Physical activity and body mass index of school children and adolescents in Abeokuta, Southwest Nigeria

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Background: **Physical inactivity and sedentary lifestyles are known to predispose to overweight and obesity. These lifestyles are also known to track from childhood into adulthood with consequent cardiovascular and metabolic problems. This study aimed to describe the frequency of physical activity and the relationship between physical activity and body mass index of urban Nigerian school children and adolescents.**

Methods: **Children from seven schools in Abeokuta, southwest Nigeria were selected using a multi-staged random sampling technique.**

Results: **Of 570 children, 411 (72.1%) were involved in moderate to vigorous physical activities. Involvement in physical activity was higher in older children (P<0.001), males (P<0.001), and children of mothers with a higher educational level (P=0.03). Eleven (1.9%) children were overweight or obese whereas 163 (28.6%) were underweight. There were more children with underweight than overweight among the subject population with a high level of physical activity (35.6% *vs.* 4.4%, P=0.499).**

Conclusions: **A large proportion of the children in urban Nigeria participate in physical activity. The prevalence of overweight and obesity is low but undernutrition is a major nutritional problem among these children.**

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Key words: **adolescents; body mass index; children; Nigeria; physical activity**

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Introduction

Overweight and obesity are emerging as a major public health problem in the developing countries.[1,2] It is worrisome because of its coexistence with chronic undernutrition among children in low income countries, a phenomenon referred to as "double burden" disease.[2,3] Obesity is associated with significant comorbidities and health problems such as diabetes mellitus, hypertension, coronary artery disease, orthopedic problems, skin fungal infections and negative self-esteem.[4] The consequences of obesity are likely to be worse in the developing countries where health facilities to manage the condition and its complications are scarce. Based on the data reported by Popkin et al,[3] the prevalence of obesity in the developing countries ranges from 7% to 10%. Interestingly de Onis and Blossner[5] reported the rapidly increasing prevalence of overweight and obesity among pre-school children in developing countries, with the prevalence of overweight in countries such as Egypt, Malawi, Uzbekistan and Nigeria exceeding that of the United States. In a recent study among urban adolescents in Lagos, Nigeria, the prevalence of overweight and obesity were 3.7% and 0.4% respectively.[6]

Among the potential determinants of overweight and obesity, less physical activity and unhealthy eating habits appear to be major contributors.[7] Many studies have reported that overweight subjects are involved in fewer physical activities than their non-overweight peers.[7-10] In South Africa, inactivity of children rather than diet was a major determinant that influences the development of overweight and obesity.[11] Opportunity for physical activity (PA) is largely determined by social, economic and cultural factors and a physical environment that influences access and availability. These factors are known to contribute to the differences in the prevalence

of overweight and obesity observed from one community to another.[12]

There is a tendency for children to carry inculcated health related behaviors into adulthood. Therefore, determining the epidemiology of PA among children as a tool for preventing overweight and obesity has become imperative. Previous studies on obesity in Nigeria have focused on the prevalence of the condition while only a few have described the associated risk factors.[13] Therefore the aim of this study was to describe the frequency of PA, influence of age, gender and socioeconomic factors on PA and the relationship between PA and body mass index (BMI) of school children and adolescents living in Abeokuta, southwest Nigeria.

Methods

The study was carried out in selected primary and secondary schools in Abeokuta. It was a cross sectional, questionnaire based study. Abeokuta, located at longitude 7'10'N and latitude 3'26'E, is the capital of Ogun State in southwestern Nigeria. It is about 100 km north of Lagos with an estimated population of 4 million. Abeokuta is predominantly made up of people of the Yoruba tribe but urbanization and industrialization have brought in many other ethnic groups.

Ethical approval and clearance were obtained from the Federal Medical Centre Research/Ethics Committee and from the Ogun State Ministry of Education respectively. The teachers, pupils and parents were well informed of the scope and extent of the survey, and consent of the parents and pupils was also obtained. At the time of the study, there were a total of 322 schools in Abeokuta (The ratio of public to private primary schools was 1:1 whereas the ratio of public to private secondary schools was 3:1). However, the population of pupils in each public primary school is almost double that in each private primary school but the population in each of the public and private secondary schools is almost equal. Thus a multi-stage random sampling method was used to select 7 schools for the study. In order to allow equal representation of the pupils, 2 private primary schools selected along with one public primary school and one private along with three public secondary schools were selected by balloting. From each of the selected schools, all grades were studied (primaries 1-6; junior and senior secondary school 1-6). On the day of the study, one arm from each grade was selected by balloting. Ballot papers were served to all the children in the selected arm. These ballot papers were blank except those that were marked with numbers 1 to 15. After all the students had picked a paper, they were asked to open and those with numbers 1 to 15 were selected. Ninety pupils were selected from each of the seven schools. In all, 630 pupils were selected but only 570 pupils (90.5%) completed the study. The other 60 pupils were excluded because of refusal to participate and evidence of chronic diseases detected clinically including sickle cell disease and poliomyelitis. Each child was interviewed to obtain information on demographic, socioeconomic characteristics of their families and frequency of PA. The families were assigned to a socioeconomic class using the method (modified) recommended by Oyedeji.[14] The occupation of the parents and their highest education were scored from 1 (highest) to 5 (lowest). The mean score for both parents gave social class falling within the 1-5 range. Those with a mean score of ≤2 were further reclassified into upper class but those with a mean score of >2 were reclassified into lower social class.

Physical activity measurement

Physical activity is defined as any bodily movement that results in energy expenditure.[15] There are many ways of measuring PA patterns in children with different limitations[15,16] but no specific method has been identified as the best option for all studies.[16] The traditional survey and recall instrument (modified) in the form of a questionnaire[15] was employed in this study for the measurement of episodes of past physical activities, their intensity and duration. In the African context, most people particularly children do not keep record of exact duration of their physical activities. To reduce limitations of this study, we decided to measure intensity of PA and number of episodes alone. In the future we intend to validate each of these components of PA measurement. A simple questionnaire was designed to assess PA in the last 4 weeks preceding the survey. The participants were asked to indicate the average number of times they were engaged in exercise and thought they lasted more than 15 minutes. The types of PA assessed were vigorous/high intensity or moderate intensity activities such as competitive and uncompetitive games like football, swimming and fast running. We did not include walking from place to place as part of PA assessment.

Anthropometric measurements

All anthropometric measurements were taken by trained student nurses. Each measurement was taken by the same examiner to minimize measurement error. The children were weighed using an electronic weighing scale calibrated in 100 g units (SECA/UNICEF, Australia). All children were weighed wearing only underwear to the nearest 0.1 kg. The height was measured using a specifically-made wooden stadiometer with a steel tape measure. This was done with the child standing erect without shoes and with the eyes looking horizontally and the feet together on a horizontal level. These measurements were done to the nearest 0.1 cm. BMI was

calculated by dividing the weight in kilogram with the square of height in meters. Standardization checks on the weighing scale and height boards were done periodically during the study period.

Definitions

BMI for age percentile was generated from the age and sex specific criteria of the Centers for Disease Control. According to the National Center for Health Statistics/ World Health Organization (NCHS/WHO) guidelines and cut off points for BMI-for-Age percentile,[17] a child is regarded as being overweight or obese if the BMI is ≥85th or ≥95th percentile for age and sex respectively. Children below the 5th percentile for age and sex are classified as underweight.

Statistical analysis

Data analysis was made by descriptive and inferential statistics using SPSS for Windows software version 11. The means and standard deviations (SD) of weight, height and BMI were calculated by age groups and gender. Differences in mean between both genders were compared using independent-sample *t* test while proportions and ratios were compared using the Chi-square test. *P* values less than 0.05 were considered statistically significant.

Results

A total of 570 children completed the study and analyzed. The mean age was 12.2 years and 296 (51.5%) were males. Table 1 shows the sociodemographic characteristics and the various anthropometric measures according to age and gender. Among the children aged 10-14 years, females had a significantly higher percentage of mothers with post secondary education (χ^2=7.2, *P*=0.007) than males, and their weight and BMI were also significantly higher than males (*t*=3.3, *P*=0.001 and *t*=4.0, *P*<0.0001 respectively). Among the children aged 15-19 years, height was significantly higher in males (*t*=5.2, *P*<0.0001) while BMI was significantly higher in females (*t*=5.2, *P*<0.0001). According to the NCHS/WHO criteria, 10 (1.8%) children were overweight, and 7 of them were females. The only obese child (0.2%) in this study was female. The prevalence of overweight/obesity increased with age and there was a significantly higher prevalence among females in the age groups of 10-14 years and 15-19 years (χ^2=13.0, *P*=0.005; χ^2=20.9, *P*<0.0001 respectively). A total of 163 (28.6%) children were underweight. The BMI percentiles in different social classes are shown in Table 2.

The frequency of physical activity was related to the gender of the age groups (Table 3). Overall 411 children (72.1%) participated in physical exercises with more

Table 2. Body mass index percentile and socioeconomic status

BMI-for-age percentile	Social class	
	Lower, *n* (%)	Upper, *n* (%)
Less than 5th	123 (30.4)	40 (24.2)
5th to ≤ 85th	277 (68.4)	119 (72.1)
Greater than 85th	5 (1.2)	6 (3.6)
Total	405 (100)	165 (100)

χ^2=5.3, *P*=0.071 for group difference between BMI-for-age percentile and social class. BMI: body mass index.

Table 1. Socio-demographic and anthropometric characteristics of the study subjects

	5-9 years		10-14 years		15-19 years	
	Males (*n*=63)	Females (*n*=84)	Males (*n*=139)	Females (*n*=106)	Males (*n*=94)	Females (*n*=84)
Age (y, mean ± SD)	7.7±1.2	7.7±1.3	12.0±1.3	11.9±1.3	16.2±1.1	16.1±1.1
Mothers' educational level, *n* (%)						
≤ secondary	17 (27.0)	19 (22.6)	38 (27.3)	14 (13.2)*	27 (28.7)	25 (29.8)
Postsecondary	46 (73.0)	65 (77.4)	101 (72.7)	92 (86.8)	67 (71.3)	59 (70.2)
Fathers' educational level, *n* (%)						
≤ secondary	13 (20.6)	16 (19.0)	25 (18.0)	19 (17.9)	20 (21.3)	18 (21.4)
Postsecondary	50 (79.4)	68 (81.0)	114 (82.0)	87 (82.1)	74 (78.7)	66 (78.6)
Social class, *n* (%)						
Upper	17 (27.0)	25 (29.8)	35 (25.2)	33 (31.1)	35 (37.2)	20 (23.8)
Lower	46 (73.0)	59 (70.2)	104 (74.8)	73 (68.9)	59 (62.8)	64 (76.2)
Weight (kg, mean ± SD)	22.3±3.4	21.7±3.8	31.1±6.5	34.6±9.3	48.2±9.5	48.4±6.6
Height (cm, mean ± SD)	124.8±7.5	123.8±9.1	141.1±10.0	142.8±11.8	163.5±9.9	157.1±6.3*
BMI (kg/m^2, mean ± SD)	14.4±1.3	14.1±1.4	15.5±1.6	16.7±2.9	17.9±2.0	19.6±2.5*
BMI-for-age percentile, *n* (%)						
Less than 5th	20 (31.7)	23 (27.4)	55 (39.6)	21 (19.8)*	36 (38.3)	8 (9.5)*
5th to ≤85th	42 (66.7)	61 (72.6)	83 (59.7)	81 (76.4)	57 (60.6)	72 (85.7)
Greater than 85th	1 (1.6)	0.0 (0.0)	1 (0.7)	4 (3.8)	1 (1.1)	4 (4.8)

*: *P*<0.05 for sex difference in mother's educational level, weight, height, BMI and BMI-for-age. BMI: body mass index.

Table 3. Frequency of physical activity according to age group and gender

Frequency of physical activity	5-9 years, *n* (%)		10-14 years, *n* (%)		15-19 years, *n* (%)	
	Males	Females	Males	Females	Males	Females
Physically inactive	22 (34.9)	34 (40.5)	23 (16.5)	33 (31.1)	12 (12.8)	35 (41.7)
About once a month	2 (3.2)	1 (1.2)	6 (4.3)	8 (7.5)	4 (4.3)	9 (10.7)
About 2 or 3 times a month	1 (1.6)	2 (2.4)	6 (4.3)	0 (0.0)	3 (3.2)	7 (8.3)
Once a week	32 (50.8)	29 (34.5)	53 (38.1)	42 (39.6)	29 (30.9)	16 (19)
Twice a week	4 (6.3)	13 (15.5)	23 (16.5)	10 (9.4)	13 (13.8)	8 (9.5)
Thrice or more a week	2 (3.2)	5 (6.0)	28 (20.1)	13 (12.3)	33 (35.1)	9 (10.7)
Total	63 (100)	84 (100)	139 (100)	106 (100)	94 (100)	84 (100)

Frequency of physical activity was measured by the number of times individuals are engaged in exercises such as football, swimming, Physical Health Education Practice Session and fast running in the last 4 weeks preceding the survey.

Table 4. Socioeconomic determinants of physical activity

Socioeconomic factors	Frequency of physical activity, *n* (%)					
	Physically inactive	About once a month	About 2 or 3 times a month	Once a week	Twice a week	Thrice or more a week
Education of mother						
≤ Secondary (*n*=140)	46 (32.9)	6 (4.3)	8 (5.7)	52 (37.1)	8 (5.7)	20 (14.3)
Post secondary (*n*=430)	113 (26.3)	24 (5.6)	11 (2.6)	149 (34.7)	63 (14.7)	70 (16.3)
P=0.03						
Education of father						
≤ Secondary (*n*=111)	34 (30.6)	4 (3.6)	5 (4.5)	42 (37.8)	9 (8.1)	17 (15.3)
Post secondary (*n*=459)	125 (27.2)	26 (5.7)	14 (3.1)	159 (34.6)	62 (13.5)	73 (15.9)
P=0.545						
Social class						
Upper (*n*=165)	39 (23.6)	10 (6.1)	5 (3.0)	57 (34.5)	23 (13.9)	31 (18.8)
Lower (*n*=405)	120 (29.6)	20 (4.9)	14 (3.5)	144 (35.6)	48 (11.9)	59 (14.6)
P=0.605						

Frequency of physical activity was measured by the number of times individuals are engaged in exercises such as football, swimming, physical education practical and fast running in the last 4 weeks preceding the survey. Upper social class includes parents such as senior public officers, large scale traders, large scale farmers and professionals while lower social class are peasant farmers, artisans and laborers. *P* values are groups' difference between physical activity and the various socioeconomic factors.

males significantly involved than females in the 10-14 and 15-19 years groups (χ^2=15.8, *P*=0.007; χ^2=33.0, *P*<0.0001 respectively). The involvement of physical activities increased with age and was the highest in the oldest age group (χ^2=42.5, *P*<0.0001).

There was association between socioeconomic factors and physical activities (Table 4). Forty-six children (32.9%) of mothers with secondary education or below were inactive compared with 8 children (5.7%) who took physical activities twice a week, while 113 (26.3%) children of mothers with post secondary education were inactive compared with 63 children (14.7%) who took physical activities twice a week (χ^2=12.4, *P*=0.030). The social class did not show any significant relationship with PA (χ^2=3.6, *P*=0.605).

The relationship between physical activity and body mass index is shown in Table 5. Among children who were physically inactive, 22.6% vs. 2.5% were underweight and overweight respectively whereas among children who were active or took physical activities 3 or more times a week, 35.6% *vs.* 4.4% were underweight and overweight respectively. These differences were not statistically significant (χ^2=14.3, *P*=0.499).

Table 5. Relationship between physical activity and body mass index

Frequency of physical activity	BMI-for-age percentile, *n* (%)		
	Underweight	Normal weight	Overweight/obese
Physically inactive (*n*=159)	36 (22.6)	119 (74.8)	4 (2.5)
About once a month (*n*=30)	9 (30.0)	21 (70.0)	0 (0.0)
About 2 or 3 times a month (*n*=19)	5 (26.3)	14 (73.7)	0 (0.0)
Once a week (*n*=201)	59 (29.4)	140 (69.7)	2 (1.0)
Twice a week (*n*=71)	22 (31.0)	48 (67.6)	1 (1.4)
Thrice or more a week (*n*=90)	32 (35.6)	54 (60.0)	4 (4.4)

P>0.05 for group difference between physical activity and body mass index. BMI: body mass index.

Discussion

To the best of our knowledge, this is the first time the frequency of PA is described in Nigerian children. In this study, a large number of children were involved in physical exercises, which is similar to the number of children in a study from Brazil where at least 93.7% of males and 91.1% of females were minimally active.[18] This is contrary to the situation in the United States where only 30% of high school children met the established

guidelines of participating in physical activities.[19] Physical exercises among the Nigerian children are done either during the compulsory physical health education class which is part of the curriculum of most schools in Abeokuta or during their leisure time when the children play football or other sports. The psychological benefits of physical exercises are broad and most studies suggest a positive relationship between physical fitness and cognitive ability necessary for good academic performance.[20,21] Physical exercises are also known to positively influence a number of chronic diseases such as obesity, diabetes and hypertension.[22] As children spend almost half of the day in schools, the policy of inculcating physical and health education activities in every school curriculum is a good way of teaching healthy living habits that will be carried into adulthood thereby preventing obesity and its consequences.

Several epidemiological studies have shown that physical activities decline with age.[23-25] Recent reports showed that this age-related decline in PA is greater in late childhood than in adolescence.[24,25] However, our data showed an increase in the frequency of physical activities as the age increases. This might be due to racial, cultural differences and a relatively lower inability of small children than adolescents to recall all their daily physical activities. With regard to gender, the finding in this study is in accordance with other studies from both developing and developed countries, showing that males were more active than females.[11,18,23-26] The factors responsible for lower participation of females in PA are not well understood. Trost et al[27] suggested that lower levels of perceived competence, enjoyment of physical activities and perceived importance of sports or PA in females may be key mediators of this gender difference.

Healthy living is also largely determined by socioeconomic, cultural and environmental conditions.[12] Children of poorer socioeconomic class are lack of space for exercises or have fewer opportunities for physical exercises. This finding is consistent with that from some countries where children of lower socioeconomic class are at greater risk for physical inactivities.[18] As the study on Czech Republic, Greenland, Ireland, Malta, Switzerland, Ukraine and Macedonia,[28] this study failed to show a significant relationship between physical activities of these children and socioeconomic class. However, the higher the educational level of the mothers, the higher the frequency of involvement of these children with physical exercises. This may be due to the fact that women with a high level of education are probably career women who may not be available to curtail their children from participating in physical activities.

In this study a large proportion of these children from the low socioeconomic class sufferred from undernutrition whereas overweight was more common in the upper social class than in the lower class. This finding is in keeping with the finding of a high prevalence of overweight and obesity in the high socioeconomic class in the developing countries in contrast to that in the developed countries where overweight and obesity are more common in people of the lower socioeconomic class.

Many studies reported a relationship between levels of PA and overweight,[7-10] and others demonstrated that there was a null association between PA and weight status.[22,29] Our study failed to show a significant positive relationship between physical inactivities and overweight. This may be due to the small number of overweight subjects in our study. Interestingly there is a higher prevalence of underweight in the physically active children. This could imply that there is a negative balance between the energy expanded in doing exercises and energy intake. This must be taken into consideration in a population where protein energy malnutrition predominates as a result of poverty, ignorance and infectious diseases. Studies have shown that chronic undernutrition experienced during prenatal and postnatal growth and development may predispose to obesity later in life.[3,18]

The limitations of this study include the subjective assessment of physical exercises which has the problem of limited recall accuracy. Nowadays it is possible to objectively measure PA with an accelerometer.[24] Another limitation is that we did not address the dietary intake of these children as obesity represents a balance between energy intake and expenditure. We hope that future studies to be conducted will address this area.

In conclusion, a large proportion of school children living in Abeokuta, southwestern Nigeria are engaged in moderate to high level physical activities. The determinants include male gender, older age, and the high educational level of mothers. There is an association between high PA and underweight. Therefore, in view of the high prevalence of undernutrition in these children, physical activity program aimed at reducing body weight must take into consideration the promotion of energy balance.

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