Physical activity, body mass index and blood pressure in primary school pupils attending private schools.

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Abstract

Background: Lack of physical activity contributes to overweight and obesity. It is recommended that children accumulate at least one hour of moderate to vigorous intensity physical activity daily.

Objective: The level of physical activity, body mass index (BMI) and blood pressure (BP) were evaluated in pupils attending private primary schools.

Method: The intensity and duration of physical activity of the pupils selected by multiple stage sampling method were obtained with the aid of a questionnaire. The BMI and BP were measured. Analysis was by SPSS.

Results: Of the 353 pupils, 132(37.4%) pupils were adequately physically active while overweight and obesity prevalences were 54(15.3%) and 65(18.4%) respectively. Hypertension prevalence in overweight/ obese children (6.5%) was significantly higher than in children with healthy weight 1.5%, P = 0.04.

Conclusion: Only a third of pupils met the recommended level of physical activity. The prevalence of overweight and obesity was high while the overweight and obese pupils were more likely to have hypertension compared to those with healthy weight. Physical activity programmes for primary school pupils in school and at home are therefore recommended.

Keywords: Physical activity; body mass index; school children; hypertension

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Introduction

The prevalence of obesity in children has been on the rise globally and currently constitutes a public health problem[1]. The prevalence of overweight and obesity in the United States is between 13 and 14%.[2] In Nigeria, several studies have reported prevalence between 0.3% and 9.4% amongst children and adolescents[3-5]. The increasing burden of overweight and obesity has been ascribed to low level of physical activity among other factors in children[6].

Children with overweight and obesity are more prone to developing cardio-metabolic problems of type 2 diabetes, elevated BP, myocardial infarction, dyslipidaemia and stroke[7-9]. Several studies have demonstrated the rising prevalence of hypertension and pre-hypertension amongst Nigerian children and most have identified obesity and overweight as contributing factors[5,10-11].

The suspected causal relationship between lack of physical activity and development of overweight and obesity has led to establishment of guidelines on required duration and intensity of physical activity for healthy living. The American department of health and human services[12], recommend that children should accumulate at least 60 minutes of moderate to vigorous intensity physical activity daily, which should include at least 3 days of muscle and bone strengthening activity[12].

In Nigeria, children from higher social class are perceived to be more likely to engage in sedentary activities such as spending long times on on-screen based activities such as playing video games and working on the computers, than in moderate to vigorous intensity physical activity. They are also more likely to be kept indoors because of the prevailing insecurity in the country.

An earlier study conducted in Abeokuta, Nigeria[13] on school children, showed that 72% of the children were

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involved in moderate to vigorous physical activities. However, the duration of physical activity was not assessed to determine if they met the daily recommended minimum level of physical activity.

This study therefore aims to determine the proportion of pupils attending private primary schools in a Local Government Area (LGA) in South-South Nigeria, who meet the recommended level of physical activity and to evaluate the relationship between their physical activity, BMI and BP.

Method

This cross-sectional study was conducted in Egor LGA, of Edo State of Nigeria as part of a larger study to evaluate cardiovascular risks in children. Egor LGA has an estimated total population of 339,899 of which 119,038 are aged less than 15 years[14]. It has ten political wards of which eight are urban. This study was conducted over a six months period (September 2011 to February 2012). Ethical approval for this study was obtained from the Ethics Committee of the University of Benin Teaching Hospital, Benin City.

Sampling technique

The sample size was determined using the formula

$$n = \frac{z^2pq}{d^2}$$ [15]

Where z is the standard normal deviate set at 1.96, p is proportion of physically active children. A proportion of 72% from a previous Nigerian study[13] was used, q = 1 – p and d is the degree of accuracy set at 0.05. The sample size of 310 was obtained, which was increased to 400 to accommodate for improper filling of questionnaires by parents. The 400 pupils from private primary schools were selected using a multi stage sampling technique. Three (3) wards representing 30%) of the 10 political wards were randomly selected as the first stage of the sampling process[16]. There were 19 private schools in the 3 selected wards from which 6(30%) were selected from a list of alphabetically arranged schools. Selection was done using a systematic sampling technique after randomly selecting the first school (second stage). The school sample size was determined as the ratio of the product of index school population and study sample size (400) over the pooled population of the 6 selected schools. The school sample size was thus determined in proportion to school population. A systematic sampling method was employed to select pupils from each school.

Evaluation of selected pupils

An informed written consent was obtained from the parents of each selected pupil. Any child whose parent declined to give consent was replaced by the next pupil on the sampling list, selected using the sampling interval and whose parent gave consent. A socio-economic class was ascribed to each selected pupil, using the method described by Olusanya et al[16]. The method was based on the level of education of the mother and the father's occupation.

Assessment of physical activity

The selected pupil was then given a questionnaire to take to the parents/ guardians. Recall of duration of physical activity is difficult especially in children[11], thus the parents were to observe the pupils over seven days noting times and types of physical activity their children engaged in. Types, duration and intensity of physical exercise engaged in during physical education sessions at school were also documented as well as those engaged in the time interval between closing from school and being picked up by their parents. The information on physical activities during these times were obtained from the children by the parents on a daily basis to enhance recall. Physical activities at home were also noted by the parents.

The questionnaires were then filled by the parents. The questionnaire sought information on biodata and the type, frequency and duration of physical activity the child engaged in daily during the week of observation. Moderate to vigorous intensity activities included riding bicycle, walking, running at home and school playground, contact sport such as playing football, tennis and basketball. Others included household chores, dancing at home and parties, recreational/ competitive swimming, aerobics and skipping. The pupils/ parents were told to indicate any other activity the child engages in, which was not captured in the questionnaire. The muscle and bone strengthening activities that were to be observed by the parents were mostly contact sports such as football, tennis and basketball and vigorous running. The children who had at least four adequately filled days including a weekend day were included in the analysis. An average of the daily physical activity with respect to type and duration was then computed for each child.

Measurement of anthropometry and blood pressure

The weight was measured with the Omron body composition monitor (BF511Netherlands) using standard meth-

ods. The weight was read to the nearest 0.1 kg. The height was taken with the aid of a stadiometer. The pupils were instructed to stand with the feet bare against the stadiometer with the heels, buttocks and occiput resting against the stadiometer. The chin was raised so that the subject was looking ahead with the upper border of the ear canal in the same horizontal plane as the lower border of their eye socket (Frankfurt plane)[18]. The height was read to the nearest 0.1 cm. The Body Mass Index (BMI) for age was then computed for the pupils as the ratio of the weight in kg/ square of the height in metres (m^2). The pupils were categorized by gender and age using the United States Center for Disease Control (CDC) BMI growth charts into obese: ≥95th percentile; overweight: 85th to <95th percentile; healthy weight: 5th to <85th percentile and underweight: <5th percentile[9].

The blood pressure (BP) was measured in the right upper arm. The pupils were asked to sit down and relax for about 3 minutes before the BP was measured. An appropriate sized cuff, with bladder width of 40% of the arm circumference between the acromion and olecranon process and the bladder length of 80 - 100% of the arm circumference was used.[20] The cuff was snugly applied to the right upper arm and the cuff inflated to about 10 mmHg above the systolic BP determined by palpation. The bell of the stethoscope was then applied over the brachial artery and the cuff was slowly deflated at a rate of 2mm per second. The first Korotkoff sound was taken as the systolic BP while the fifth Korotkoff sound represented the diastolic BP. Two BP readings were taken three minutes apart and the average was taken as the patient's BP[20].Pre-hypertension was defined as elevated SBP or DBP between the 90th and <95th percentile for the age, sex and height. Stage 1 hypertension was defined as SBP or DBP between 95th percentile and 99th percentile plus 5mmHg and stage 2 hypertension was defined as SBP or DBP >99th percentile plus 5mmHg, according to the recommendation of National Blood Pressure Education Programme[20].

Statistical analysis

The data was entered into SPSS version 16 (Chicago IL) spread sheet and analysis done with the same tool. The number of pupils who reported moderate to vigorous activity of at least one hour a day and those with hypertension or pre-hypertension were presented as simple proportions. Differences in means of systolic and diastolic blood pressures were compared using student's t test. Differences in medians were compared with Krukas-Wallis Test. Level of significance was set at P = <0.05 at 95% of confidence level.

Results

Characteristics of study population

There were 353 of 400 pupils who responded and filled the questionnaire appropriately, giving a response rate of 88.3%. Of the 353 pupils, 159(45.0%) were males while 194(55.0%) were females. The mean age of the pupils was 8.5 ± 1.9 years with a range of 5 – 12 years. Most of the pupils, 255(72.2%) were from high SEC while 54(15.3%) and 44(12.5%) were from middle and low social economic classes (SECs) respectively.

BMI classification

The median BMI percentiles of the males and females were 66.1(range: 0.2 – 99.7) and 56.7(range: 0.1 – 99.8) respectively, P = 0.56. Most of the pupils 207(58.6%) had healthy weight, 27(7.7%) were underweight, 54(15.3%) and 65(18.4%) were overweight and obese respectively. The mean ages, gender and socio-economic classes according to the BMI categories is shown in table 1.

Table 1. The mean age, gender and socio-economic distribution according to BMI categories (original)

Characteristics	Underweight N (%)	Normal n(%)	Overweight n(%)	Obesity n(%)	P value
Mean age (years ± SD)	8.2 ± 2.0	8.3 ± 2.0	9.0 ± 1.6	9.0 ± 1.4	0.009
Gender					
Male	11(6.9)	92(57.9)	25(15.7)	31(19.5)	0.93
Female	16(8.2)	115(59.3)	29(14.9)	34(17.5)	
SEC					
High SEC	16(6.3)	143(56.1)	44(17.3)	52(20.4)	
Middle SEC	5(9.3)	29(53.7)	8(14.8)	12(22.2)	0.0062
Low SEC	6(13.6)	35(79.6)	2(4.5)	1(2.3)	

Blood pressure

The mean systolic BP of the male pupils 96.9 ± 9.7 (range: 70 – 138) mmHg and female pupils 98.5 ± 10.4 (range: 70 – 130) mmHg were not significantly different, P = 0.14. Similarly, the mean diastolic BP of the male and female pupils 62.8 ± 7.9 (range: 35 – 85) mmHg and 63.4 ± 8.5 (39 – 90) mmHg respectively were not significantly different, P = 0.51. Of the 353 pupils recruited, 10(2.8%) had hypertension while 14(4.0%) had pre-hypertension. Of the pupils with hypertension 7(70.0%) were female and 5(50.0%) were from high social class. There was no statistically significant differences in prevalence of hypertension by gender or socio-economic status, P = 0.35 and 0.46 respectively. The mean age of the children with hypertension was 9.6 ± 2.4 years, those with pre-hypertension was 8.6 ± 2.5 years and those with normal BP was 8.5 ± 1.8 years, P = 0.21. The prevalence of hypertension in overweight and obese children (6.5%) 7/107 was significantly higher than in children with healthy weight 1.5% (3/197), P = 0.04. The odds of a child who is overweight or obese having elevated BP was 4 folds compared to the child with healthy weight. [Odds ratio (R) = 4.0, Confidence Interval = 1.1 – 19.0]. The prevalence of pre-hypertension amongst overweight/obese children 5.6% (6/107) was not significantly higher than that amongst children with healthy weight 3.6% (7/194), P = 0.56. Similarly, pupils with hypertension had a significantly higher median (range) BMI percentile 91(41.7 – 99.4) compared to those with pre-hypertension 73(0.2 – 99.5) and those with normal BP 61.8(0.1 – 99.8), P = 0.038. The distribution of the pupils with hypertension and pre-hypertension according to gender and socio-economic class is shown in table 2.

Table 2. The prevalence of hypertension and pre-hypertension by gender and socio-economic class (original)

Characteristics	Normal BP N (%)	Hypertension n (%)	Pre-hypertension n(%)	P value
Gender				
Male	153(96.2)	3(1.9)	3(1.9)	0.12
Female	176(90.7)	7(3.6)	11(5.7)	
SEC				
High	238(93.3)	5(2.0)	12(4.7)	0.46
Middle	50(92.6)	3(5.6)	1(1.9)	
Low	42(95.4)	1(2.3)	1(2.3)	

Physical activity

Of the 353 pupils, 132(37.4%) met the recommendation and were deemed to be adequately physically active while 221(62.6%) were not. Sixty two (47.0%) were males while 70 (53.0%) were females. There was no statistically significant gender difference, P = 0.58. The mean ages of those who met the recommendation and those who did not were 8.5 ± 1.9 years and 8.6 ± 1.8 years respectively, P = 0.62. The median (range) BMI percentile of the pupils who met the recommendation 58.9(0.1 - 99.8) kg/M^2 was not significantly lower than those who did not 67(0.2 – 99.7) kg/M^2, P = 0.44. The relationship between physical activity and nutritional status, socio-economic class, gender and mean age is shown in table 3.

Table 3. Relationship between physical activity, BMI and socio-economic class amongst male and female pupils (original)

Characteristics	Males			Female		
	Active n(%)	Inactive n(%)	P value	Active n(%)	Inactive n(%)	P value
Nutritional status						
Underweight	3(4.9)	8(8.2)	0.62	7(10.0)	9(7.3)	0.92
Healthy weight	39(62.9)	53(54.6)		40(57.1)	75(60.5)	
Overweight	10(16.1)	15(15.5)		11(15.7)	18(14.5)	
Obesity	10(16.1)	21(21.7)		12(17.1)	22(17.7)	
Socio-economic class						
High	51(82.3)	64(66.0)	0.17	51(72.9)	89(71.8)	0.70
Middle	4(6.5)	20(20.6)		11(15.7)	19(15.3)	
Low	7(11.3)	13(13.4)		8(11.4)	16(12.9)	
Blood pressure						
Normal BP	61(98.4)	92(94.8)	0.37	64(91.4)	112(90.3)	0.92
Prehypertension	0(0.0)	3(3.1)		4(5.7)	7(5.6)	
Hypertension	1(1.6)	2(2.1)		2(2.9)	5(4.1)	

The mean systolic BP of males that met the daily recommendation for physical activity 96.1 ± 8.5 mmHg was lower than that of the males who did not meet the recommendation 97.4 ± 10.5 mmHg, but the difference did not reach statistical significance, P = 0.38. Similarly, the mean systolic BP of the females who met the recommendation 97.5 ± 10.1 mmHg was lower than those who did not meet the recommendation 98.8 ± 10.4 mmHg, but the difference did not reach statistical significance, P = 0.38.

The effect of physical activity on blood pressure of subjects in different BMI categories

The mean BP of pupils who were obese and had adequate physical activity 102.6 ± 9.9mmHg was lower than that of obese pupils who had inadequate physical activity 104.1 ± 10.5mmHg, although the difference was not statistically significant, P = 0.56. The mean BPs of pupils who had adequate physical activity and also had healthy weight or were overweight was lower than their counterparts who did not have adequate physical activity (Table 4).

Table 4. The mean blood pressure in mmHg of pupils in the different BMI categories who had adequate and inadequate physical activity (Original)

BMI categories	Adequate activity Mean BP (n)	Inadequate activity Mean BP(n)	P value
Underweight	95.1 ± 7.1 (10)	93.8 ± 8.5 (17)	0.69
Healthy weight	95.1 ± 9.5 (78)	96.2 ± 10.1 (123)	0.44
Overweight	98.1 ± 7.1 (21)	100.7 ± 9.3 (33)	0.30
Obesity	102.6 ± 9.9 (22)	104.1 ± 10.5 (42)	0.58

Discussion

Over a third (37.4%) of the pupils were engaged in the recommended moderate to vigorous intensity activity for at least one hour a day in this study. This is lower than the 72.1% of school children and adolescents in Abeokuta, Nigeria[13]. The higher value in the Abeokuta study is due to the method of determining level of physical activity that included all children who were physically active for at least 20 minutes whereas the present study used the more stringent recommendations by the United States, Preventive Services Task Force[12]. It is also possible that the children in the Abeokuta study who were attending both private and public schools could have been more physically active because of the availability of bigger playgrounds especially in the public schools. The implication of this is that while many children may be active physically, only about a third do actually meet the level of intensity of physical activity that is recommended for healthy living. It becomes imperative that parents/ guardians and teachers become aware of the recommendations and thus appropriately structure the physical activity programmes/ schedule of the children during school hours and at home to enable them accumulate the required duration and intensity of physical activity.

The median BMI percentiles of the pupils who met the recommended level and duration of physical activity were lower than those who did not meet the recommendation, although the difference was not significant. This may be due to the fact that other factors such as eating habits and genetics which are known to contribute to elevated BMI and which were not evaluated in this study may have confounded the effect of physical activity on BMI in the studied children[9]. The data from this study also suggests that about a third of the overweight and obese children met the recommendation for the duration and intensity of physical activity. That these overweight and obese pupils were physically active is desirable as physical activity will help in keeping them fit and also contribute to weight reduction. However efforts to gradually increase the duration of physical activity to > one hour will be better as longer duration of moderate to vigorous intensity physical activity has more beneficial effects on the health of children[2].

The prevalence of overweight and obesity in this study of 15.3% and 18.4% respectively is higher than the figures obtained from most studies within[3-5,10] and outside[1,6] Nigeria. The high figure in the present study may have been due to the fact that only children from private schools who were predominantly from the high socio-economic class were recruited for the study. The figure is however similar to the 18% prevalence reported by Owa and co-worker[21]. In the study by Owa et al[21], there was no distinction between overweight and obese children, which could have accounted for the higher figure in that study. The present study thus identifies a group of children whose parents should be targeted for education on childhood overweight and obesity, the attendant problems and on how to mitigate the excess weight. The perception in the study community that big and fat children are better as they indicate that their wealthy parents are taking good care of them is perhaps another reason why overweight and obesity is high in private schools and is yet another reason to educate the parents and teachers. Most private schools are built within small compounds that hardly have enough space for the children to play and engage in sport activities. The children, who are driven to and from school, may close late and are often too tired to take part in physical activity at home. They may thus go for many days without significant physical activity.

The prevalence of elevated BP in the range of pre-hypertension and hypertension in the current study is consistent with previous studies in Nigeria[5,10]. The prevalence of hypertension and pre-hypertension was significantly higher in the children with overweight/ obesity compared to those with healthy weight. The finding is congruent with other similar studies[5,10]. The influence of body mass on BP was further demonstrated in this study in that the pupils who were overweight or obese had a 4-fold risk of having hypertension compared to those with healthy weight. This finding is consistent with those of Oduwole et al[15]. This further buttresses the pivotal role body mass plays in the development of elevated BP and the need to establish measures/ programmes to reduce weight in overweight and obese children by engaging them in physical activities amongst other things.

In this study, the pupils who had adequate physical activity and had healthy weight, overweight or were obese had lower mean BP compared to their counterparts in the respective BMI categories who had inadequate physical activity. This finding further shows the effect that physical activity has on producing a lower mean BP amongst pupils who are physically active compared to those who are not irrespective of their body mass index. The difference in BP values were small and did not reach statistical significance, perhaps because of the influence of other factors such as genetics and other environmental factors on BP.

This study has certain limitations, the method used to obtain data on physical activity that involved parents monitoring and noting the physical activities of their children over a seven-day period to enable them correctly fill the questionnaires, would rely on the children providing sometimes estimated duration where the parents are unavailable to observe them. Although the design of this questionnaire was meant to ensure accuracy of data, the process could still have resulted in over/ underreporting of duration of physical activity. The ability of the parents to correctly fill the questionnaire may depend on their level of education and their cooperation to diligently fill the questionnaire. This may have been addressed by studying only pupils from private schools most of whom are from high and middle socio-economic classes and whose parents especially the mothers would likely have a high level of education.

Conclusion

About a third of pupils in private primary schools in Egor LGA of Edo State of Nigeria engage in moderate – vigorous intensity physical activity for at least one hour a day. About two thirds of the pupils who were obese did not meet the daily recommendation of physical activity. The percentage of overweight and obesity in this study of 15.3% and 18.4% respectively is high. The pupil who is overweight or obese has a fourfold risk of having hypertension compared to those with healthy weight. There is an urgent need to raise awareness amongst children, their parents and teachers about the importance of engaging in moderate-vigorous intensity activity for at least one hour a day. Scheduled physical fitness programmes should be compulsorily incorporated into school health programmes, the availability of infrastructure in schools and the community such as sporting clubs and facilities in schools and the communities, parks and gardens for sport and exercise should also be assured by the relevant authorities.

Conflict of interest

None to declare.

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