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Research Article
Relationship Between Body Composition and Musculoskeletal Fitness in Nigerian Children

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Abstract

Background and Objective: Substantial evidence indicates that high level of obesity assessed by body mass index (BMI) could affect the motor performance, musculoskeletal fitness and wellbeing of the youths. This study investigated the relationship between the BMI and musculoskeletal fitness in a cross-sectional sample of school children in Ado-Ekiti, Southwest Nigeria. **Materials and Methods:** Body weight, height and three components of musculoskeletal fitness (sit and reach, sit-ups and standing broad jump) were measured in 1229 school children (boys = 483, girls = 746, ages: 9-13 years). Body mass index was computed to classify participants into underweight, normal weight, overweight and obese categories. **Results:** Significantly low inverse correlation was observed between BMI and standing broad jump (SBJ) ($r = -0.196$, $p<0.01$), while underweight individuals were likely to perform poorly in sit and reach (OR = 0.98, CI = 0.97, 1.00), but had greater likelihood of performing well in sit-ups (OR = 1.01, CI = 0.99, 1.03) and standing broad jump (OR = 1.03, CI = 1.01, 1.06) test. Being overweight was associated with a poor sit and reach (OR = 0.99, CI = 0.92, 1.06) and standing broad jump (OR = 0.96, CI = 0.94, 0.98) performances, but greater propensity of sit-up (OR = 1.00, CI = 0.93, 1.08) performance. Obese participants were significantly associated with poor sit and reach (OR = 0.83, CI = 0.74, 0.91) and standing broad jump (OR = 0.94, CI = 0.92, 0.96), but greater likelihood of significant sit-ups (OR = 1.22, CI = 1.12, 1.33) compared to normal individuals' performance. **Conclusion:** There was a significant negative relationship between the BMI and standing broad jump in Nigerian children and adolescents. Both underweight, overweight and obese participants performed poorly in either flexibility, sit-ups or SBJ test, obese individuals being mostly affected. Musculoskeletal fitness could serve as a pointer of possible health risks for both malnourished and excessively weighty youths.

Key words: Obesity, musculoskeletal fitness, physical activity, body composition, youths

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The increase in overweight and obesity in children across several developed and developing countries has been subject of continuing investigation[1]. Obesity is a public health problem that can be influenced by genetics, social conditions, lifestyle, nutritional behaviours, physical activity (PA) levels and environmental factors[2]. Studies have reported that the high levels of obesity assessed by body mass index (BMI) could affect the motor performance and aerobic fitness of youths[1]. The use of BMI has been widely accepted as body weight evaluation tool among children and adolescents[3]. Furthermore, the increase in the obesity levels prompted researchers in the field of obesity to focus their attention on the association between the BMI and musculoskeletal fitness[3].

A higher level of fitness during childhood and youth could positively influence adult health status[4]. Musculoskeletal fitness is understood as a branch of physical fitness, which plays an important role in day-to-day individual activity. Musculoskeletal fitness could denote muscular strength, muscular endurance, flexibility and motorfitness[4]. Among children and adolescents, the low level of musculoskeletal fitness has been attributed to the activity behaviours related with the school physical education (PE) programme and curriculum, whose emphasis has declined in many countries including Nigeria. Aside this, the issue of financing, facilities and equipment and qualified personnel that can implement PE programme seems scarce[5]. Therefore, it is important for school PE programmes to incorporate activities that could enhance children's fitness level[5].

Physical fitness could be understood as the ability of the body's physiology and muscles to function at their best, in order to prevent the risk of cardiovascular diseases[6] and poor skeletal and mental health[7]. Monyeki *et al.*[8] stated that the relationships between body composition and musculoskeletal fitness in youths in industrialized nations has been well studied, but little information is available regarding this phenomenon in developing nations, including Nigeria. Observing the correlation between BMI and musculoskeletal fitness level in children is pertinent for public health, since slimness in developing countries could be seen as result from under nourishment[8]. Similarly, both musculoskeletal fitness and body composition are usable markers of individual's total health[7,9] especially the youths. However, the health benefits of musculoskeletal fitness are not apparent compared to that of cardio respiratory fitness, but plays a role in some health factors such as increased bone mineral density; reduced blood pressure and injury risks and diseases[10]. Therefore, regular screening should be undertaken for the early detection of musculoskeletal problems among school children[10].

Adequate promotion of total well-being based on PA participation could lead to efficient cardiovascular fitness, body composition, muscle strength, endurance and flexibility[11]. Therefore, the relationship between the BMI and musculoskeletal fitness test scores necessitates valid and dependable assessment, in order to provide data to support the strategy of decreasing the occurrence of cardio metabolic risk factors in youths[12]. Limited literature is available on the relationship between BMI and musculoskeletal fitness in Nigerian children and adolescents. Information on the relationship between BMI and musculoskeletal fitness could increase awareness of the health status of school children and adolescents. Therefore, this study investigated the relationship between BMI and three components of musculoskeletal fitness in a sample of youths, aged9 - 13 years old in Ado-Ekiti, Southwest Nigeria.

MATERIALS AND METHODS

Research design and sample: A cross-sectional research design was used to collect data on body composition and musculoskeletal variables among 1229 (boys = 483, girls = 746, aged 9-13 years) school children randomly selected from 5 public primary schools in Ado-Ekiti, Ekiti State, Nigeria. The participants' ages verified from school registers were used to recruit them for participation in the study.

Ethical considerations: Permission to conduct the study was obtained from the children's parents, school authorities and Ekiti State Ministry of Education. Initial distribution of information leaflet about the study was performed, followed by explanation of the purpose and procedure of the study to the children and their parents or guardians. Written informed consent was subsequently obtained from the school children's parents or guardians. The children also verbally agreed to participate in the study. This study was carried out based on the ethical principles of Helsinki declaration for research involving human participants[13].

Measurements

Anthropometry: The procedures of the International Society for the Advancement of Kinanthropometry (ISAK) were used to assess the participants' height and body weight[14].

Defining weight categories: The BMI was determined by dividing the participants' body weight (kg) by the square of their height (m)[15]:

$$\text{BMI} = \frac{\text{Bodyweight}(\text{kg})}{\left[\text{Height}(\text{m})\right]^2} \quad (1)$$

Thus BMI defined as kg m^{-2} offers a reasonable measure of fatness in children. The children's BMI was subsequently classified as underweight, overweight or obese for age and gender[16] using the age and sex specific BMI cut-off point recommended by the Childhood Obesity Working Group of the International Obesity Task Force (COWG/IOTF). The data were then used to screen the school children at risk of obesity. The IOTF cut-off points are widely accepted and have been used as a global standard for age and gender-specific norms of BMI classifications to categorise overweight and obesity in youths aged 2-18 years old[17]. The recommended BMI cut-off point is also related to the adult cut-off point of 25 and 30 kg m^{-2} used to determine the risk for excessive body weight and obesity among children and adolescents aged 2-18 years.

Musculoskeletal fitness measurements: For the purpose of this study, 3 health-related physical fitness variables were tested using the European test of physical fitness[18] and the[19] protocol. The tests were selected because of their ease of administration to a large number of subjects and of the fact that they would provide reliable and valid health-related physical fitness measures. Specifically, the musculoskeletal fitness variables which included flexibility (sit-and-reach test), muscular endurance (sit-up test) and explosive leg power (standing broad jump) were carried out as follows:

Sit-and-reach test: A sit-and-reach test was performed to assess flexibility in school children. The flexibility test was carried out using a standard sit and reach box. In a seated position with knees and feet placed firmly against a floor mat, subjects gradually pushed the ruler on top of the standard reach box with both hands stretched, without jerking and bent their trunk trying to reach as far as possible with both hands straight and knees fully extended. In the test, the fingers have to reach the same distance at the same time without bouncing. The test was done twice with the better result recorded as the furthest distance reached in cm.

Sit-up test: Sit-ups test was used to assess the children's muscular endurance. This test measures the performance of the abdomen and hip flexor muscles[19,20]. In a starting position subjects sat on a floor mat, back straight, hands clasped behind the neck and knees flexed at an angle of 90 degrees with heels and feet flat on the floor mat, then laid down on their backs, so that shoulders touched the floor mat and returned to the sitting position with their elbows out in front to touch their knees. The test was terminated when participants were too tired to complete a full sit-up. The total number of correctly performed movement was recorded as completed sit-up.

Standing broad jump: Standing broad jump (SBJ) test assessed the children's explosive strength. The participants stood behind the starting line and were instructed to push off vigorously and jump as far as possible. The participants had to land with their feet together and remain upright. The test was repeated twice and the best score was retained. The farther of the two scores was recorded to the nearest 0.1 cm as the distance between toes at take-off and heels at landing or whichever body part landed nearest to the take-off point.

Pilot test: A pilot study was carried out before data collection to refine the logistical and technical procedures for the measurements. This was preceded by a training workshop conducted by two experts in Kinanthropometry with many years of research experience in body composition as well as childhood and adolescent musculoskeletal measurements. The objective of the workshop and pilot test was to ensure that the field workers could competently measure children's anthropometric and musculoskeletal variables.

Statistical analysis: Means and standard deviations of anthropometric and musculoskeletal variables across age and gender were calculated. Differences in the body weight, height, BMI, sit and reach, sit-ups and standing broad jump were evaluated for boys and girls according to age group using an independent samples t-test. Bivariate correlation analysis was performed to examine if significant relationships existed between BMI and musculoskeletal variables. Multiple regression analysis was undertaken to determine significant predictors of BMI among the school children. All data analyses were performed with the Statistical Package for the Social Sciences (SPSS), version 24.0 (SPSS Inc., 2016) and probability level was set at $p \leq 0.05$.

RESULTS

A total of 1229 children participated in this study. The differences between the anthropometric and musculoskeletal characteristics between boys and girls was highlighted by Table 1. Girls were significantly older (11.8 years), higher in WHR (0.87), sit-ups (21.8 min^{-1}) and standing broad jump (136.0 m) than boys whose corresponding mean values were 11.6 years, 0.86, 17.4 min^{-1} and 121.1 m, respectively ($p<0.05$). The boys had significantly higher mean values of body weight

Table 1: Anthropometric and musculoskeletal characteristics of Nigerian children (n = 1229)

Variables	Total group (Mean±SD)	Boys (n = 483) (Mean±SD)	Girls (n = 746) (Mean±SD)	p-value
Age (years)	11.70±1.05	11.60±1.05	11.80±1.05	0.007**
Weight (kg)	37.10±7.60	38.00±8.14	36.50±7.17	0.001**
Stature (cm)	144.10±9.49	144.80±9.54	143.70±9.43	0.038*
BMI (kg m^{-2})	17.80±3.20	18.00±3.49	17.60±2.98	0.019*
WtHR	0.42±0.06	0.42±0.07	0.41±0.05	0.427
Waist circumference (cm)	60.50±9.35	61.00±10.7	60.10±8.30	0.127
Hip circumference (cm)	69.90±10.3	71.00±11.9	69.10±9.03	0.003*
WHR	0.86±0.08	0.86±0.06	0.87±0.09	0.005**
Sit and reach (cm)	23.10±7.34	23.90±8.93	22.50±6.04	0.004**
Sit-ups (per 1 min)	20.10±7.34	17.40±6.86	21.80±7.13	<0.000***
Standing broad jump (m)	130.20±23.3	121.10±22.6	136.00±21.8	<0.000***

***p≤0.001,**p≤0.01,*p≤0.05; SD: Standard deviation, n: Number, WtHR: Weight to hip ratio, WHR: Waist hip ratio

Table 2: Anthropometric and musculoskeletal characteristics of participants as stratified by age and gender

Age (years)	n	Body mass (kg) (Mean±SD)	Stature (cm) (Mean±SD)	BMI (kg m^{-2}) (Mean±SD)	Sit and reach (cm) (Mean±SD)	Sit-ups (per 1 min) (Mean±SD)	Standing broad jump (m) (Mean±SD)
Boys							
9	13	34.4±8.4	138.3±7.8	17.8±3.5	22.8±4.9	16.2±7.5	114.7±21.3
10	56	32.5±6.3	138.2±8.0	17.0±3.4	23.7±6.0	17.7±6.2	119.1±17.6
11	126	36.4±8.4	143.9±9.0	17.4±3.2	24.1±14.2	17.3±7.3	115.8±24.1
12	168	39.6±7.6	146.1±9.9	18.6±3.9	23.5±5.7	18.0±6.7	123.5±21.6
13	120	40.4±7.5	147.8±8.3	18.4±3.0	24.4±6.6	16.8±6.6	125.0±23.7
Girls							
9	15	31.6±9.1	133.6±8.5	17.3±2.4	23.5±6.0	19.0±5.2	124.6±17.7
10	77	31.6±5.3	136.7±6.9	16.8±1.9	22.8±6.4	22.3±7.2	128.5±20.6
11	165	35.7±6.6	141.1±8.5	17.9±3.1	23.2±5.9	21.6±7.7	129.8±21.8
12	244	36.3±7.0	143.9±9.5	17.5±3.7	22.3±5.8	22.2±7.1	137.5±21.7
13	245	39.1±6.8	148.0±8.3	17.7±2.1	22.2±6.1	21.5±6.7	141.8±20.5

*Statistically significant at p≤0.05

Table 3: Performance characteristics of participants (n = 1229)

Variables	Boys (n = 483) (Mean±SD)	Girls (n = 746) (Mean±SD)	Combined (n = 1229) (Mean±SD)	p-value
Age (years)	11.6±1.05	11.8±1.05	11.7±1.05	0.007
Sit-and-reach (cm)	23.9±8.93	22.5±6.04	23.1±7.34	0.004
Sit-ups (per 1 min)	17.4±6.86	21.8±7.13	20.1±7.34	<0.001
Standing broad jump (kg)	121.1±22.6	136.0±21.8	130.2±23.3	<0.001

(38.0 kg), stature (144.8 cm), BMI (18.0 kg m^{-2}), hip circumference (71.0 cm) and flexibility (23.9 cm) than girls ($p<0.05$). In this regard, data for the girls were 36.5 kg, 143.7 cm, 17.6 kg m^{-2}, 69.1 cm and 22.5 cm, respectively. No significant mean values were observed for waist circumference (61.0 and 60.1 cm) and waist-to-height ratio (0.42 and 0.41) for boys and girls, respectively.

The anthropometric and musculoskeletal characteristics of participants, stratified by age and gender as shown in Table 2. Boys (39.6 kg) were significantly heavier than girls (36.3 kg) in body mass at age of 12 years ($p<0.05$). Boys (143.9 and 146.1 cm) also were significantly taller compared to girls (141.1 and 143.9 cm) at ages 11 and 12 years, respectively. Mean BMI values were significantly higher in boys at ages 12 (18.6 kg m^{-2}) and 13 (18.4 kg m^{-2}) years compared to those of girls matched for age (12 years: 17.5 kg m^{-2}, 13 years: 17.7 kg m^{-2}) ($p<0.05$). Boys had significantly higher mean value of sit and reach at age 13 (24.4 cm) years compared to the girls, whose result was 22.2 cm. Meanwhile, girls had significantly higher mean value of sit-ups at ages 10 (22.3 sec), 11 (21.6 sec), 12 (22.2 sec) and 13 (21.5 sec) years compared to the boys, whose corresponding data were 17.7, 17.3, 18.0 and 16.8 sec, respectively. Significant differences were also observed in SBJ in favour of the girls at ages 10 (128.5 m), 11 (129.8 m), 12 (137.5 m) and 13 (141.8 m) years ($p<0.05$).

The performance characteristics of participants as provided by Table 3. Boys (23.9 cm) were significantly flexible than girls (22.5 cm) while significant differences were found for sit-ups ($p<0.001$) and SBJ ($p<0.001$) in favour of girls.

Table 4: Correlation matrix between the BMI and musculoskeletal variables (n = 1229)

Variables	Age	Stature	Body mass	BMI	WtHR	Waist	Gluteal	WHR	Sit and reach	Sit-ups	SBJ
Age (years)	1	0.358**	0.297**	0.084**	-0.062*	0.097**	0.136**	-0.049	-0.025	0.020	0.213**
Stature (cm)	0.358**	1	0.637**	-0.094**	-0.155**	0.291**	0.325**	-0.014	0.070*	-0.117**	0.217**
Body mass (kg)	0.297**	0.637**	1	0.684**	0.193**	0.462**	0.518**	-0.058*	0.037	-0.095**	0.002
BMI (kg m^{-2})	0.084**	-0.094**	0.684**	1	0.357**	0.287**	0.334**	-0.075**	-0.034	0.002	-0.196**
WtHR	-0.062*	-0.155**	0.193**	0.357**	1	0.893**	0.752**	0.285**	0.028	0.014	-0.082**
Waist (cm)	0.097**	0.291**	0.462**	0.287**	0.893**	1	0.883**	0.259**	0.061*	-0.044	0.016
Gluteal (cm)	0.136**	0.325**	0.518**	0.334**	0.752**	0.883**	1	-0.168**	0.050	-0.057*	-0.009
WHR	-0.049	-0.014	-0.058*	-0.075**	0.285**	0.259**	-0.168**	1	0.040	0.018	0.056
Sit and reach (cm)	-0.025	0.070*	0.037	-0.034	0.028	0.061*	0.050	0.040	1	-0.025	0.119**
Sit -up (per 1 min)	0.020	-0.117**	-0.095**	0.002	0.014	-0.044	-0.057*	0.018	-0.025	1	0.275**
SBJ	0.213**	0.217**	0.002	-0.196**	-0.082**	0.016	-0.009	0.056	0.119**	0.275**	1

**Correlation is significant at the 0.01 level (2-tailed), *Correlation is significant at the 0.05 level (2-tailed), SBJ: Standing broad jump, WtHR: Weight to hip ratio, WHR: Waist hip ratio

Table 5: Association between BMI categories and musculoskeletal performance of the participants

	Sit and reach (cm)		Sit-ups (sec)		SBJ (kg)	
Musculoskeletal variables	Adjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
BMI categories						
Underweight	0.98 (0.97, 1.00)	0.229	1.01 (0.99, 1.03)	0.080	1.00 (1.00, 1.01)	0.015
Overweight	0.99 (0.92, 1.06)	0.826	1.00 (0.93, 1.08)	0.819	0.96 (0.94, 0.98)	0.001
Obese	0.83 (0.74, 0.91)	0.000	1.22 (1.12, 1.33)	0.000	0.94 (0.92, 0.96)	0.000
Normal weight	1		1		1	

SBJ: Standing broad jump, CI: Confidence intervals, OR: Odds ratio, $p \leq 0.05$

The correlation matrix between the BMI and the musculoskeletal variables of the participants is represented in Table 4. The results revealed a significantly low inverse correlation between the BMI and SBJ ($r = -0.196$, $p<0.01$).

Results on multinomial regression model are presented in Table 5. The model revealed that individuals who were underweight, were likely to perform poorly in sit and reach (OR = 0.98, CI = 0.97, 1.00), but greater likelihood of performing well in sit-ups (OR = 1.01, CI = 0.99, 1.03) and standing broad jump (OR = 1.03, CI = 1.01, 1.06) test compared individuals of normal weight. Similarly, overweight individuals were associated with less likelihood of sit and reach (OR = 0.99, CI = 0.92, 1.06) and SBJ (OR = 0.96, CI = 0.94, 0.98) performance, but greater likelihood of non-significant sit-ups (OR = 1.00, CI = 0.93, 1.08) performance compared to normal individuals. Similarly, obese participants were significantly associated with less likelihood of sit and reach (OR = 0.83, CI = 0.74, 0.91) and SBJ (OR = 0.94, CI = 0.92, 0.96), but greater likelihood of significant sit-ups (OR = 1.22, CI = 1.12, 1.33) compared to the performance of normal individuals.

DISCUSSION

This study examined the relationship between BMI and musculoskeletal fitness (sit and reach, sit-ups and SBJ) in 1229 Nigerian children and adolescents. Published data have consistently emphasised that the promotion of a physically active lifestyle is valuable from childhood and if introduced at an early age could reduce the rate of obesity related disease in adulthood[21].

Musculoskeletal fitness such as the sit and reach test is a health related fitness attribute because it is understood that maintaining hamstring and low-back flexibility could guard against acute and chronic musculoskeletal injuries and low-back problems, postural deviations, gait limitations and risk of falling[22]. Sit and reach test is an assessment of hamstring flexibility which could be used to assess a large group of participants[10]. Studies have reported that girls are more flexible at all ages than boys[5,23,24], which most commonly occurs during the pubertal period[10]. However, the present study showed that overall, boys were more flexible than girls. Based on age and gender specific analysis, no substantial age and gender differences were observed in boys' and girls' trunk and hamstring flexibility between ages 9-12 years. Monyeki *et al.*[8] had earlier reported a similar finding in which non-significant gender differences in flexibility were observed among rural South African school children. Surprisingly, at age 13 years, boys significantly demonstrated greater flexibility than girls. However, this finding contradicts that reported by Monyeki *et al.*[8].

The overall performance in the strength and endurance of the abdominals and hip-flexors (sit-ups) showed that girls significantly performed better than boys. Whereas, going by age and gender, girls significantly outperformed boys between the ages 10-13 years, but no substantial age and

gender differences were observed in boys' and girls' aged 9 years. This contradicts the findings of Andreasi *et al.*[25] study which examined the association between health-related fitness and anthropometric and demographic indicators of Brazilian children. Andreasi *et al.*[25] reported that boys consistently performed better than the girls. The substantial performance of girls in this study was explained by Karavelioglu *et al.*[26], who studied gender differences in hand grip strength of child athletes using the absolute, ratio and allometric scaling methods. Karavelioglu *et al.*[26] explained that overall, girls attain puberty earlier on average than boys.

In general, girls significantly performed better in SBJ compared to the boys. In this study, age and gender specific data also showed that girls significantly performed better than boys between the ages 10-13 years, but no substantial age and gender difference were observed in boys' and girls' data at age 9 years. This finding was contrary to those of Ramos-Sepulveda *et al.*[7] which examined sex-and age-specific physical fitness and anthropometric reference standards among 576 Colombian-Indian school children, aged 10-17 years. In the Ramos-Sepulveda *et al.*[7] study, boys significantly performed better than girls ($p = 0.001$). The superior performance of girls in this study could probably be explained in the light of their maturity levels and eating behaviours[2], but this was beyond the scope of the present study. Zivkovic *et al.*[2] also stated further that boys devote less time participating in structured and unstructured physical activities and extra time on inactive activities.

High levels of BMI were reported to be associated with poor sit and reach performance. On the other hand, flexibility seems to be consistently less influenced by body weight[27]. With regard to relationships between flexibility and BMI in this study, no relationships were observed between flexibility and the participants' BMI. This contradicts Andreasi *et al.*[25] which indicated an inverse relationship between the flexibility and BMI in school children. Similarly, our findings showed that there was no substantial relationship between the sit-ups and BMI. Several studies[1-3,6,28] have all reported contrary findings, showing a positive relationship between the BMI and sit-ups. With regard to the relationship between the lower limb explosive strength (SBJ) and BMI, our study showed a significant negative correlation. Zivkovic *et al.*[2] examined the relationship between overweight, obesity and physical fitness among 1835 school-going Macedonian adolescents aged 13-14 years old and found that SBJ was negatively correlated with the BMI.

The result of multinomial regression showed that being underweight ($p = 0.229$) and overweight ($p = 0.826$), was not significantly associated with a less likelihood of a high sit and reach performance, but was significant with being obese ($p<0.001$). In contrast, underweight, overweight and obese participants performed poorly in either the flexibility, sit-ups, or SBJ test, obese individuals being mostly affected. However, in a study of the correlation between health-related physical fitness and weight status in Hong Kong adolescents, Mak *et al.*[29] reported that only the children who were underweight performed poorly in the flexibility test. The findings of this study also disagree with those of Deforche *et al.*[30] which indicated non-significant differences in muscle flexibility between obese and non-obese individuals. In addition, an individual's flexibility could be dropped at greater BMI[12]. Being underweight ($p = 0.080$) and overweight ($p = 0.819$) was not significantly associated with a greater likelihood of a strength and endurance of the abdominal and hip-flexor muscles performance. Whereas, being obese ($p<0.001$) was significantly associated with greater odds of sit-ups performance compared to normal individuals. On the other hand, obese individual could significantly put up a better performance than other individuals in normal body weight category. However, in this study, the probability of obese participants performing well in strength and endurance of the abdominal and hip-flexor muscles is surprising. This result disagreed with that of Al-Asiri and Shaheen[12], which reported poorer performances among obese participants. The performance put up by the obese participants in this study could be attributed to gender specific, physical activity and levels of maturity[12].

On the other hand, being underweight ($p = 0.015$) was significantly associated with greater odds of performing well in SBJ, while being overweight ($p = 0.001$) and obese ($p<0.000$) was significantly associated with less likelihood of a great performance in SBJ compared with individuals of normal weight. In this regard, overweight and obese individual have an odds of performing poorly, of which the odds of great performance is related with underweight persons. These findings support those of previous studies[30-33] which reported consistently poor fitness performance, including SBJ among obese individual. The poor performance of obese individuals in strength and power-related tasks could be due to the difficulty to execute ballistic movements probably because of excess body fat, lack of experience in weight bearing exercise and fear of overloading their joint in order to prevent injury[30], low physical activity and self-confidence levels[31].

CONCLUSION AND FUTURE RECOMMENDATIONS

There was a negative relationship between the BMI and SBJ in Nigerian children and adolescents. The children regardless of their weight status performed poorly in either flexibility, sit-ups, or SBJ test, obese individuals being mostly affected. Surprisingly, obese individuals performed better in sit-up compared to those with normal BMI. However, overweight/obese boys and girls performed poorer in the SBJ test than those with normal weight. Early detection of musculoskeletal fitness coupled with appropriate PA intervention could reduce chronic non-communicable disease risk among children and adolescents.

Regular participation in PA, adoption of healthy lifestyle and diet should be emphasised in school curriculum in order to effectively manage body fat and weight faltering, as well as improve musculoskeletal fitness levels among children and adolescents. Periodic monitoring of their musculoskeletal fitness should commence from the first day of their enrolment at school so as to reduce disease risk and improve the children's health and overall quality of life.

SIGNIFICANCE STATEMENT

The results gave credibility to the significance of physical fitness in the management of obesity in children and adolescent. The results will be helpful to clinicians, researchers and physical education teachers to establish standards for monitoring children's musculoskeletal fitness early in life in order to reduce disease risks and improve their health and overall quality of life.

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