Association between physical fitness and anthropometric, cardiovascular and socioeconomic risk factors in primary schoolchildren in KwaZulu-Natal Province, South Africa

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Background. Physical fitness (PF) status in children has been identified as a predictor of chronic disease risk factors, and has also been linked to various non-communicable diseases and an increased risk of premature death in adulthood. Studies have shown that PF has been declining. In South Africa (SA), a similar trend is noted and attributed to urbanisation and shifts from traditional active practices to sedentary lifestyles.
Objectives. To examine possible associations between PF levels and socioeconomic status (SES) and anthropometric and cardiovascular risk factors among 407 primary schoolchildren aged 6 - 13 years in KwaZulu-Natal Province, SA.
Methods. In a cross-sectional study, children's PF scores were assessed using the Eurofit test battery: sit and reach, standing long jump (SLJ), sit-ups (SUs), 5 m shuttle run (5m-SRT) and cricket ball throw (CBT). SES was assessed using a structured questionnaire. Standardised procedures were used for anthropometric and cardiovascular measures.
Results. Girls weighed significantly more than boys (p=0.001) and had a significantly higher body mass index (BMI) (p<0.001), waist circumference (WC) (p<0.001) and hip circumference (HC) (p<0.001), while boys performed significantly better in SLJ (p=0.030), SUs (p=0.022), CBT (p<0.001) and 5m-SRT (p<0.001). A significant low negative correlation was found between PF and BMI (r=–0.151; p=0.002), WC (r=–0.107; p=0.031) and HC (r=0.123; p=0.013). Multinomial logistic regression analysis identified BMI as the main predictor of low PF (odds ratio 1.16; 95% confidence interval 1.01 - 1.33) in this cohort of primary schoolchildren. The occurrence of low PF status in children of primary school age may be influenced by gender and adiposity.
Conclusion. Assessment of PF at policy levels as part of the health screening process may help create a more explicit depiction of the health status of children and assist in early identification of risk factors.

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Physical fitness (PF) levels in children have been shown to indicate their cardiometabolic health profile and their way of life.[1,2] Moreover, PF has been identified as a predictor of chronic disease risk factors such as obesity, cardiovascular disease, skeletal issues and mental health.[3-6] Poor PF levels in childhood have been linked with various non-communicable diseases (NCDs) and an increased risk of premature death in adulthood.[7-9] Since PF includes elements that allow us to perform physical activities and activities of daily living, desired levels have been associated with reduction in disease risk and a better quality of life.[10]

Studies have shown that children's PF levels have been declining in developed and developing countries.[1,3,7] Research in South Africa (SA) has observed a similar trend in children's PF, attributed to urbanisation and, in part, shifts from traditional active practices to sedentary lifestyles, and dietary changes.[11-14]

Studies have also noted that decreasing PF levels are associated with reduction in physical activity (PA) levels and increased obesity in children.[7,15-18] This increase in obesity has also been linked to an increased risk of NCDs.[13] Notwithstanding these associations, factors such as body composition, socioeconomic status (SES) and the environment have been identified as predictors of children's PF status.[4,11,19]

In SA, studies examining PF levels of schoolchildren between the ages of 6 and 13 years are still scarce.[20-23] In the study by Armstrong *et al.*,[21] it was evident that black African children had lower PF levels than their white and mixed-race counterparts. A subsequent study demonstrated further declines.[16] Within the available studies, little has been done to examine the direct relationship of low PF status with predictive variables such as SES, cardiovascular and anthropometric indices.

There is evidence that SA health and financial systems are currently overburdened by the increase in NCDs, so it is important to determine the likely predictors of low PF status among primary schoolchildren.

Methods

This study investigated low PF status in relation to SES and anthropometric and cardiovascular measures in black African children in SA via a cross-sectional design.

Participants

The study participants were 407 children, 182 boys and 225 girls, aged between 6 and 13 years and recruited from randomly selected public primary schools in the eThekwini district of KwaZulu-Natal (KZN) Province, SA. To yield a diverse mix of socioeconomic backgrounds, computer-generated random numbers were used to select schools following the assignment of codes to public schools in the district.

Sampling technique and sample size calculation

Primary schoolchildren were recruited for the study using non-probability purposive sampling. This depended on the availability of parental or guardian consent and assent from the child. The formula for cross-sectional studies described by Charan and Biswas[24] was used to determine a minimum sample size of 384 for the study. A conventional response distribution of 50% and a 5% margin of error at the 95% confidence level were adopted.

Inclusion and exclusion criteria

Children were included in the study if they were enrolled/registered in the selected primary schools for the academic year. Children who had evidence of cardiopulmonary or respiratory illnesses, physical impairments or injuries that could affect their mobility and flexibility were excluded from the study. Children who did not give assent or provide parental or guardian signed informed consent were also excluded.

Ethical considerations

The protocol for the study was reviewed and approved by the Biomedical Research Ethics Committee of the University of KwaZulu-Natal (ref. no. BE563/18). The KZN Department of Education also granted gatekeeper permission for the study. The research was executed according to the provisions of the Declaration of Helsinki.[25]

Data collection process

Information letters and informed consent forms were sent to the principals of the selected schools following ethical approval and gatekeeper permission. Information sessions were arranged with the children, where they were provided with detailed information on the study and informed that participation was voluntary. This was explained in English and IsiZulu. With the consent of the school principal, potential study participants were provided with parental information letters and informed consent forms. Children who returned informed consent letters signed by their parents and then volunteered to participate by signing the minor assent form were finally recruited into the study. Demographic information such as age, gender and grade of study was elicited using a biographical questionnaire.

Anthropometric measurements

During all anthropometric measurements, children were in light clothing and barefoot. For body weight measurements, the child stood on the scale for 5 seconds with feet hip-width apart.[26] Body weight was measured to the nearest 0.1 kg. Prior to body weight assessment at the beginning of each week, the weighing scale was calibrated using repeatability and eccentricity tests.[26] To measure standing height (stature), the child stood with heels together and touching the base of a Seca 213 portable stadiometer (Seca Precision for Health, Germany) and head positioned in the horizontal plane with eyes looking straight ahead.[27] Body mass index (BMI) was calculated using the formula BMI = body weight/height^2. Waist circumference was measured to the nearest 0.1 cm using an inelastic tape measure with a BMI calculator (MediPro, South Africa), with the umbilicus as the reference point. The same tape measure was used to measure hip circumference, with the most protruding point on the child's buttocks as the reference point. The waist-hip ratio was calculated as waist circumference/hip circumference.

Socioeconomic status

The children's SES was assessed by requesting them to answer nine items in the biographical questionnaire. The questions were adopted from a similar SA study by Gall *et al*.[28] The questionnaire items covered household-level living standards, such as infrastructure and housing characteristics (house type, number of bedrooms, type of toilet and access to indoor water, indoor toilet/bathroom, and electricity), and questions related to ownership of three durable assets (a working refrigerator, washing machine and car). The dichotomised items (0 = poor quality, not available; 1 = higher quality, available) were summed to build an overall SES index, with higher scores reflecting higher SES. The overall SES index was categorised into low, middle and high categories for further analysis.

Cardiovascular measures (blood pressure and heart rate)

An electronic blood pressure monitor (M3 HEM-7154-E; Omron Healthcare, Japan) was used to measure the children's resting systolic and diastolic blood pressure and heart rate in the sitting position. Following 5 minutes of sitting at rest, five measurements were taken at 2-minute intervals, and the mean of the last three measurements was used in the analysis.[29]

Physical fitness

The modified Eurofit test battery, comprising sit and reach (S and R), standing long jump (SLJ), sit-ups (SUs), 5 m shuttle run (5m-SRT) and cricket ball throw (CBT) and described by Armstrong *et al*.,[21] was used for assessment of PF. The Eurofit has an excellent field-based use because it is cheap and easy to administer, is practical in the school setting, requires minimal equipment and personnel, and is appropriate for testing of large groups.[1] Eurofit tests demonstrate excellent test-retest reliability and good criterion validity for tests where appropriate criterion measures have been identified.[1]

The children's body flexibility was measured using the S and R test. The child was asked to sit with the lower limbs parallel and the knees extended forward with the arms straight, and tried to reach as far forward as possible. A helper held the legs to prevent them from bending. The measuring box was 33 cm high with an overhang of 50 cm. The measurement was recorded in centimetres, with 15 cm coinciding with the toes of the child. The child repeated the test twice, with the highest reading of the two (to the nearest centimetre) recorded as the final score.

Abdominal muscular strength was assessed as the number of SUs in 30 seconds. The child lay supine with knees bent to 90° and feet flat on the ground, and was instructed to perform complete sit-ups as many times as possible. Only those done in the full range were counted, and SUs performed with pelvic tilting were not counted.

The children's lower-body muscular fitness was measured using the SLJ test. The child was instructed to jump as far as possible from a standing point with feet together. Each child was allowed two attempts to perform the test, and the better of the two attempts was recorded as the test result. A child who lost balance during the test was granted an additional attempt. The distance was measured in metres.

Cardiorespiratory fitness was assessed using the 5m-SRT. Plastic marker cones were placed five metres apart. Two pieces of ski rope (10 m × 10 m) were placed along the ground at these points to clearly indicate the start and finish lines of the five-metre distance. After a count of one, two, three, the child started behind the rope on one side of the shuttle and ran as fast as possible between the cones, crossed the line with both feet, and then ran back to the starting point. This was repeated until 10 shuttles were completed to make

50 m in the shortest time possible. The time taken to complete 10 shuttles was recorded to the nearest 0.1 second. If a child did not cross the line with both feet, he/she was penalised 0.1 second. When this occurred more than once, he/she was required to repeat the test following 3 minutes of rest. Time was monitored using a digital stopwatch (Fastime O; AST Ltd, UK).

Upper-body fitness was measured using the CBT test. The test required the child to throw a 135 g (4.75 oz.) Dunlop League cricket ball as far as possible. A restraining line was marked out, in front of which the child stood when throwing. The child was required to remain behind a second line, marked out two metres away, during the test. A run-up was allowed, provided that the child remained within the delineated two-metre area, even during the follow-through. The children were allowed two attempts each. The better throw was recorded as the test score, in metres.

Data analysis

SPSS version 25.0 software (IBM, USA) was used for data analysis. Frequencies, percentages, medians and quartiles were used for descriptive summary of the data. A normality test performed on the data using the Shapiro-Wilk test highlighted that the data were not normally distributed, hence the choice of non-parametric tests for comparison of continuous variables.

Following the method used by Monyeki *et al*.,[30] Rank Cases (N'tiles) in SPSS was used to first group each of SLJ, S and R, 5m-SRT, SUs and CBT into four groups (from low to high scores: 1 - 4, respectively) on the PF variable. The group scores were summed to calculate combined PF scores. Combined PF scores were also grouped into three ordinal variables of low, moderate and high PF. Since PF is known to vary according to age and gender, the ranking of cases was computed separately for males and females by age category (6 - 13 years). The same ranking technique was done to categorise SES index into lower (0 - 3), middle (4 - 5) and upper (6 - 9) SES, but not by age category.

Controlling for age, the non-parametric Quade analysis of covariance was computed to compare the median scores of demographic characteristics (weight, height, BMI), SES index and fitness tests (S and R, SLJ, 5m-SRT, SUs and CBT) across gender. The Kruskal-Wallis test with Dunn-Bonferroni *post hoc* multiple comparisons was used to compare the anthropometric, cardiovascular and fitness test parameters across socioeconomic ranking. The relationship of PF with anthropometric and cardiovascular parameters and SES index was examined using Spearman's correlation coefficient. Variables that showed significant correlations with PF were entered into the multinomial logistic regression model to determine the predictors of low fitness status. The level of significance was set at $p<0.05$.

Results

A total of 407 primary schoolchildren aged 6 - 13 years participated in the study; 225 (55.3%) were female and 182 (44.7%) were male. The anthropometric characteristics, cardiovascular parameters, fitness test scores and SES index of male and female children are presented and compared in Table 1.

The girls were significantly taller than the boys ($p<0.001$) and weighed more ($p<0.001$). The girls also had significantly higher BMI ($p<0.001$), waist circumference ($p<0.001$), hip circumference ($p<0.001$), systolic blood pressure ($p=0.033$) and diastolic blood pressure ($p<0.001$) than the boys. Results further showed that the boys had significantly higher SLJ ($p=0.030$), SU ($p=0.022$) and CBT ($p<0.001$) scores and a significantly lower 5mSRT ($p<0.001$) than the girls.

The frequency distributions of PF status of the children stratified by age and SES ranking are presented in Table 2. Overall, low PF was observed in 32.4% ($n=132$) of the children, moderate PF in 37.1% ($n=151$) and high PF in 30.5% ($n=124$). The highest and lowest prevalence of low PF status (39.3% v. 28.4%) was found among children aged 13 and 11 years, respectively. With regard to SES ranking, the highest prevalence of low PF status (33.8%) was observed among children in the middle SES category, while the lower SES category had the lowest prevalence (29.0%).

Table 3 compares the children's anthropometric characteristics, cardiovascular parameters and fitness test scores across socioeconomic ranking. Results of the Kruskal-Wallis test indicated a significant difference across the median scores of the children's hip circumference and waist-hip ratio. Multiple *post hoc* comparison showed that children categorised as lower SES had a significantly smaller hip circumference and higher waist-hip ratio than their counterparts in the middle and upper SES categories.

A correlation matrix examining the relationship of PF with anthropometric characteristics, cardiovascular parameters and SES index is presented in Table 4. Analysis of all data ($n=407$) indicated that PF demonstrated a negative significantly low correlation with BMI ($r=-0.151$; $p=0.002$), waist circumference ($r=-0.107$; $p=0.031$) and hip circumference ($r=-0.123$; $p=0.013$). Among the boys, only BMI showed a negative, significantly low correlation with PF. Analysis of the girls' data showed that PF was negatively significantly correlated with BMI ($r=0.146$; $p=0.028$) and hip circumference ($r=0.136$; $p=0.041$).

The multinomial regression model computed to determine the predictors of low fitness status is presented in Table 5. The analysis revealed a significant association between BMI and PF, as BMI increased the odds for low PF (odds ratio 1.16; 95% confidence interval 1.01 - 1.33). A child with a unit increase in BMI is 1.16 times more likely to develop low PF.

Discussion

The results of this study showed that girls weighed significantly more and had a higher BMI and waist and hip circumferences compared with boys. These findings are similar to another SA study by Amusa *et al*.,[18] where girls were found to be significantly taller and heavier and to have a higher BMI than boys. A systematic review study by Monyeki *et al*.[31] also found that in all studies conducted between 1990 and 2014, more girls were overweight and obese compared with boys. These findings could indicate that girls are at higher risk of developing obesity, as observed in previous review studies on childhood and adolescence overweight and obesity trends in SA.[13,14] Variances in energy requirements between girls and boys, differences in PA levels and the fact that girls are naturally anatomically endowed with wider hips than boys were some of the reasons given.[13,14,32,33] Other SA studies have found mixed results: for instance, Moselakgomo *et al*.[16] found that boys were taller and heavier than girls, while an earlier study by Monyeki *et al*.[23] did not note any cases of overweight in the group they studied. However, these results differ from a European study by Pojskic and Eslami,[15] where no significant differences in weight or BMI were noted between the genders, but girls were found to be significantly shorter with narrower WC compared with boys.[15]

In the present study, the boys had significantly higher performance scores in the SLJ, SU, CBT and 5mSRT tests. These results seem to agree with reports from previous studies that reported better PF outcomes in boys compared with girls.[10,15,18,22] Better PF outcomes in boys may be explained by observations in

Table 1. Comparison of male and female anthropometric characteristics, cardiovascular parameters, PF test scores and socioeconomic variables (*N*=407)

Variable	Boys (*n*=182), median (IQR)	Girls (*n*=225), median (IQR)	*F*-value	*p*-value
HT (m)	1.39 (1.25 - 1.46)	1.41 (1.28 - 1.49)	19.718	<0.001*
WT (kg)	32.05 (25.75 - 38.92)	37.00 (27.10 - 46.60)	39.661	<0.001*
BMI (kg/m²)	17.03 (15.53 - 18.51)	18.14 (16.12 - 21.53)	24.087	<0.001*
WC (cm)	60.75 (55.75 - 65.00)	63.00 (57.00 - 68.50)	16.590	<0.001*
HC (cm)	72.00 (63.00 - 78.00)	74.00 (66.00 - 83.45)	19.813	<0.001*
WHR	0.85 (0.81 - 0.92)	0.84 (0.79 - 0.91)	3.661	0.056
SES index	5.00 (4.00 - 7.00)	5.00 (3.50 - 7.00)	0.348	0.556
SBP (mmHg)	102.50 (93.00 - 113.00)	107.00 (96.00 - 115.50)	4.582	0.033*
DBP (mmHg)	64.00 (60.00 - 72.00)	69.00 (62.00 - 75.00)	15.656	<0.001*
HR (bpm)	82.00 (72.00 - 92.00)	86.00 (72.00 - 94.00)	3.339	0.068
S and R (cm)	17.25 (14.37 - 21.12)	18.00 (15.00 - 22.00)	2.502	0.114
SLJ (m)	1.35 (1.10 - 1.57)	1.27 (1.03 - 1.48)	4.727	0.030*
SUs (30 s)	19.50 (10.00 - 28.00)	18.00 (10.00 - 24.00)	5.302	0.022*
5mSRT (s)	25.00 (22.60 - 27.00)	25.72 (24.00 - 28.00)	14.344	<0.001*
CBT (m)	16.00 (11.07 - 20.83)	12.60 (9.30 - 17.11)	26.894	<0.001*

PF = physical fitness; IQR = interquartile range; HT = height; WT = weight; BMI = body mass index; WC = waist circumference; HC = hip circumference; WHR = waist-hip ratio; SES = socioeconomic status; SBP = systolic blood pressure; DBP = diastolic blood pressure; HR = heart rate; S and R = sit and reach; SLJ = standing long jump; SUs = sit-ups; 5mSRT = 5 m shuttle run, CBT = cricket ball throw; ANCOVA = analysis of covariance.
*Significant at $p<0.05$.
Quade's ANCOVA comparisons controlled for participants' age.

Table 2. Frequency distribution of participants' PF levels by age and SES

Variable	Total (*N*=407), *n* (%)	Low PF (*n*=132), *n* (%)	Moderate PF (*n*=151), *n* (%)	High PF (*n*=124), *n* (%)
Age (years)				
6	48 (11.8)	15 (31.3)	18 (37.5)	15 (31.3)
7	54 (13.3)	18 (33.3)	19 (35.2)	17 (31.5)
8	24 (5.9)	8 (33.3)	9 (37.5)	7 (29.2)
9	25 (6.1)	9 (36.0)	9 (36.0)	7 (28.0)
10	32 (7.9)	11 (34.4)	10 (31.3)	11 (34.4)
11	74 (18.2)	21 (28.4)	30 (40.5)	23 (31.1)
12	94 (23.1)	28 (29.8)	39 (41.5)	27 (28.7)
13	56 (13.8)	22 (39.3)	17 (30.4)	17 (30.4)
SES				
Lower	100 (24.6)	29 (29.0)	43 (43.0)	28 (28.0)
Middle	151 (37.1)	51 (33.8)	55 (36.4)	45 (29.8)
Upper	156 (38.3)	52 (33.3)	53 (34.0)	51 (32.7)

PF = physical fitness; SES = socioeconomic status.

previous studies indicating that SA girls are less active than their male counterparts, and the general report that SA children engage in levels of PA that are not sufficient to support wellbeing and the prevention of chronic diseases.[20,34] Diastolic blood pressure was also found to be significantly higher in girls ($p<0.001$) compared with boys in the present study. These results could suggest that girls are at increased risk of an unrecognised form of hypertension, isolated diastolic hypertension (IDH), which mainly affects young individuals. It results from increases in arteriolar resistance[35] and is linked with weight increases and obesity.[36] An 11.2-year follow-up study of adults by Niiranen *et al*.[37] found a significantly higher prevalence of cardiovascular incidents in child participants with IDH than in other groups. Similarly, Monyeki *et al*.[38] found that SA schoolgirls had significantly higher systolic blood pressure than boys.

Comparison of children's anthropometric indices and cardiovascular and fitness test parameters across SES ranking in the present study showed that children in the lower SES category had significantly smaller HC and higher WHR compared with those in the middle and higher SES categories. No significant differences were observed in the performance PF tests according to SES in this group of children. The reasons behind these results are not clear. However, they are contrary to the assumption that low SES is associated with reduced cardiovascular fitness and higher risks of adverse health-related outcomes.[1,21,27]

Analysis of combined boys' and girls' data in the present study showed that PF was negatively correlated with BMI, WC and HC. These findings concur with a number of studies showing that increases in central obesity and fat distribution negatively affect PF. Obesity increases risks for NCDs, poor quality of life and premature death.[23,39] Further analysis showed a negative correlation between PF and BMI for boys, while a negative correlation was found with both BMI and HC in the girls. These results imply that PF decreases with increased BMI, WC and HC. A similar negative correlation was also noted by Truter *et al*.,[22] indicating that progressive increases in BMI decreased aerobic

Table 3. Comparison of children's anthropometric, cardiovascular and PF test parameters across SES ranking

	SES				
Variable	Lower, median (IQR)	Middle, median (IQR)	Upper, median (IQR)	*H*	*p*-value
Age (years)	10.00 (07.00 - 12.00)	11.00 (08.00 -12.00)	11.00 (08.00 - 12.00)	5.33	0.070
HT (m)	1.36 (1.21 - 1.46)	1.39 (1.28 - 1.48)	1.42 (1.28 - 1.49)	5.73	0.057
WT (kg)	30.85 (23.00 - 43.60)	34.90 (27.10 - 41.60)	34.35 (27.75 - 42.77)	3.44	0.179
BMI (kg/m^2)	17.13 (15.52 - 20.12)	17.54 (15.97 - 20.16)	17.71 (15.73 - 20.05)	0.79	0.671
WC (cm)	60.00 (55.25 - 67.00)	62.00 (57.00 - 67.00)	62.00 (56.47 - 68.00)	1.89	0.387
HC (cm)	69.85 (59.00 - 80.00)†	73.00 (67.00 - 81.30)‡	74.00 (68.00 - 81.00)‡	10.17	0.006*
WHR	0.89 (0.83 - 0.95)†	0.84 (0.79 - 0.90)‡	0.84 (0.80 - 0.89)‡	22.50	<0.001*
SBP (mmHg)	103.50 (92.25 - 112.75)	104.00 (94.00 - 116.00)	106.50 (97.00 - 114.00)	2.19	0.347
DBP (mmHg)	66.00 (62.00 - 72.75)	67.00 (60.00 -75.00)	67.00 (62.00 - 73.00)	0.15	0.928
HR (bpm)	87.00 (74.25 - 94.75)	84.00 (72.00 - 93.00)	81.50 (69.00 - 91.00)	5.55	0.062
S and R (cm)	17.25 (15.25 - 20.57)	18.00 (16.00 - 22 -00)	18.00 (14.00 - 21.85)	1.16	0.568
SLJ (m)	1.21 (1.03 - 1.49)	1.30 (1.10 - 1.48)	1.36 (1.10 - 1.56)	6.17	0.046
SUs (30 s)	18.00 (8.25 - 24.00)	19.00 (11.00 - 26.00)	19.00 (10.00 - 25.00)	2.52	0.283
5mSRT (s)	26.00 (24.00 - 27.00)	25.00 (23.00 - 27.00)	25.00 (23.00 - 27.95)	3.69	0.157
CBT (m)	13.10 (09.07 - 16.45)	14.00 (10.00 - 19.00)	14.50 (10.32 - 19.67)	6.00	0.050

PF = physical fitness; SES = socioeconomic status; IQR = interquartile range; H = test statistic for Kruskal-Wallis test; HT = height; WT = weight; BMI = body mass index; WC = waist circumference; HC = hip circumference; WHR = waist-hip ratio; SBP = systolic blood pressure; DBP = diastolic blood pressure; HR = heart rate; S and R = sit and reach; SLJ = standing long jump; SUs = sit-ups; 5mSRT = 5 m shuttle run, CBT = cricket ball throw.
*Significant at $p<0.05$.
† and ‡ represent multiple *post hoc* analysis for the Kruskal-Wallis test. Variables with median scores with different superscripts are significantly different.

Table 4. Correlation matrix for examining the relationship of PF with anthropometric, cardiovascular and socioeconomic variables

	All children (*N*=407)		Boys (*n*=182)		Girls (*n*=225)	
Variable	*r*	*p*-value	*r*	*p*-value	*r*	*p*-value
Anthropometric measures						
HT	0.015	0.763	–0.011	0.885	0.031	0.644
WT	–0.084	0.092	–0.090	0.224	–0.084	0.212
BMI	–0.151	0.002**	–0.171	0.021*	–0.146	0.028*
WC	–0.107	0.031*	–0.111	0.135	–0.106	0.113
HC	–0.123	0.013*	–0.113	0.130	–0.136	0.041*
WHR	0.051	0.301	0.005	0.949	0.089	0.184
Cardiovascular indices						
SBP	–0.064	0.199	–0.053	0.474	–0.070	0.297
DBP	–0.030	0.553	–0.058	0.440	–0.014	0.840
HR	–0.043	0.382	–0.010	0.892	–0.064	0.336
SES index	–0.014	0.785	0.103	0.166	–0.111	0.097

PF = physical fitness; HT = height; WT = weight; BMI = body mass index; WC = waist circumference; HC = hip circumference; WHR = waist-hip ratio; SBP = systolic blood pressure; DBP = diastolic blood pressure; HR = heart rate; SES = socioeconomic status.
*Significant at $p<0.05$.
**Significant at $p<0.01$.

Table 5. Multinomial logistic regression analysis for predictors of low PF status in the children

Variable	B	Wald	OR (95% CI)	*p*-value
BMI	0.149	4.504	1.16 (1.01 - 1.33)	0.034*
WC	–0.002	0.002	1.00 (0.93 - 1.07)	0.963
HC	–0.004	0.045	1.00 (0.96 - 1.03)	0.833

PF = physical fitness; B = regression estimate; OR = odds ratio; CI = confidence interval; BMI = body mass index; WC = waist circumference; HC = hip circumference.
*Significant at $p<0.05$.

capability. Pojskic and Eslami[15] and Armstrong *et al*.[21] also found low cardiorespiratory levels in children with higher central obesity. This negative correlation of increases in BMI levels with a decline in PF performance has also been identified in adults;[19] the authors also stressed the gravity of these effects if changes in behaviour patterns are not implemented.

The multinomial logistic regression results identified BMI as a significant predictor of low PF status, as BMI increased the odds for a child being in the low fitness category. These results suggest that PAs aimed at putting BMI within normal limits could decrease BMI in this cohort of children, thus reducing risks for future adverse health-related outcomes.

Study limitations

The authors acknowledge certain limitations of this study. These include the cross-sectional nature of the study, wherein directionality of associations cannot be determined, while reverse causality may have influenced the results.

Conclusion

This study has revealed that low PF status in children of primary school age may be influenced by gender and adiposity. Since children spend much of their time in school, the school is the most appropriate place for the monitoring of children's PF levels.[2] Weight and height measurements and BMI calculation have been implemented as standard on the capturing of vital signs in all primary healthcare programmes, including within the existing school health teams. Moreover, including assessment of PF at policy levels as part of the health screening process may help create a more explicit depiction of the health status of children and assist with the early identification of risk factors or behaviours associated with poor PF levels, where programmes to mitigate risks could be implemented.

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