Adolescent Physical Activity Levels and Their Relationship with Anthropometric Measures

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ABSTRACT

Background: *Adolescence, a period of significant biological, psychological, and social changes, is critical for establishing lifelong healthy habits. However, many adolescents engage in unhealthy lifestyle patterns, such as poor nutrition and inadequate physical activity. In Nigeria, few adolescents meet the recommended international activity guidelines of 60 minutes per day, five days a week.*

Objective: *To assess physical activity (PA) levels in relation to anthropometric measures among adolescents.*

Methodology: *A cross-sectional study involving 277 adolescent boys and girls (10-19 years) selected through a four-stage simple random sampling from three public secondary schools in Umuahia metropolis Abia state, Nigeria. Height and weight were measured, while Height-for-age and BMI-for-age Z-scores were calculated using WHO Anthro Plus. Physical Activity Questionnaire for adolescents (PAQ-A) was used for the physical activity score. Inferential statistics was performed with the student's t test, Pearson's correlation and Chi Square test.*

Results: *Adolescents showed stunting at 14.8% and obesity at 9%. Stunting was higher in boys (25.0%) than girls (3.8%) ($P<0.05$). Boys had more physical activity (composite score: 2.50) than girls (2.22; $P<0.05$). Generally, physical activity was low (composite score: 2.37) and fell short of the recommended cutoff (2.75). Height-for-Age Z score (HAZ) negatively correlated with physical activity ($r=-0.132$).*

Conclusion: *The negative correlation between HAZ and physical activity and also the low physical activity levels recorded in this study underscore the need to promote physical activity among adolescents in Nigeria, particularly among girls. This can be achieved through targeted interventions that encourage participation in physical activity during spare time.*

Keywords: Physical activity, Adolescents, Anthropometry, PAQ-A.

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INTRODUCTION

Adolescence, a phase marked by significant biological, psychological, and social changes (1), is crucial for establishing habits that can influence lifelong health. However, unhealthy lifestyle patterns, including poor nutrition and reduced physical activity, are prevalent, particularly among sedentary adolescents (1). Early-life risk factors contribute to chronic non-communicable diseases (NCDs), making interventions during adolescence vital for preventing such diseases later in life.

Physical activity (PA) practice is an extremely important, health-related factor, but studies have shown that physical activity (PA) declines from adolescence to young adulthood (2, 3). Adolescent physical inactivity likely contributes to key global health problems, including cardio-metabolic and mental health disorders (4).

More than 80% of the world's adolescent population is insufficiently physically active (5). In Nigeria, physical activity levels have significantly declined, with a substantial proportion of adolescents (50% to 75%) being sedentary or inactive, and only 37% meeting the recommended international activity guidelines of 60 minutes per day, five days a week (6). WHO recommends that children and adolescents aged <18 years accumulate at least an average of 60 minutes per day of moderate-to-vigorous intensity physical activity, whereas people aged ≥18 years should accumulate at least 150-300 minutes of moderate-intensity physical activity or 75-150 minutes of vigorous-intensity physical activity per week, or an equivalent combination (7).

Overweight and obesity are becoming increasingly prevalent among adolescents and are an emerging cause of non-communicable diseases (NCDs). Lifestyle factors, such as insufficient levels of physical activity and sedentary behaviors, are responsible for the increased prevalence of NCDs (8). Children and adolescents suffer from overweight and obesity in both developed and developing countries (9), and the international prevalence has risen within the period 1975–2016 from 4% to >18% in adolescents of both genders (10).

Importantly, high levels of sedentary behaviours and insufficient levels of physical activity increase obesity among both children and adolescents (11), and raise the risk of morbidity and mortality, cardiovascular diseases, and type 2 diabetes (12), among adolescents. Sedentary behaviors and insufficient levels of physical activity were separately and independently associated with metabolic risk and obesity (13). Sedentary activity has also been linked with dietary habits and unhealthy lifestyle choices (14,15). Several studies have reported a negative association between low physical activity and anthropometric measurements (16,8,17).

Thus, the aim of this study was to explore physical activity levels in relation to anthropometric measures among a sample of adolescents in Abia State, Nigeria.

METHODS

Study design

A four- stage simple random sampling technique was employed to select three urban public secondary schools in Umuahia metropolis. The list of students in the selected schools made up the sampling frame for the target age group and gender. Oral informed consent was obtained from the guardians/parents of adolescents who met the inclusion criteria.

Data collection

Data collection for this study took place between October 2022 and February 2023, during the school year. The principal of the schools and the parents or guardians of the participating adolescents were provided with a verbal description of the study, and they gave their consent for their children to participate. Ten research assistants, who were nutrition students, were trained to assist with data collection. The research assistants were taught how to measure weight and height and administer questionnaires.

Eligibility criteria

Adolescents aged 10 to 19 years who attended government-owned public day secondary schools and had their parents' or guardians' oral consent were included in the study. Those with ill health were excluded from the study.

Ethical approval

The ethical approval for this study was granted by the Research Ethics Committee of the Federal Medical Centre, Umuahia, Abia State, with approval number: FMC/QEH/G.596/Vol.10/642.

Socio-demographic questionnaire

Socio-demographic information, including personal and family data (e.g., parents' education and employment), was collected using structured questionnaires.

Anthropometry measurement

The height of adolescents was determined with extreme precision, down to the nearest 0.1 cm, using a portable stadiometer, while their weight was measured in light clothing, with an accuracy of 0.1 kg, using an OMRON BF511 body composition scale (OMRON, Japan). To calculate BMI, the weight of each adolescent was divided by their height squared (in kg/m2), and then the result was computed based on age- and sex-specific Z-scores relative to the WHO BMI-for-age reference, using the WHO Anthro Plus package (Stata Corp, USA). Obesity was defined as a BMI z-score ≥+2.00 SD and overweight as a BMI z-score ≥+1.00 SD (22). The adolescents were classified as stunted (height-for-age Z score < −2 Standard Deviation (SD) using age- and sex-specific reference heights according to the WHO standards (18).

Physical activity measurement

Physical Activity Questionnaire for Adolescents (PAQ-A) (19,20) was used for the physical activity score. The physical activity questionnaire for adolescents (PAQ-A) was completed with the help of the researcher and research assistants. The completion of the questionnaire took about 10 minutes. Cards

with different activities were shown to participants to interpret the activities they engaged in over a 7-day period. The PAQ-A is a nine-item, seven-day physical activity recall questionnaire. The PAQ-A was used to assess the physical activity behaviour of the participants at different times and places (i.e., during school, after school, recess, weekends, etc.) during the previous seven days. The PAQ-A has been established and validated for school students, and it has a Cronbach's alpha value between 0.70 and 0.74 (21, 22). Scoring was based on a 5-point Likert-type scale from low physical activity (1) to high physical activity (5). The final PAQ-A score is the mean score of all the items. Cut-off score (2.75) for physical activity in adolescents was used to classify the adolescent physical activity levels. This 2.75 cut-off point is equivalent to >60 minutes of moderate and vigorous physical activity recommended by WHO (14) for adolescents. The final PAQ-A score ≥ 2.75 was classified as high physical activity and meets the WHO physical activity recommendation, while the final PAQ-A score < 2.75 was classified as low physical activity and does not meet the physical activity recommendations.

Data analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 20. The Student t-test was used to compare means of continuous variables, while the Chi-square test was used to compare categorical variables. Descriptive statistics of means, standard deviation, and percentages were used to process the data from the physical activity questionnaire and anthropometry.

BMI Z score and Height-for-age Z score were calculated using the WHO Anthro plus software for each age and sex group. The physical activity level was compared between male and female adolescents using a t-test. The Chi-square test was used to determine the association between BMI-for-age Z, Height -for-age Z-score, and physical activity levels. The relationship between the WHO BMI-for-age Z score, Height-for-age Z score, and physical activity was compared using Pearson's correlation. A p-value of <0.05 was taken to be statistically significant.

RESULTS

Socio-demographic characteristics of adolescents

Table 1 below shows the socio-demographic characteristics of the adolescents. More than half (52%) of the adolescents were males. The mean age of the adolescents used in this study was 13.58 ± 1.62 years. Junior secondary school 1 and 2 (JSS 1 and 2) (28.2%) had the most participants, and the middle-aged adolescents (13 – 15 years) dominated (59.6%). The majority were of Igbo ethnicity (93.5%), and 95.3% were Christians.

Mean frequency of physical activities during spare time activities by sex

Table 2 shows the mean spare time activities of adolescents. Significant (<0.05) difference was found between males and females who spent their spare time cycling (p=0.025), dancing (0.001), playing football (p=0.000), engaging in multiple clapping (p=0.042), swimming (p=0.000), and playing table tennis (p=0.008). Specifically, males spent more time on bicycling, football, swimming, and table tennis, while females spent more time on dancing and multiple clapping. The mean score of the different activities showed that males were significantly (<0.05) more physically active than females, including the final PAQ-A score for males (2.50±0.54) and females (2.22±0.57), respectively. The general PAQ score of both male and female adolescents was 2.37

Physical activity pattern of adolescents

Table 3 represents the physical pattern of adolescents, with data on different types of activities and the frequency of engagement in those activities. The majority (65.3%) do not attend physical education (PE) trainings, while a few (4.3) engaged actively (always) in PE with a mean score of 1.7. In the last 7 days, some (24.2%) of the adolescents were involved in little physical activity, while very few (4.0%) were involved in regular physical activity.

Mean anthropometric characteristics and physical activity

Table 4 shows the means and standard deviation of the anthropometric characteristics and physical activity. Height and height-for-age Z score were significantly (p<0.05) different within the age groups, with late (> 16) adolescents being taller (160.42±6.43), and stunted (-1.08±0.91) compared to other age groups. Females were taller (154.45±7.64) and had better HAZ (-0.32±0.99) than boys. BAZ score was significantly different between the age groups (P>0.05), with early adolescents (10-12years) having low Z-scores (-0.62±0.82). The BAZ between the male and female adolescents was not statistically significant (P< 0.05). Higher physical activity level was found in males (2.50±0.54) (P< 0.05).

Table 1: Socio-demographic characteristics of adolescents (10-19 years)

Socio-demographic characteristics	Frequency (277)	Percentage (%)
Sex		
Male	144	52.0
Female	133	48.0
Age (years)		
10-12	77	27.8
13-15	165	59.6
>16	35	12.6
(Mean ±SD)	13.58 ± 1.62	
Class		
Junior Secondary School 1	78	28.2
Junior Secondary School 2	78	28.2
Junior Secondary School 3	75	27.1
Senior Secondary School 1	16	5.8
Senior Secondary School 2	18	6.5
Senior Secondary School 3	12	4.3
Religion		
Muslim	12	4.3
Christian	264	95.3
Traditionally	1	0.4
Ethnicity		
Igbo	259	93.5
Yoruba	12	4.3
Hausa	4	1.4
Akwa Ibom	1	0.4
Edo	1	0.4

Table 2: Mean frequency of physical activity during spare time

Spare time activity	Male (N=144)	Female (N=133)	Total	P-value
Brisk walking	3.79 ± 1.58	4.71 ± 5.92	4.23 ± 4.28	0.073
Multiple clapping	3.09 ± 1.74	3.50 ± 1.57	3.29 ± 1.67	0.042*
Dancing	2.86 ± 1.54	3.50 ± 1.52	3.17 ± 1.56	0.001*
Jogging/running	3.10 ± 1.43	3.11 ± 1.49	3.10 ± 1.46	0.995
Football	3.76 ± 1.44	2.07 ± 1.41	2.95 ± 1.66	0.000*
Jumping	2.90 ± 1.48	2.71 ± 1.42	2.81 ± 1.45	0.300
Hide and seek	2.15 ± 1.38	2.23 ± 1.49	2.19 ± 1.44	0.615
Gardening	2.13 ± 1.38	1.95 ± 1.31	2.04 ± 1.35	0.274
Bicycling	1.99 ± 1.39	1.62 ± 1.28	1.81 ± 1.35	0.025*
Swimming	1.85 ± 1.27	1.36 ± 0.92	1.62 ± 1.14	0.000*
Skipping	1.47 ± 0.92	1.59 ± 1.05	1.52 ± 0.98	0.305
Singing	1.56 ± 1.20	1.41 ± 1.20	1.49 ± 1.20	0.304
Table tennis	1.58 ± 1.03	1.29 ± 0.77	1.44 ± 0.92	0.008*
Basketball	1.46 ± 0.93	1.32 ± 0.80	1.40 ± 0.87	0.199
Composite PA score	**2.50 ± 0.54**	**2.22 ± 0.57**	**2.37 ± 0.57**	**0.000***

* Significant at $p<0.05$

Correlation between anthropometric measurements and physical activity

Table 5 shows the correlation between anthropometric measurements and physical activity. Significantly negative correlation was found to exist between physical activity level and height (r=-0.122) and Height- for –age Z score (r=-0.132). There was also a significant positive correlation between HAZ score and weight (r=0.322), height (r=0.636), and BAZ score (r=0.198). Similarly, a significantly positive correlation was found between height, HAZ-score (r=0.636), and BAZ (r=0.338).

Table 3: Physical activity pattern of adolescents

Activities	Frequency (277)	Percentage (%)	Mean ± SD
Activity during PE			1.73 ± 0.069
Don't attend PE	181	65.3	
Hardly	24	8.7	
Sometimes	49	17.7	
Quite often	11	4.0	
Always	12	4.3	
Lunch time activity			2.16 ± 0.07
Sat down	127	45.8	
Walked around	30	10.8	
Ran or played a little	83	30.0	
Ran around and played quite a bit	22	7.9	
Ran and played hard	15	5.4	
After School Activity			2.55 ± 0.08
None	74	26.7	
1 time last week	68	24.5	
2-3 times last week	78	28.2	
4-5 last week	24	8.7	
6-7 times last week	32	11.6	
Hardly ever	1	0.4	
Evening activity			2.63 ± 0.07
None	65	23.5	
1 time last week	67	24.5	
2-3 times last week	83	30.0	
4-5 last week	32	11.6	
6-7 times last week	28	10.1	
Hardly ever	2	0.7	
Weekend activity			2.78 ± 0.07
None	50	18.1	
1 time	67	24.2	
2-3 times	83	30.0	
4-5 times	50	18.1	
6 or more times	24	8.7	
Hardly ever	3	1.1	
Last seven days activity			2.25 ± 0.06
Involved in little activity	67	24.2	
Sometimes (1-2times)	111	40.1	
Often (3-4 times)	72	26.0	
Quite often (5-6 times)	16	5.8	
Very often (7 or more times)	11	4.0	

PE=Physical Education

Table 4: Mean Anthropometric characteristics and physical activity of the adolescents according to age and gender (mean ±SD)

Anthropometric characteristics	Age group			P value	Sex		P value
	10-12 (n=77)	13-15 (n=165)	>16 (n=35)		Male (n=144)	Female (n=133)	
Weight (kg)	35.46 ± 6.84	45.95 ± 12.66	54.23 ± 6.50	0.000*	42.95 ± 14.49	45.30 ± 9.05	0.109
Height (cm)	146.00±8.70	154.46 ± 8.57	160.42± 6.43	0.000*	151.40±10.87	154.45±7.64	0.007*
HAZ	-0.41 ± 1.14	-0.78 ± 1.13	-1.08 ± 0.91	0.007*	-1.08 ± 1.12	-0.32 ± 0.99	0.000*
BAZ	-0.62 ± 0.82	-0.29 ± 1.20	-0.36 ± 1.08	0.036*	-0.46 ± 1.17	-0.25 ± 0.96	0.120
PA score	2.38 ± 0.53	2.39 ± 0.57	2.21 ± 0.57	0.246	2.50 ± 0.54	2.22 ± 0.57	0.000*

BAZ= BMI for age Z score; HAZ = Height for age Z-score; PA = Physical activity

Table 5: Pearson's correlation between anthropometry and physical activity

	Weight (kg)	Height (cm)	Body fat (%)	HAZ	BAZ	Physical activity
Weight (kg)	1	0.723**	0.527**	0.322**	0.788**	-0.036
Height (cm)	0.723**	1	0.262**	0.636**	0.338**	-0.122*
Height for age Z-score	0.322**	0.636**	-0.005	1	0.198**	-0.132*
BMI for age Z-score	0.788**	0.338**	0.626**	0.198**	1	0.044
Physical activity	-0.036	-0.122*	0.022	-0.132*	0.044	1

**Correlation significant at 0.01; *Correlation significant at 0.05

Prevalence of overweight/obesity and stunting

Figure 1a and 1b show the anthropometric characteristics of the participants based on sex. The prevalence of stunting based on height-for-age Z-score and obesity based on BMI-for-age Z-score are 14.8% and 9.0%, respectively. In this study, only stunting was significantly (P <0.05) higher in boys (25.0%) than in girls (3.8%). There was no significant difference in the prevalence of obesity between adolescent males and females.

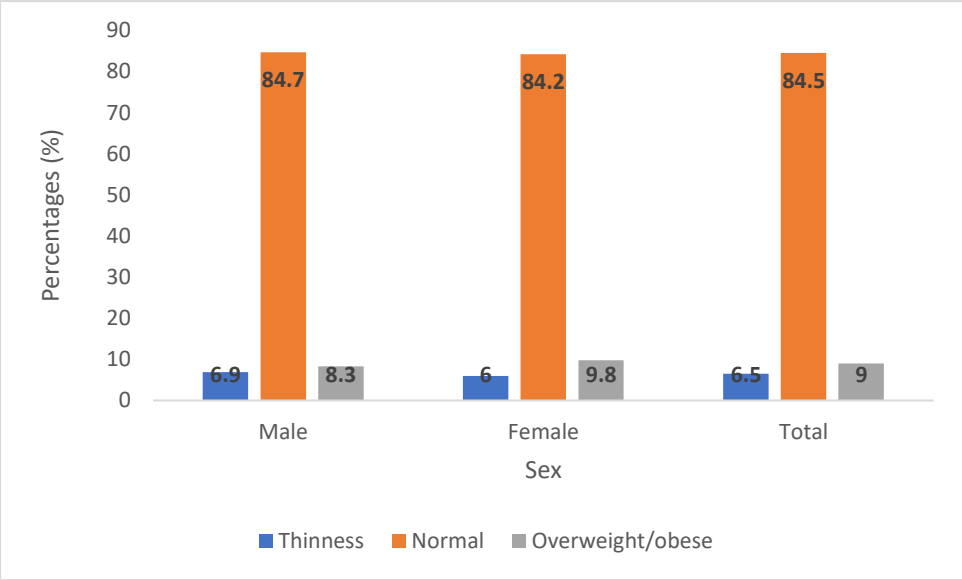

Figure 1a: Prevalence of overweight/obesity

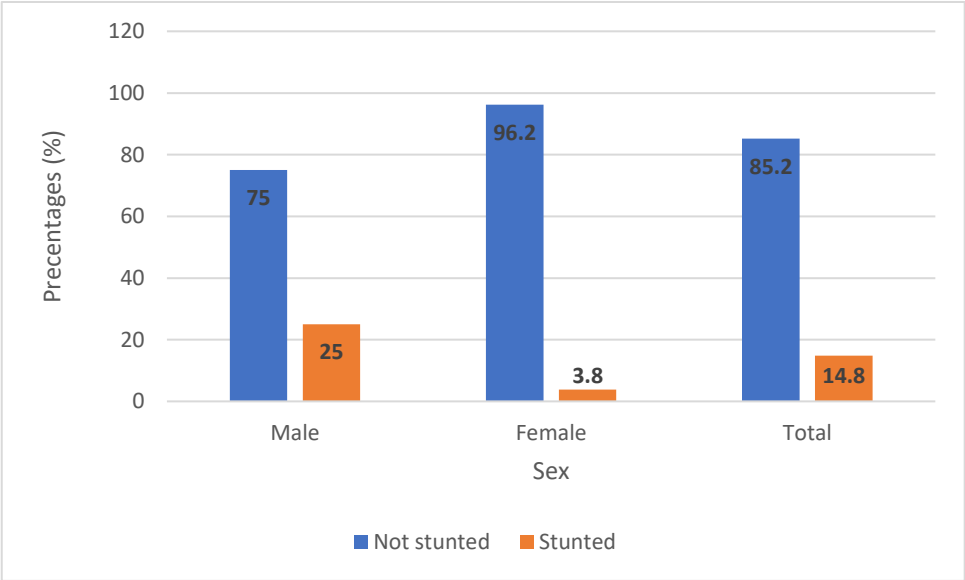

Figure 1b: Prevalence of stunting

DISCUSSION

This study aimed to assess adolescent physical activity levels and their relationship with anthropometric measures among adolescent boys and girls. Results from this study showed that the adolescents had a low level of physical activity (2.37). A study of Nigerian adolescents using the PAQ-A revealed that only 37% of Nigerian adolescents met the recommended level of physical activity. The mean level of physical activity recorded in this study (2.37) falls below the established cutoff point of 2.75 for physical activity in adolescents (23). This 2.75 cutoff point corresponds to the >60 minutes of moderate and vigorous physical activity recommended for adolescents (15). This is because, from the results of the study, only a few adolescents attend physical education classes and also engage in lunch and after-school physical activities.

A global systematic review and meta-analysis of 298 studies across 146 countries found that only 20% of adolescents aged 11-17 years met the WHO recommendation of at least 60 minutes of moderate to vigorous physical activity per day (24). Consistent with previous research (25, 6), the majority of adolescents in Nigeria were found to be physically inactive, with girls exhibiting lower activity levels than boys. These findings align with the results of our present study, reinforcing the gender disparities in physical activity levels and affirming that girls are less physically active than boys. Nevertheless, our study underscores the imperative to promote physical activity among adolescents in Nigeria, with a specific emphasis on interventions targeting girls. Encouraging participation in activities such as dancing, which girls enjoy, during their spare time can be an effective strategy.

Results from this study revealed that few adolescents engage in regular physical activity, with the majority abstaining from physical education (PE) classes altogether. This is concerning as PE classes offer a crucial opportunity for structured physical activity and education on its health benefits. Research indicates that PE classes, along with lunchtime and after-school periods, are pivotal for adolescent physical activity (26). For instance, a study demonstrated a positive association between physical activity during school breaks, including PE classes and lunchtime, and overall physical activity levels among adolescents (26). The results presented in Table 2 emphasized the importance of interventions targeting specific times of the day, such as PE classes, lunchtime, and after school, to promote physical activity among adolescents. Moreover, these interventions should be inclusive of all genders and focus on overall physical activity levels rather than specific activities.

The current study identified sitting down as the most common lunchtime activity, aligning with other research indicating that school-based physical activity interventions can enhance activity levels among adolescents during school hours (27).

The composite summary score affirmed that males exhibited significantly higher levels of physical activity than females, in line with the findings of several studies (6, 28). This gender difference is consistent with other research reporting that more males tend to be physically active than females (29). However, a study by (30) found no significant gender differences in overall physical activity levels among adolescents when using a composite summary score. This suggests that while patterns of activity during specific times of the day may vary, males and females may exhibit similar overall activity levels.

The observed gender differences in physical activity levels align with numerous studies indicating that males tend to be more physically active than females (25, 29, 6). This divergence may be attributed to the fact that Nigerian adolescent girls devote more time to domestic and light-intensity physical activities, while boys engage more in outdoor leisure-time and vigorous-intensity activities. These distinctive behavioural patterns highlight the potential impact of social orientation on adolescents' health behaviours in Africa and underscore the need for gender-specific interventions in promoting physical activity among Nigerian adolescents.

The adolescents in this study demonstrated a significant decrease in height-for-age Z score showing that stunting increased with age. This is consistent with findings by previous studies (31,16), which reported that stunting in adolescents increased with age. Interestingly, in this study, females were significantly taller than boys, in contrast to the results of other studies (31,32), which reported that the mean height of boys was significantly higher than that of girls. Findings from this study aligns with previous research indicating a higher prevalence of stunting in males compared to females (16, 32). A similar study reported a higher prevalence of stunting in male Pakistani children and adolescents (32). The increased prevalence of stunting in males is a common occurrence in low- and middle-income countries, where growth faltering persists

throughout school-age years, often attributed to factors such as prolonged poor nutrition (16).

Furthermore, BMI-for-age demonstrated a significant increase in late adolescents with early adolescents (10-12 years) exhibiting lower Z-scores, indicating that BMI increases with age. This observation aligns with previous studies reporting an age-related increase in BMI (33, 34). Various factors influencing BMI, including age, sex, race, genetics, and eating habits, contribute to this trend (35).

The study showed a negative correlation between height, height-for-age Z-score (HAZ), and physical activity, indicating that stunted children are often less physically active than their non-stunted peers. Similar findings were reported in a study of Peruvian youths (16), where stunted youths performed poorly in various physical activities. Stunting significantly and negatively impacted the physical activity level of adolescents in this study, highlighting the consequences of reduced body size and muscle mass associated with stunting early in life. On average, stunted children and adolescents may exhibit a deficiency in the muscle tissue required to generate force (36).

CONCLUSION

This study revealed low physical activity among the adolescents, with males being more physically active than females. HAZ was negatively correlated with PA and no significant correlation was found between BMI and PA.

The low physical activity level recorded in this study suggests a need to promote physical activity among adolescents in Nigeria, particularly among girls. This can be achieved through targeted interventions that encourage participation in physical activity during spare time, such as promoting dancing or other activities that girls enjoy.

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