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Physical Activity and BMI Status of School-Age Children in Tamale, Northern Ghana

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Abstract: Diet and physical activity are principal determinants of nutritional status and energy balance. Low physical activity has been shown to be one of the risk factors for development of obesity in children. One's physical activity as a child is a predictor of physical activity level as an adult. This study was aimed at describing the type, frequency and duration of physical activity and their association to BMI-for-age status of school-age children in Tamale. In this cross-sectional study, a sample of 400 school-age children was selected from randomly selected schools in Tamale, Ghana. The physical activity questionnaire for children (PAQ-C) was used to assess physical activity levels. Anthropometric measurements of age, weight and height were measured and computed to determine the adiposity status of the children. More than 80% of the studied children engaged in moderate to heavy type of physical activity. By frequency, 88.3% of boys and 75% of girls participated in a physical activity at least 2 times a week. During leisure times, more boys than girls played football and more girls than boys watched television. A significant proportion of the children engaged in heavy type of physical activity with increase in age. An overweight/obesity prevalence of 8.5% was found. A large proportion of the children reported being in the moderate to heavy type of physical activity. Type, frequency and duration of physical activity were associated to age. A double burden (overweight vs. underweight) of malnutrition was found.

Key words: Body mass index, children, ghana, physical activity, tamale

INTRODUCTION

Most nutrition intervention programmes in Ghana including many other developing countries focus on reducing under nutrition, eradicating hunger, and reducing the micronutrient deficiencies, among others. Statistics indicate that there has been some success in this regard even though it is not enough. Recent statistics indicate that internationally, there have been a drop in the percentage of people who are underweight from 32% to 28% (Hawkes *et al*., 2005)

However, statistics have indicated an emerging, probably an emerged epidemic already with regards to diet-related chronic diseases in developing countries. This has brought about the existence of the double burden of malnutrition in Ghana and other developing countries. This implies that on one hand is the burden of under nutrition and infectious diseases such as HIV/AIDS, diarrhoea, TB, among others in which a lot have been done with minimal success. On the other hand is the burden of diet-related chronic diseases/non-infectious/non-communicable diseases such as obesity, hypertension, and diabetes, among others, in which less has been done.

Statistics indicate that just like the developed world there is the emergence of childhood obesity in developing countries including Ghana. A study showed that from 1988 to 1993-4 children between the ages of 0-3 years, 0.5-1.9% of them had > 2SD from median weight-for-height (Ebbeling *et al*., 2002).

According to Lobstein et al. (2004) childhood obesity is increasing in both developed and developing countries with increased risks of developing type 2 diabetes, heart disease and other co-morbidities.

It is evident from research that physical activity is considered to be one of the risk factors or the causes of obesity. Physical activity contributes to the total daily energy expenditure in most individuals. The energy expended in any given physical activity does depend largely on the kind and duration of the different activities carried out in a day. Thus one's level of physical activity determines one's energy expenditure. It is noted that one's physical activity level as a child is a good predictor of physical activity level as an adult (Dennison *et al*., 1988). According to Ebbeling *et al*. (2002) a lifestyle of inactivity such as television viewing might cause obesity in children. A cross-sectional in South Carolina reported

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that obese children spent less time in moderate and vigorous physical activity than non-obese children (Trost *et al*., 2001).

Studies on physical activity among children in Ghana are either few or non-existent. As such, this study was aimed at describing the type, frequency and duration of physical activity among school-age children in Tamale, Ghana. It was also aimed at assessing the association between physical activity and BMI-for-age status of the school-age children.

MATERIALS AND METHODS

Participants: This cross-sectional study was undertaken between July and August 2011. A sample of 400 children aged 6-14 years were selected from 6 randomly selected schools in Tamale from which data was collected. 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 922km^2. Tamale has a population of 537,986 people and located 600km north of Accra, the capital city of Ghana.

Before participation in the study, informed consent was sought from the children's parents as well as the school authorities. Both anthropometric and physical activity data were taken.

Anthropometric data: Anthropometric indices such as height, weight and age were taken. Height was measured without shoes on, to the nearest 0.1cm using a wall-mounted microtoise manufactured by SECA.

To the nearest 0.1kg body weight was measured using the UNICEF electronic scale manufactured by SECA. The school-age children wore light clothing during the measurement. The ages of the children were determined using their birth certificates.

Physical activity data: The Physical activity levels of subjects were assessed using the physical activity questionnaire for children (PAQ-C). This questionnaire is a modification of self-reported questionnaires that have been validated and used in large scale epidemiological studies (Andersen *et al*., 1998; Heath *et al*., 1994). Selected physical activities were presented on a 5-point Likkert scale, allowing for creation of a composite score that was used as a measure of activity. It assessed type, frequency and duration of participation in different types of activities during the week. The listed physical activities were grouped into 3 categories: light activities, moderate activities and heavy activities.

Frequency of activity was put into three categories; 0-1 times, 2-3 times and = 3 times within a week. The amount of time spent on a physical activity was put into = 30 minutes, 31-120 minutes and = 121 minutes per day.

Statistical analysis: The anthropometry data was analyzed using the World Health Organization (WHO, 2006) Anthropometric Software Program, Version 1.0.3. 2005. Data was computed into BMI - for - age; standard deviation (Z - scores) and mean. Subjects were put into three age groups. These groups were 6-8 years, 9-11 years and 12-14 years. According to the WHO Multicenter Growth Reference Study Group (2006) cut-off points; overweight was considered to be > + 2SD, Obesity: > + 3SD, Thinness/wasted: < - 2SD, Severe thinness/ severely wasted: <-3SD and possible risk of overweight < +1SD. Thinness and severe thinness were combined into thinness. Overweight and obesity was also combined into overweight/obesity.

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 by gender. Fischer's exact test or Chi-square for trend analysis was used to test for the trend of association between type, frequency and duration of physical activity with adiposity. A level of $p<0.05$ was considered as statistically significant. GraphPad Prism version 5.00 (GraphPad software, San DiegoCalifornia USA, www.graphpad.com) for windows was used for the statistical analysis.

RESULTS

Displayed in Table 1 are the general characteristics of the studied population in which, 73.0% of the school-age children were above age 12. There was no significant difference in the age distribution, even though 52.0% of the studied population was boys.

From the entire sample, 54.5% children were moderately active. Proportionally more girls engaged in heavy type of physical activity than boys. However, there was no significant differences in the type of physical activity participated by the children when the studied population was classified by gender.

Concerning frequency of physical activity, almost half (48.5%) of the studied population engaged in a physical activity of any kind, 2-3 times within a week. Almost the same proportion of boys and girls engaged in a physical activity once in a week (23.6% vs. 24.5%) and more than 3 times in a week (28.4% vs. 26.6%).

Generally, 40.0% of the entire studied population spent between 31-120 minutes on a physical activity of any kind. Significantly and proportionally there were no differences when the amount of time spent on a physical activity was classified by sex. Similar proportions of boys and girls spent almost the same amount of time on any physical activity.

For activities participated by children during leisure time, 61.5% boys significantly (<0.0001) played football compared to girls (24.0%). In the reverse, 29.7% girls significantly (<0.0002) watched television and engaged in other activities (34.9%) rather than playing football and playing video games during leisure time as compared to boys (9.6% and 14.9% respectively).

Table 1: General characteristics of the studied population

Variable	Total (n = 400)	Boys (n = 208)	Girls (n = 192)	P-value
Age				
6yr-8yr	17 (4.3%)	12 (5.8%)	5 (2.6%)	0.1404
9yr-11yr	91 (22.8%)	41 (19.7%)	50 (26.0%)	0.1522
12yr-14yr	292 (73.0%)	155 (74.5%)	137 (71.4%)	0.5002
Type of physical activity participated by the School-age children				
Light	59 (14.8%)	32 (15.4%)	27 (14.1%)	0.7783
Moderate	218 (54.5%)	119 (57.2%)	99 (51.6%)	0.2702
Heavy	123 (30.8%)	57 (27.4%)	66 (34.4%)	0.1585
Frequency of physical activity				
0-1 times	96 (24.0%)	49 (23.6%)	47 (24.5%)	0.9068
2-3 times	194 (48.5%)	101 (59.9%)	93 (48.4%)	1.0000
>3 times	110 (27.5%)	59 (28.4%)	51 (26.6%)	0.7371
Amount of time spent on physical activity				
= 30 minutes	133 (33.3%)	70 (33.6%7	63 (32.8%)	0.9155
31-120 minutes	160 (40.0%)	84 (40.4%)	76 (39.6%)	0.9187
> 120 minutes	107 (26.8%)	56 (26.9%)	51 (26.6%)	1.0000
Leisure time activities				
Playing video games/TV viewing	128 (32.0%)	49 (23.6%)	79 (41.4%)	0.0002
Playing football	174 (43.5%)	128 (61.5%)	46 (24.0%)	<0.0001
Others	98 (24.5%)	31 (14.9%)	67 (34.9%)	<0.0001
Level of adiposity				
Thinness	31 (7.8%)	17 (8.2%)	14 (7.3%)	0.5504
Normal	335 (83.8%)	172 (82.7%)	163 (84.9%)	0.589
Overweight/obesity	34 (8.5%)	19 (9.1%)	15 (7.8%)	0.5756

Table 2: Comparison between frequency and duration of physical activity with age

Variable	6yr-8yr (n = 17)	9yr-11yr (n = 91)	12yr-14yr (n = 292)	P value
Type of physical activity				
Light	3 (17.6%)	15 (16.5%)	62 (21.2%)	0.5296
Moderate	9 (52.9%)	43 (47.3%)	126 (43.2%)	0.3234
Heavy	5 (29.4%)	33 (36.3%)	194 (66.4%)	< 0.0001
Frequency of physical activity				
0-1 times	3 (17.6%)	27 (29.7%)	66 (22.6%)	0.4901
2-3 times	8 (47.1%)	33 (36.3%)	153 (52.7%)	0.0337
>3 times	6 (35.3%)	31 (34.1)	73 (25.0%)	0.0778
Amount of time spent on physical activity				
≤30 minutes	3 (17.6%)	39 (42.9%)	91 (31.2%)	0.5052
31-120 minutes	8 (47.1%)	20 (22.0%)	132 (45.2%)	0.0091
> 120 minutes	6 (35.3%)	32 (35.2%)	69 (23.6%)	0.0293

Whereas the prevalence of overweight and obesity in the studied population defined by BMI-for-age was found to be 8.5, 8.2% were thin and 83.8% were normal. Upon stratifying the study population by gender, there was no significant difference in the level of adiposity.

Using chi-square for trend analysis, the type, frequency and duration of physical activity was stratified by age and presented in table 2. The number of children who engaged in a type of physical activity that is heavy, increased significantly with increase in age ($p<0.0001$). Considering frequency of activity within a week, the proportion of children who engaged in a physical activity 0-1 times a week, increased from 17.6% children aged 6-8 years to 29.7% children aged 9-11 years and decreased to 22.6% children aged 12-14 years. For a frequency of 2-3 times a week, significantly, the proportion decreased from 47.1% among children aged 6-8 years to 36.3% among children aged 9-11 years and finally increased to 52.7% children aged 12-14 years. In a frequency of more than thrice in a week, children aged 6-8 and 9-11 years had a proportion of approximately 35%, which decreased to 25.0% among children aged 12-14 years.

The proportion of children who spent = 30 minutes on a physical activity increased from 17.6% among children aged 6-8 years to 42.9% among children aged 9-11 years and decreased to 31.2% children aged 12-14 years. For an amount of time of 31-120 minutes, 47.1% children aged 6-8 years engaged in a physical activity, decreased significantly to 22.0% children at age 9-11 years and significantly rose to 45.2% children at age 12-14 years. Generally, 35% children aged 6-11 years spent more than 120 minutes in a week on a physical activity and significantly, this proportion decreased to 23.6% among children aged 11-14 years.

In Table 3, the frequency of participation and the amount of time spent on a physical activity were stratified with BMI-for-age status using chi-square for trend analysis.

Table 3: Comparison between frequency of activity, amount of time used and level of adiposity

Variable	Normal (n = 335)	Overweight/obesity (n = 34)	P value
Type of activity			
Light	49 (14.6%)	6 (17.6%)	0.6155
Moderate	183 (54.6%)	18 (52.9%)	0.8587
High	103 (30.7%)	10 (29.4%)	1.0000
Frequency of activity			
0-1 times	79 (23.6%)	9 (26.5%)	0.6770
2-3 times	168 (50.1%)	15 (44.1%)	0.5902
>3 times	88 (26.3%)	10 (29.4%)	0.6865
Amount of time spent on physical activity			
≤30 minutes	111 (33.1%)	16 (47.1%)	0.1290
31-120 minutes	180 (53.7%)	12 (35.3%)	0.0476
>120 minutes	44 (13.1%)	6 (17.6%)	0.4350
Leisure time activities			
Playing video games/TV viewing	106 (31.6%)	10 (29.4%)	0.8488
Playing football	148 (44.2%)	17 (50.0%)	0.5883
Others	81 (24.2%)	7 (20.6%)	0.8329

From the studied population, 50.1% children who engaged in a physical activity in a frequency of 2-3 times in a week had normal BMI-for-age status compared with 44.1% children who had a similar frequency. The difference was not significant. Generally, there was no significant association when the frequency of participation in a physical activity was stratified with BMI-for-age status.

Whereas, 47.1% children who spent =30 minutes on a physical activity were overweight/obese, 33.1% children who spent the same amount of time had normal BMI-for-age status. Significantly, 53.7% of normal BMI-for-age status children spent 31-120 minutes a week on a physical activity compared with 35.3% overweight/obese children.

DISCUSSION

In the present study, most of the children were found to be physically active in which more than 80% participated in moderate-to-heavy type of physical activities. This is similar to the physical activity prevalence of 85% of Chinese children (Kong *et al*., 2010) and 70.1% found among children in Nigeria (Senbanjo and Oshikoya 2010). The high proportion of physical activity prevalence is higher than the 64.1% of Italian children participating in moderate to heavy activity (Federico *et al*., 2009), 30% of high school children who met the established guidelines of participating in physical activities (Kann *et al*., 2000) in the US and 43% of children in Dublin who lacked moderate type of activity (Hussey *et al*., 2001). Children in Ghana participate in both organized physical activities conducted in schools as physical education and activities undertaken during leisure time such as playing football. The risk of developing chronic diseases such as obesity, diabetes and hypertension has been shown to reduce with increase in physical activity (Al-Nakeeb *et al*., 2007). It is therefore good that the children in this study are physically active. This is reflected in the BMI-for-age status of the children in which more than 80% were normal.

There were no significant differences between sexes in the type of activity participated by the children. It was found that 88% of boys and 75% of girls participated in a physical activity at least twice a week. According to the WHO survey, similar proportion of 82% of boys and 68% of girls aged 11-15 in 1998 participated in physical activity at least twice a week (Aarnio *et al*., 2002). Even though the differences were not significant, more girls than boys were found in the low frequency (0-1 times) category and more boys than girls were found in the moderate (2-3 times) and high (> 3 times) frequency categories.

Generally, more than 70% of the studied children spent between 30 to 120 minutes on any physical activity and by proportion, more boys than girls were found in this group. The differences between the sexes were not significant. In contrast, Feldman *et al*. (2003) in a cross sectional study of high school students in Montreal, Canada reported that more girls than boys were found in the low and moderate activity and more boys than girls in the high activity group. In conformity with our findings several other studies have also reported minimal or no difference in moderate to high activity between boys and girls (Armstrong and Bray, 1991; Falgairette *et al*., 1996). Hussey *et al*., (2001) reported that 57% of children engaged in 20 minutes of light exercise at least three times a week and there were no significant differences between the sexes. It therefore appears that there is no clear consistency in the sex differences with regards to physical activity. It is important to note that cultural and racial differences could have contributed to the non-significant gender differences in physical activity in this study. In addition, the general high level of physical activity prevalence identified in this population could have contributed to the lack of significant differences between the sexes.

The leisure time activities of the children were assessed in which more than 40% played football and significantly, more boys than girls played football during leisure

times. Playing football is considered a vigorous activity and several studies have indicated that boys significantly engage in vigorous activities than girls (Tudor-Locke *et al*., 2003; Olivares *et al*., 2004; Senbanjo and Oshikoya 2010; Feldman *et al*., 2003)

A proportion of 19.3% of children watched television and significantly more girls than boys watched television. Even though the amount of time spent watching television was not assessed the prevalence of T.V watching found in this study is lower than the 67% of children watching television for at least 2 hours a day in the US (Andersen *et al*., 1998) and 48% of Filipino children (Tudor-Locke *et al*., 2003). In contrast to our findings a study among Filipino youth aged 14-16 years, reported that males watched television a median of 2.3 h/day, significantly greater than the 1.8 h/day reported by females (Tudor-Locke *et al*., 2003). A study in Singapore among youth aged 8-16 years reported equal viewing time patterns between males and females in a 2-4 h of multimedia usage daily (combined television, video, or computer) (Schmidt *et al*., 1998). In Ghana, girls appear to spend more time indoors as compared with boys and since television is watched indoors it is not surprising that more girls watched television than boys. In addition the apparent differences between our study and the others could also reflect television programming relevance and appeal or cultural differences in viewing habits. The low prevalence of TV watching/playing video games in this study confirms to the findings in this study that the children were active (more than 80% participated in moderate to heavy physical activity) and spent most of their time outside probably playing.

The prevalence of overweight and obesity combined was found to be 8.5% and more than 80% were normal. In comparison to other studies the prevalence of overweight/obesity is lower than the 38.7% prevalence among children aged 5-10 years in Porto (Moreira *et al*., 2010), 28.0% prevalence among Chilean children aged 8-13 years (Kain *et al*., 2002) and 27.9% among 10-18 year children in Brazil (Cole *et al*., 2000). As indicated earlier more than 80% of the children participated in moderate to heavy type of physical activity and a similar proportion participated in a physical activity at least 2 times a week. This probably contributed to the low prevalence of overweight/obesity observed in this study as low physical activity has been shown to be a contributing factor to the increase in childhood obesity (Uauy *et al*., 2001; Albala *et al*., 2002).

Our study has also demonstrated that childhood overweight/obesity exist in a developing country like Ghana as well as thinness (7.8%) exposing the country to the double burden of malnutrition. Strategies put in place by the Ghana Health Service to tackle malnutrition should be comprehensive enough encompassing aspects of under nutrition and over nutrition.

Contrary to the findings of several studies significantly the proportion of children who participated in a heavy type of physical for at least 2 times a week and for an amount of time of at least 31 minutes increased with increase in age (Sallis, 1993; Caspersen *et al*., 2000; Trost *et al*., 2002; Sherar *et al*., 2007). Numerous epidemiological studies have shown that as age increases physical activity declines and the decline is greater in late childhood than in adolescence (Sherar *et al*., 2007; Trost *et al*., 2002). The difference in our findings could be attributed to racial and cultural differences. In a study among children in Nigeria, Senbanjo and Oshikoya (2010) also reported a similar increase in physical activity as age increases in which the differences were attributed to racial and cultural differences.

It has been reported that obese children are less physically active (Page *et al*., 2005) and spend less time in moderate to vigorous physical activity than their non obese peers (Haerens *et al*., 2007). This is in conformity to our study which has shown a significant association between children spending 31-120 minutes on a physical activity of any kind and a decrease in weight gain. Moliner-Urdiales *et al*. (2009) have also reported that both average and at least moderate physical activity levels may have an impact on total and central body fat in youth.

In comparing leisure time activities like TV watching/playing video games and level of adiposity no significant differences were observed. Similar to our findings Olivares *et al*. (2004) did not also find any association between TV watching/playing video games and nutritional status. In a study by Hussey *et al*. (2001) in Dublin differences were not seen in energy burned in regular activity for those spending more or less than three hours a day watching television. The lack of significant association between TV watching/playing video games in this study could be related to the fact that majority of the children were physically active. As such even though the children watched TV/played video games, the high physical activity levels among the children may be a contributing factor to a better energy balance (Lazarou and Soteriades, 2010). In addition a higher proportion of the children played football, which is a vigorous activity and could contribute to energy expenditure. Also, a small proportion of the children watched television/played video games making it difficult to measure the difference.

Conclusion: Most of the children engaged in moderate to high physical activity. Physical activity was not associated with sex. Type of activity, frequency and amount of time spent on a physical activity was associated to level of adiposity. There was an association between high physical activity and increase in age. Increase in age was associated to high physical activity.

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