/obesity and thinness/underweight. This cross-sectional study was conducted to assess the prevalence of childhood overweight/obesity and thinness among school-aged children in Tamale, Ghana and examine their influencing factors.

Methods: From January to July 2010, a random sample of 218 from randomly selected schools was selected for the study. Anthropometric measurements of age, weight, height of the selected children were measured by standard methods. Age- and sex-specific prevalence of overweight and obesity were determined by Body-mass-index-for-age Z-scores using the criteria defined by the World Health Organisation (WHO) cut offs points for school-age children. The statistical software Graphpad was used to analysis the data. Fischer's exact test or chi-square for trend analysis was used to test for significance a confidence interval of 95%.

Results: Prevalence rates for thinness and overweight/obesity was found to be 29.8% and 17.4%. As more girls than boys were found to be overweight/obese (18.9% vs. 15.4%, p=0.5883), more boys than girls were found to be thin (38.5% vs. 23.6%, p=0.0241). Whereas, 71.1% (p=0.0112) of overweight/obese children went to bed between 20:00Hrs and 21:00 Hrs, 41.5% of children who were thin went to bed after 21:00Hrs (p=0.0375). Significantly, 34.2% overweight/obese children and 13.9% of children who were thin watched Television during leisure times. Snacking status, religious

background and parent's/guardian's occupation was neither associated, significantly, to overweight/obesity nor to thinness.
Conclusion: The prevalence of overweight/obesity was high. Factors that were positively associated to overweight/obesity were television viewing and late bedtimes. The male gender and late bedtimes were also positively associated with thinness.

Keywords: BMI-for-age, Childhood overweight/obesity, Ghana, School-age, Tamale, Thinness

Introduction

Childhood overweight and obesity has been an issue concern for both developing and developed countries (Lobstein *et al.*, 2004; 2009; Troiano *et al.*, 1995). According to Strauss *et al* (2001), the prevalence of obesity among school-aged children has more than tripled since the 1970s. Janssen (2005) in obesity reviews identified a childhood overweight/obesity prevalence of 25.4% in Malta and 21.2% in Wales. A high prevalence of childhood obesity has also been reported in developing regions such as Latin America and Asia (Bellizzi *et al.*, 1999). A study in Brazil reported a childhood overweight/obesity prevalence of 22% among 7-10 year olds (de Assis *et al.*, 2005). In Saudi Arabia El Mouzan *et al.*, (2010) reported a childhood and adolescent overweight, obesity and severe obesity prevalence of 23.1%, 9.3% and 2% respectively.

It has been shown that overweight/obese children are at a higher risk than their normal counterparts of growing up to become obese adults. A strong link between childhood obesity and cardiovascular diseases has also been established (Must *et al.*, 1992; Vignerova *et al.*, 2007). Overweight/obese children are at a high risk of developing hypertension, angina pectoris, non-insulin dependent diabetes mellitus, and hypercholesterolaemia (Langendijk *et al.*, 2003). Compared with non-obese school-aged children, obese school-aged children are between 3.9 and 6.5 times more likely to become obese adults (Serdula *et al.*, 1993). Considering the fact that it's difficult to treat adults with obesity (NIH Technology Assessment Conference Panel, 1993), prevention of childhood obesity is advisable (Chaput *et al.*, 2006). Several factors including physical inactivity, television viewing, diet as well as an obesogenic environment has been shown to be the cause of increasing prevalence of obesity among children (Andersen *et al.*, 1998; Guillaume *et al.*, 1997; Maffeis *et al.*, 1998; Parsons *et al.*, 1999; Popkin *et al.*, 1998; Whitaker *et al.*, 1997).

The situation is even more complex for countries in nutrition transition in the sense that they are faced with prevalence of overweight/obesity and thinness/underweight with similar proportions

among children (de Onis M *et al.*, 2002; de Onis *et al.*, 2000; Martorell *et al.*, 2000). A study conducted by Ene-Obong *et al.*, (2012) in Nigeria identified overweight, obesity and thinness prevalence of 11.4%, 2.8% and 13.0% among children aged 5 t0 18 years. Similar findings have been reported in South Africa, Tanzania, Pakistan, Mexico, Australia and Brazil (de Assis *et al.*, 2005; Mosha *et al.*, 2010; Mushtaq *et al.*, 2011; Renzaho *et al.*, 2006). As a result both diseases related to under nutrition, infectious diseases coexist with obesity-related diseases contributing substantially to the burden of disease (WHO, 2002).

Data on childhood overweight/obesity and thinness in Sub-Saharan Africa including Ghana is limited and probably scarce. The issue of childhood obesity is less recognised in developing countries, making less information available (McDonald *et al.*, 2009). This research was therefore intended to report on the prevalence of childhood overweight/obesity and thinness as well as their determining factors among school-aged children (5-14 years) in Tamale, Ghana.

Methods

Participants

This cross-sectional study was carried out from January to July 2010 children aged 5-14 years. Through a multi-stage random sampling technique, 5 schools were selected from the Tamale metropolis. To have a random distribution of the 218 selected children from all the classes in a particular school, a random numbers statistical table was used to select a proportionate random sample that included more subjects from larger classes. Tamale is the capital city of the Northern region of Ghana. It lies between latitude 9°22'N and longitude 0°50'W covering an area of about 922km2. Tamale has a population of 537, 986 people and located 600km north of Accra, the capital city of Ghana. Participation in the study was voluntary and consent was sought from the school authorities as well as parent/guardians of the selected children. Prior to data collection the study was approved by the Ethics Committee of the University for Development Studies, School of Medicine and Health Sciences, Ghana. Anthropometric measurements of all the selected children were taken and a questionnaire administered to them.

Questionnaire

The selected children completed a 23-item self-administered semi quantitative questionnaire on demography, socioeconomic and educational status of subjects' parents/guardians. Parents/care takers answered the questionnaire for children below the age of 10. The questionnaire also included questions on the time at which children went to bed, means of transport to school and their snacking status.

Anthropometric measurements

Anthropometric measurements of weight, height and age of the selected children were taken. All measurements were done at the school premises. Weight was measured to the nearest 0.5kg by means of a UNICEF electronic scale manufactured by SECA (Item No.0141015 Scale, mother/child electronic with a capacity of 150kg). Height was measured to the nearest 0.1cm without their shoes on using a wall-mounted microtoise manufactured by SECA. The ages of the selected children was determined by using school records which had date of births for children below 7 years. Children above the age of 7 verbally mentioned their ages.

Statistical Analysis

Age- and sex-specific prevalence of overweight and obesity were determined by Body-mass-index-for-age Z-scores using the criteria defined by the World Health Organisation (WHO) cut offs points for school-age children (WHO, 2006). According to the WHO cut-off points; overweight was considered to be >+1SD (equivalent to BMI 25 kg/m2 at 19 years), Obesity: >+2SD (equivalent to BMI 30 kg/m2 at 19 years), Thinness: <-2SD Severe thinness: <-3SD and Normal: > -1 to < +1 SD. Standard deviations (Z-scores) were computed by using the World Health Organization (WHO) reference population, 2007 soft ware (Anthropometric Software Program, Version 2.1, 2005). BMI was calculated as weight (kg) divided by height (m) squared. Severe thinness and thinness were combined into thinness. Overweight and obesity were combined into overweight/obesity.

Subjects were put into 2 age groups: 5-9 years and 10-14 years. Using Fischer's exact test or Chi-square for trend analysis as appropriate the results have been compared and expressed as proportion. Fischer's exact test was used to test for significance by stratifying general characteristics of participants with gender. Fischer's exact test or X^2 for trend analysis was used to test for the trend of association between BMI-for-age status with age, snacking status, time of going to bed, among others. A level of $p<0.05$ was considered as statistically significant. GraphPad Prism version 5.00 for windows was used for all the statistical analysis (GraphPad software, San DiegoCalifornia USA, www.graphpad.com).

Results

Presented in table 1 are the general characteristics of the studied participants. The study included 91 boys and 127 girls. Generally, 93.1% (117/218) of the studied participants were aged 10-14 years of age and more boys than girls were found within that age range. The differences were not significant when age was stratified by gender. The most practiced religion was the Islamic religion (57.3%). However, by proportion as more boys (46.3% vs. 40.2%) said they practiced Christianity, more girls (59.8% vs.

53.8%) said they practiced the Islamic religion. The differences were not significant.

In general, 57.3% (125/218) of the studied children said they get to school daily by means of a car or motor cycle. Even though the differences were not significant, more boys than girls walked (24.2% vs. 21.3%) or rode bicycles (26.4% vs. 15.7%) to school than girls. During leisure time activities, 72.9% of the children said they read, 16.1% watched television, 9.6% played football and 1.4% slept. Whereas, more girls than boys watched television (21.3% vs. 8%, p=0.0149) during leisure times, more boys than girls played football (19.8% vs. 2.4%, p=0.0017).

From the studied children, 72.0% snacked between breakfast and lunch, 53.2% between lunch and supper and 45.9% before bedtime. Significantly, 52.8% (67/127, p=0.0192) of boys snacked before bedtime compared with 36.3% (33/91, p=0.0192) of girls.

Regarding the BMI-for-age status of the studied children, 17.4% were overweight and obese, 29.8% were thin and 52.8% were normal. Significantly, 38.5% of boys compared to 23.6% of girls were found to be thin. On the other hand, by proportion more girls were found to have normal BMI-for-age status (57.5% vs. 46.2%) and more overweight/obese (18.9% vs. 15.4%) than boys. The differences were not significant.

Table 1a: General Characteristics of the studied population stratified by gender

Variable	Total (n=218)	Boys (n=91)	Girls (n=127)	P value
Age				
5yr-9yr	14(6.4%)	4(4.4%)	10(7.9%)	0.4047
10yr-14yr	204(93.6%)	87(95.6%)	117(92.1%)	0.4047
Religious Background				
Islam	125(57.3%)	49(53.8%)	76(59.8%)	0.4066
Christianity	93(42.7%)	42(46.2%)	51(40.2%)	0.4066
Parent's Occupational status				
Skilled labour	159(72.9%)	69(75.8%)	90(70.9%)	0.4433
Unskilled labour	59(27.1%)	22(24.2%)	37(29.1%)	0.4433
Means of transport to school				
Walking	49(22.5%)	22(24.2%)	27(21.3%)	0.6251
		24(26.4%)	20(15.7%)	0.0611

Rides bicycle	44(20.2%)			
Picks a car/motorcycle	125(57.3%)	45(49.5%)	80(63.0%)	0.0526

Data are presented as proportion and analysed using Fischer's exact test.

Table 1b: General Characteristics of the studied population stratified by gender

Variable	Total (n=218)	Male (n=91)	Female (n=127)	P value
Leisure time activities				
Sleeping	3(1.4%)	3(3.3%)	0(0.0%)	0.0713
Television viewing	35(16.1%)	8(8.8%)	27(21.3%)	0.0149
Reading	159(72.9%)	62(68.1%)	97(76.4%)	0.2163
Plays football	21(9.6%)	18(19.8%)	3(2.4%)	0.0017
Snacking status				
Snacks between breakfast and lunch	157(72.0%)	65(71.4%)	92(72.4%)	0.8795
Snacks between lunch and supper	116(53.2%)	43(47.3%)	73(57.5%)	0.1687
Snacks before going to bed	100(45.9%)	33(36.3%)	67(52.8%)	0.0192
BMI-for-age status				
Thinness	65(29.8%)	35(38.5%)	30(23.6%)	0.0241
Normal	115(52.8%)	42(46.2%)	73(57.5%)	0.1017
Overweight/obesity	38(17.4%)	14(15.4%)	24(18.9%)	0.5883

Data are presented as proportion and analysed using Fischer's exact test.

Displayed in table 2 is a comparison of identified factors with the BMI-for-age status of the studied children. Among the studied children who snacked between lunch and supper, 89.3% (25/38) were overweight/obese, 49.6% (57/115) had normal BMI-for-age status and 52.3% (34/65) were thin. When snacking status of the studied children was compared with their BMI-for-age status the association was not significant.

No significant association was found when the occupational status of the children's parent/guardian was compared with BMI-for-age status. With regards to religious background, 61.5% (40/65) thin children were found to

practice the Islamic religion, more than 50% normal and overweight/obese children were Christians.

From this study about 20% of thin, normal and overweight/obese participants said they walked to school every day. Proportionally, 13.2% of overweight/obese children said they ride bicycle to school, 60.5% went to school by means of car/motorcycle and 26.3% walked to school. The differences were not significant when BMI-for-age status was stratified by means of transport to school.

Table 2: Comparison between Snacking status, parent's/guardian's occupation, religious status and means transport to school with BMI-for-age status

Variable	BMI-for-age status			
	Thinness (n=65)	**Normal (n= 115)**	**Overweight/ Obesity (n=38)**	**P value**
Snacking status				
Snacks between breakfast and lunch	44(67.7%)	83(72.2%)	30(78.9%)	0.2244
Snacks between lunch and supper	34(52.3%)	57(49.6%)	25(89.3%)	0.2813
Snacks before going to bed	28(43.1%)	49(42.6%)	17(44.7%)	0.8966
Occupational Status of Parent/Guardian				
Skilled labour	45(69.2%)	86(74.8%)	28(73.7%)	0.5438
Unskilled labour	20(30.8%)	29(25.2%)	10(26.3%)	0.5438
Religious Background				
Islam	40(61.5%)	64(55.7%)	21(55.3%)	0.4761
Christianity	25(38.5%)	51(44.3%)	17(44.7%)	0.4761
Means of transport to school				
Walking	14(21.5%)	25(21.7%)	10(26.3%)	0.6196
Rides bicycle	13(20.0%)	26(22.6%)	5(13.2%)	0.5244
Picks a car/motorcycle	38(58.5%)	64(55.6%)	23(60.5%)	0.9223

Data was presented as proportion and analysed using chi-square for trend

Time at which the studied children went to bed was stratified by BMI-for-age status and presented in figure 1. Going to bed between 20:00hrs and 21:00hrs and beyond was associated to BMI-for-age status. Significantly, 71.1% of overweight/obese children went to bed between 20:00Hrs and 21:00Hrs compared with 44.6% of thin and 53.9% of normal weight children. However, 41.5% thin, 33.9% normal and 21.1%

overweight/obese children went to bed after 21:00Hrs and the differences were significant.

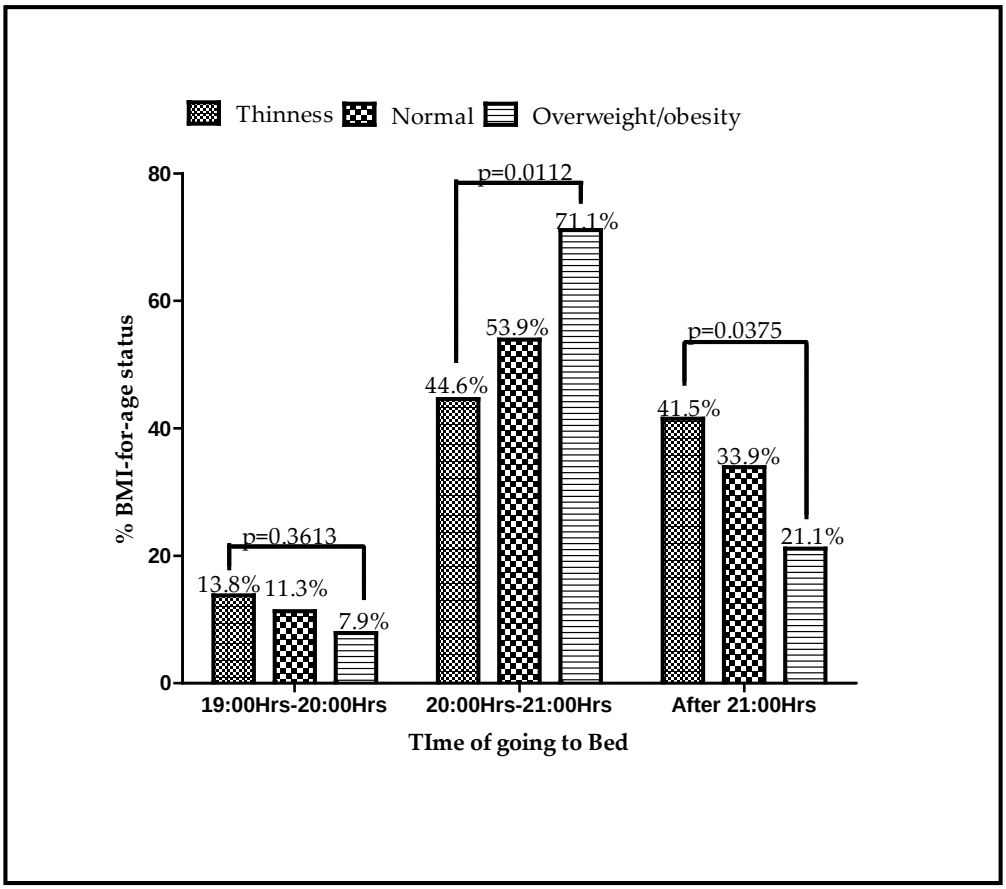

Figure 1: Association between time of going to bed and BMI-for-age status. Data was analyzed using chi-square for trend.

Presented in figure 2 is a comparison between leisure time activities with BMI-for-age status of the studied children.

From figure 2 (A), 34.2% (p=0.0215) of overweight/obese children significantly watched television during leisure time compared with 13.9% and 13.8% thin and normal weight children respectively. By proportion, 70.8%, 76.5% and 65.8% thin, normal and overweight/obese children read during their leisure time (figure 1B). In figure 1 (C), 12.3% thin, 9.6% Normal and 5.3% overweight/obese children played football during leisure times. Using chi-square for trend analysis, reading during leisure time as well as playing football was not associated to weight gain.

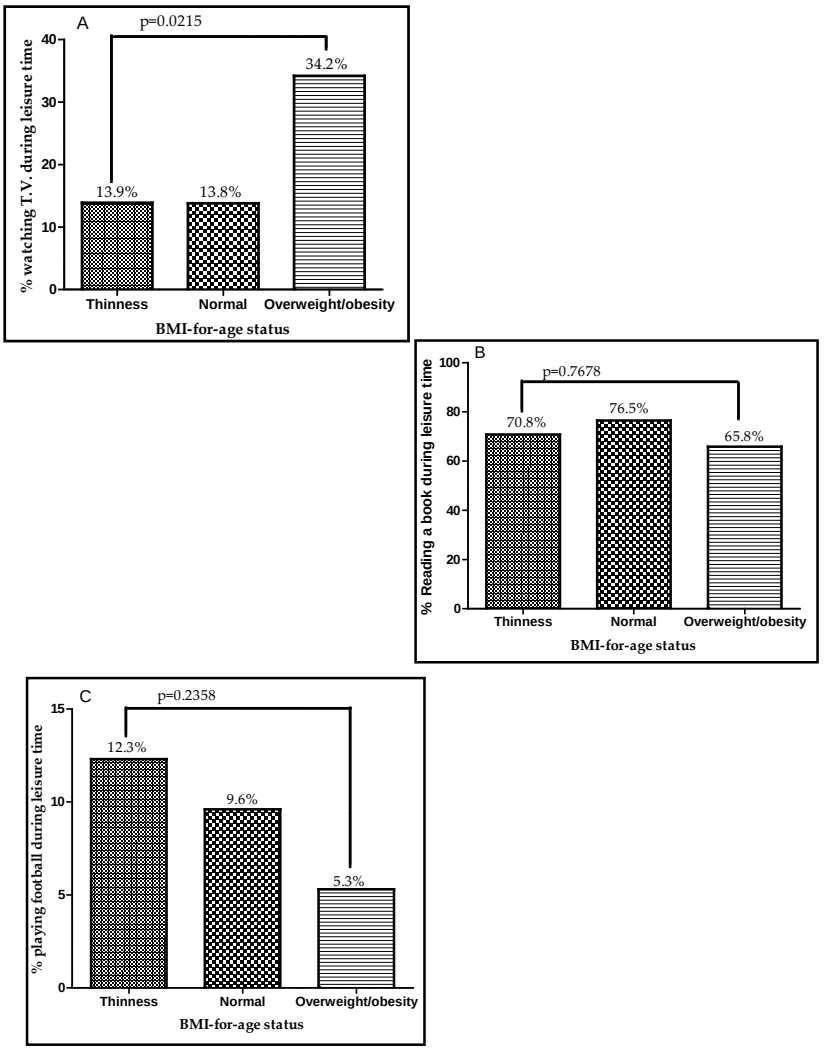

Figure 2: Association between BMI-for-age status and watching television during leisure time (**A**), reading a book during leisure time (**B**) and playing football during leisure time (**C**). Data was analyzed using chi-square for trend.

Table 3: Comparison between age and BMI-for-age statuS

Variable	5yr-9yr (n=14)	10yr-14yr (n=204)	P value
Thinness	2(14.3%)	63(30.9%)	0.2393
Normal	9(64.3%)	106(52.0%)	0.4189
Overweight/obesity	3(24.4%)	35(17.2%)	0.7153

Data was presented as proportions and analysed using chi-square for trend.

As presented in table 3, 14.3% of children aged 5-9 years were thin compared to 30.9% of children aged 10-14 years. The differences were not significant. On the other hand, more children aged 5-9 years were normal and overweight/obese (normal: 64.3% vs. 52.0% and Overweight/obese: 24.4% vs. 17.2%) compared to children aged 10-14 years. The differences were not significant.

Discussion

This study has revealed an overweight/obesity prevalence of 17.4%. This is comparable to childhood overweight/obesity prevalence rates of some developed countries. An overweight/obesity prevalence of 17% has been reported among children aged 10-16 years in Greece and Italy (Janssen *et al.*, 2005). It is however lower than prevalence estimate of other countries, including Chicago in the US where 40.5% of 6-12 year old children where obese (Margellos-Anast *et al.*, 2008); among Aboriginal communities in Australia where 26.8% children aged 5-15 years were overweight/obese (Schultz, 2012); Saudi Arabia where 29.0% aged 5-19 years where overweight/obese (El Mouzan *et al.*, 2010) and Sub-Saharan African Immigrants and refugees, Australia where 27% children aged 3-12 years (Renzaho *et al.*, 2006). The childhood overweight/obesity found in this study can be said to be one of the highest in Sub-Saharan Africa. A study among children aged 2 to 18 years in Nigeria reported a childhood overweight/obesity prevalence of 14.2% (Ene-Obong *et al.*, 2012). Another study by Peltzer *et al.*, (2011) among a sample of children from Ghana and Uganda found a childhood overweight/obesity prevalence of 7.6%. The differences could be due to the different methods used in the classification of weight status of the children. The Nigerian study defined overweight/obesity using the International Obesity Task force cut-off points. The IOTF makes use of BMI-for-age percentile curves instead of the WHO BMI-for-age Z-scores used in this study. The Ugandan and Ghanaian study measured the heights and weights of the studied participants based on self-report. The use of self-reported weight and heights may lead to underestimation of overweight and obesity (Elgar *et al.*, 2005).

In agreement with the findings of McDonald *et al* ., (2009) among Columbian children (aged 5 to 12 years) and Schultz (2012) among Australian children (aged 5 to 15 years), overweight/obesity was not associated to gender. Contrary to the findings of this study, a study by Peltzer *et al.*, (2011) among a sample of 5613 Ugandan and Ghanaian children aged 13-15 years found a significant association between gender and overweight/obesity. In their study more girls were found to be more overweight/obese than boys. The sample population of the Ugandan study was largely adolescents among which several studies in developing countries have shown a positive relationship between the female gender and

overweight/obesity (Armstrong *et al.*, 2006; Hamaideh *et al.*, 2010; Kimani-Murage *et al.*, 2011). Toriola *et al .*, (2012) reported no significant gender differences in BMI at age groups 10, 11, and 12 years but found that girls at ages 13-16 years exhibited significantly higher mean BMI values compared to the boys. As such gender differences is not so significant among school-aged children but more significant among adolescents. This probably contributed to the differences.

As if a "double edged sword", a thinness prevalence of 29.8% was observed indicating the co-existence of under nutrition and over nutrition culminating to the double burden of malnutrition. In concurrence with a study among 5-14 year old children in India (Fazili *et al.*, 2012), significantly more male children were thinner than female children. A study by Kimani-Murage *et al.*, (2010) among rural South African children, reported the prevalence of underweight to be significantly higher in boys, than in girls. A study by Mogre *et al.*, (2013) among school-aged children in Tamale, Ghana and several other studies in other Sub-saharan African countries have reported a coexistence of under nutrition and overweight/obesity (de Onis M *et al.*, 2002; Ene-Obong *et al.*, 2012; Mamabolo *et al.*, 2005; Martorell *et al.*, 2000). .Similar findings have also been reported in the Middle East, North America and Latin America(de Onis *et al.*, 2000). This occurrence presents the double burden of malnutrition experienced by countries in nutrition transition (McDonald *et al.*, 2009).

Children who went to bed after 20:00hrs but before 21:00Hrs were significantly more overweight/obese than children who slept at earlier times. Surprisingly, children who went to bed after 21:00Hrs were significantly thinner than children who went to bed before 21:00Hrs. Research among school-aged children have consistently found that later bedtimes were associated with increased obesity risk (Maddah *et al.*, 2009; Olds *et al.*, 2010; Sekine *et al.*, 2002; Snell *et al.*, 2007). Later bedtimes are simply a proxy for shorter sleep duration (Hart *et al.*, 2011). The inconsistent relationship found in this study could be due to measurement error as time of wake was not recorded. In addition other factors such as physical inactivity and diet which have shown to influence body weight were not controlled and might have contributed to the differences. More elaborate research is therefore needed in this area to establish the relationship between sleep and overweight/obesity in a developing country.

As expected television viewing during leisure time was significantly associated to overweight/obesity. This is consistent with several studies done in Sub-Saharan Africa (Mogre *et al.*, 2013) and several developed countries (Andersen *et al.*, 1998; Whitaker *et al.*, 1997).

In contrast to McDonald *et al .*, (2009) authors did not find a significant association between snacking in between meals and

overweight/obesity. However, this finding is not peculiar to this study Field *et al.,* (2004) reported a non-significant association between the consumption of snack foods and body weight in 9-to-14 year old children in the U.S.

Playing outside the household and reading a book during leisure time was not significantly associated with overweight/obesity in Tamale. Several studies have reported that childhood overweight/obesity was negatively associated with physical activity and positively associated with sedentary activities like reading a book (Berkey *et al.*, 2000). The lack of an objective definition for physical activity and ascertainment of the amount of time spent reading a book could have contributed to the differences observed in this study. Parental report or self-report of physical activity by children has been shown to have a low validity(Kohl *et al.*, 2000). It is therefore recommended that more elaborate research into objective measurement of these exposures to establish their true relationship with childhood overweight/obesity.

Age was not significantly associated with childhood overweight/obesity. In contrast to the findings of this study, Schultz (2012) reported that overweight significantly increased with age while obesity did not, in a cross-sectional study of Aboriginal kids aged 5-15 years. Toriola *et al.,* (2012) also reported that overweight and obesity among children aged 10-16 increased with age, peaking at age 12 years but declined thereafter. This study included children over age 14 which probably contributed to the differences in the relationship between age and level of childhood overweight/obesity. It is also important to note that increase in age was not associated to childhood obesity but to overweight in the Schultz study. As such the combination of overweight and obesity used in this study might have contributed to the differences.

Regardless of the consistency in findings in this study, some limitations should be considered. The study design used in this study was cross-sectional which is not appropriate to establish a causal relationship between snacking status or time of going to bed or leisure time activities and childhood overweight/obesity. Experimental studies should be conducted to establish causal links. The results of this study are based on a small sample making it difficult to generalize the findings to all school-aged children in Tamale.

Conclusion

A high childhood overweight/obesity and thinness of 17.4% and 29.8% respectively was revealed. Gender was significantly associated with thinness but not to overweight/obesity. Television viewing during leisure times were was positively associated with overweight/obesity. Late bedtimes were associated with both overweight/obesity and thinness.

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