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Relationship between physical activity and risk factors of body weight disorders among south African primary school children.

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Abstract

The study determined the relationship between physical activity (PA) and risk factors of obesity among primary school children (boys: mean age 11.17±1.29, n=678; girls: mean age 10.88±1.27, n=683) in Limpopo and Mpumalanga provinces, South Africa. The children were classified according to age and sex-specific body mass index (BMI) categories (underweight: 0<18, normal weight: 18.5<25, overweight: 25<30 or obese: >30) and their blood pressure (BP) measurements. Health-related fitness was assessed with standardised test protocols. Using the International PA Questionnaire (IPAQ), the children's PA levels were judged as: Low (METs scores of less than 500); Moderate (METs scores from 500 to 1499) or High (METs >1500). The children were mostly underweight (74%) compared to other weight categories (normal weight: 23.7%; overweight: 1.0%; obese: 0.6%). Girls had non-significant elevated BP values (systolic: 112.94±11.28mmHg; diastolic: 79.40±12.80mmHg) than boys (systolic: 110.71±14.95mmHg; diastolic: 75.53±12.53mmHg) who had higher PA levels (METs = 1286.72±317.47) than girls (METs = 397.28±30.14) (p<0.01). The children's PA level correlated positively with BMI (.86) (p<0.01) but negatively with %BF (-.67); weight circumference (WC) (-.41); SUP (sit-up) (-.22); and predicted VO_2max (-.17) (p<0.05). BMI positively associated with SBP (standing broad jump) (.06) and SAR (sit-and-reach) (.16) (p<01) whereas, it was negatively related with DBP (-.15); %BF (-.67); WC (-.26); SUP (-.21) and predicted VO_2max (-.12) (p<0.05). Understanding the relationship between body composition, PA and non-communicable disease risk among children could provide a reliable basis for designing appropriate intervention programmes needed to optimise health outcomes.

Keywords: body composition; body weight; physical activity; health risk factors; children; South Africa.

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Introduction

Childhood obesity, has over the past two decades, increased significantly and is now considered a serious public health issue with both short-term and long-term health consequences [1]. Habits of physical inactivity along with excessive body fat increase cardiovascular and metabolic disease risk and these habits are often established during childhood, thus propagating overweight and obesity to an epidemic proportion in many countries [1]. Symptoms of chronic diseases might not be apparent in children and adolescents, but their manifestation during childhood may track into adulthood. A number of studies have provided overwhelming evidence that low physical activity (PA) or fitness is associated with an increased risk of diseases including hypertension and body weight disorders: the CASPIAN Study [2], AVENA Study [3], HELENA-CSS project [4], Bogalusa Heart Study [5] and the European Heart Study [6]. It has been noted from these studies that disproportionately low PA patterns predispose children to various disease, of which underweight, overweight, obesity, hypertension and metabolic syndrome are glaring examples.

In many developed countries, studies have shown that increased PA and/ or high cardiorespiratory fitness confer protection against chronic illness in individuals with underlying risk factors, including obesity [7]. Such studies have documented that increase in PA is the key strategy for the treatment of paediatric body weight faltering, and have demonstrated a strong negative relationship between PA and obesity [8]. Additionally, increased daily PA and high cardiorespiratory fitness reduce the risk of a large number of chronic diseases, including hypertension [9] and body weight disease [8]. In addition, physical fitness is important from a health perspective not only in adults but, children and adolescents as well [10]. Thus, children with low fitness could derive health benefits by improving their PA level as this is associated with numerous physiological and psychological health benefits [11-13].

South Africa is a country undergoing modern transition due to industrial revolution. Modern technology has brought about notable changes in lifestyle which promote sedentary living. The number of hours spent on activities for survival and daily living are reduced due to urbanisation and modern technology, leaving an ample free time at people's disposal. According to Huang and Malina [9], sedentary lifestyle in adults has been associated with the development of many health problems such as obesity, coronary heart disease (CHD), hypertension, low back pain, which have both social and economic consequences [14-16]. Notably, it is now established that these diseases have precursors during childhood and adolescence [17-20].

Despite the fact that the major cause of the growing prevalence of obesity and its associated diseases is a reduction in daily PA among children [16, 21-23], studies examining the relationship between PA and related health risk factors in children and adolescents are scarce in South Africa. Studies carried out in rural areas of Limpopo Province have consistently reported body weight disorders and incidence of health-risk behaviours in South African school children and adolescents [24-27]. These studies emphasized the need for urgent intervention programmes to reverse the growing trend of obesity in children and youth. Despite the fact that physical fitness plays a vital role in the overall health of individuals with and without CVDs, PA participation has decreased tremendously, especially among the youth. Results from South Africa's 2014 report card on PA for children and adolescents have indicated the co-existence of obesity and underweight as well as low level of PA among the children [28].

It is of interest therefore, to examine the role of PA in the aetiology and prognosis of body weight disorders and associated health risks among children in the South African context. As risk factors of disease are of a major public health concern, children's predisposition needs to be closely monitored. The trends are difficult to quantify or to compare as a wide variety of definitions of body weight disorders of childhood are in use and available standards are debatable. Even in the presence of consensus of opinion regarding health risks associated with PA participation in children and adolescents, it is important to continuously monitor observable trends as such outcomes will inform development and implementation of appropriate health policies. Therefore, this study was designed to assess the relationship between PA and risk factors of disorders of body weight among South African primary school children. In addition to facilitating meaningful comparisons with results obtained in other countries, the present study could provide baseline data for interpreting future epidemiological surveys on body composition, PA and fitness in children. Specifically, the study evaluated anthropometric indices, PA and physical fitness profiles of South African children and its relationship with risk factors of cardiovascular and metabolic diseases.

Methodology

Research design

A cross-sectional design was used to collect data on anthropometric, hemodynamic, PA and physical fitness variables as determinants of health risks in targeted samples of primary school children in Limpopo and Mpumalanga provinces of South Africa. The descriptive characteristics of the children's anthropometric, physiological and health-related fitness variables are presented.

Participants

A total of 678 boys and 683 girls aged 9-13 years were randomly selected from eight schools in each of Limpopo (LP) (n=708) and Mpumalanga (MP) (n= 653) provinces for the study. Class registers were used to draw targeted samples of children depending on the pupil density at each school. Information regarding the children's socio-demographic characteristics (correlates of disorders of body weight, PA, fitness and cardio-metabolic disease risk) which included; age, gender, ethnicity and residence, was obtained from the school register. However, children who were reportedly ill and whose ages were beyond the lower and upper limits of the categories set for the study were excluded.

Anthropometric measurements

The participants' anthropometric measurements, which included body weight, body height, skinfold and waist circumference was measured using the protocol of the International Society for the Advancement of Kinanthropometry [29]. Based on these variables, body mass index (BMI) (weight/height^2) was derived and used to classify the children according to weight categories as follows: underweight (0<18), normal (18.5<25), overweight (25<30) or obese (>30) for age and gender. Waist circumference (WC) measured the abdominal visceral adipose tissue to estimate percentage body fat (%BF) among the children. In addition, the sums of two skinfolds (triceps and subscapular) were calculated and the equation was used to predict %BF [30].

Blood pressure measurement

Blood pressure (BP) was measured using electronic blood pressure monitor with cuff designed for children (Omron

HEM-705 CP devices, Tokyo, Japan). The standardised guidelines of the National Heart, Lung, and Blood Institute/ the National High Blood Pressure Education Programme [31] were applied for the BP measurements to determine potential health risk factors and the relationship between of PA and BP among children. BP values between 90^{th} and 95^{th} percentiles in childhood are designated as "high normal" or "pre-hypertensive," and are an indication for lifestyle modification [32]. Based on these guidelines, the readings at the first and third BP monitors were taken as systolic blood pressure (SBP) and diastolic blood pressure (DBP), respectively.

Health-related physical fitness measurements

For the purpose of this study, five health-related physical fitness variables were tested using the standard protocols of European Test of Physical Fitness (EUROFIT) and the American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD): flexibility (sit-and-reach test), muscular endurance (sit-up test), muscular strength and upper body extremities (hand grip and standing broad jump tests) and cardio-respiratory endurance (20-meter multistage shuttle run). The tests were selected because of their ease of administration to large number of subjects.

Physical activity measurement

A short version of the International Physical Activity Questionnaire (IPAQ) was used to evaluate PA level among the children. The self-report questionnaire included items on habitual PA, frequency and duration of sports participation including indoor ball games such as soccer, basketball, volleyball, and other outdoor activities like running/jogging, track-and-field sports, dancing and free play among the school children. The school children completed the IPAQ in the classroom under the supervision and guidance of trained investigators. The children were defined as physically active (those who participate in sports and/or vigorous activities), moderately active (those who participate in hard physical and moderate activities) and low active (those who participate in activities like walking and sitting) according to their participation in the mentioned activities at least seven times per week for a minimum of 10 minutes at a time. In the IPAQ only those sessions which lasted 10 minutes or more were analysed. All types of PA related to occupation, transportation, household chores and leisure time were also included. IPAQ also covers information about time spent sitting, which is used as an indicator of inactivity. Based on the children's IPAQ scores, their PA levels were categorised as follows: Low = the METs scores of less than 500; Moderate = METs scores of between 500 to 1499 and High = METs >1500.

Measurement procedure

Eight trained research assistants who were post-graduate students at the Department of Nursing and School of Education, University of the Limpopo, South Africa participated in the data collection. A specialized training workshop was conducted for the research assistants to enable them to competently carry out the measurements. At the workshop each assistant was trained to perform a specific task and measurement procedure at a designated work station, e.g. performance measurement. Each work station had a team leader who coordinated prescribed data collection procedures. Before data collection commenced, the participants filled the demographic section of the data form. In addition, the participants reported their habitual PA under the supervision of the principal investigators.

Ethical considerations

The Ethics Sub-Committee of the Faculty of Health Sciences, North-West University, South Africa (Ethics no: NWU-00088-12-S1) and other relevant provincial regulatory organizations granted approval for the research to be carried out. Before data collection, permission to conduct the study was granted by Provincial Heads of Education Departments and District Managers of the Department of Basic Education in Limpopo and Mpumalanga Provinces. An information leaflet and informed consent form were administered to the head teachers, pupils and their parents or guardians who permitted that the study be carried out.

Data analysis

Data were analysed using descriptive statistics, such as means, standard deviations and frequencies. Independent *t*-test was used to examine significant differences between two ordinal variables to assess disparity between the categorical variables. Pearson's correlation coefficient was calculated to determine the relationship between physical activity, health-related fitness and risk factors of body weight disorders among the school children. All data analyses were performed using the Statistical Package for the Social Sciences (SPSS), version 21.0 [33]. For all statistical analysis the level of significance was set at $p \le 0.05$.

Results

Results revealed that regarding BMI frequencies among the children, prevalence of underweight (74%; n=1 016) was higher than other weight categories such as normal (23.7%; n=323); overweight (1.0%; n=14) and obese (0.6%; n=8). Furthermore, the results indicated that with regards to the hemodynamic variables, 81% (n=1089) of the combined sample had normal BP and 19% (n=253) had BP values indicative of prehypertension. Prevalence of prehypertension was considerably higher among children in LP province (10.6%) as compared to their peers in MP province (9.0%).

Table 1 presents BMI classification of the combined sample of school children in MP and LP provinces according to gender. When the BMI classification was analysed, the results showed that girls had higher prevalence of underweight (99.9%) and lower incidence of obesity (0.1%) than boys (underweight: 49.3%; normal weight: 47.6%; overweight: 2.1%; and obesity: 1.0%). Further analysis of the data according to provinces indicated that prevalence of underweight was higher among MP children (77.0%) than those in LP (72.5%). However, the results on the BMI classification also revealed that LP children had higher incidence of normal weight (24.6%), overweight (2.0%) and obesity (1.0%) than their MP counterparts, who by contrast had lower corresponding percentages: normal weight (22.8%), overweight (0%) and obesity (0.2) (Table 2).

It was also of interest to this study to examine gender-related distribution of body weight categories according to province. The results are presented in Table 3. When the data was analysed separately by gender across provinces, distribution of the children's BMI categories were as follows: MP boys (underweight: 53.3%; normal weight: 46.7%) and LP boys (underweight: 45.7%; normal weight: 48.5%). None of the male children measured in MP were overweight and obese in contrast to those in LP: overweight (3.9%) and obese (1.9%). The results for MP girls indicated that none of them were neither normal nor overweight, but one was obese (0.3%), whereas an overwhelming majority were underweight (99.7%). However, all LP girls were underweight.

The descriptive data on body composition, fitness and PA measurements of LP and MP school children are provided in Table 4. The results show that the combined sample of boys (mean age: 11.17±1.29) was significantly older than the girls (mean age: 10.88±1.27). Similarly, significant differences were observed regarding anthropometric variables with boys having greater values for body mass, stature, sitting height and consequently, BMI than girls ($p<0.05$). However, regarding adiposity, as indicated by %BF and WC, girls exhibited higher values than boys ($p<0.05$). Data on the hemodynamic variables showed that girls had higher mean SBP (112.94±11.28) and DBP (79.40±12.80) than boys (SBP: 110.71±14.95; DBP: 75.53±12.53). Results on physical fitness parameters, revealed that mean scores for SUP and VO_2max were significantly different ($p<0.05$) with the girls having greater values compared to boys. However, boys were significantly more flexible than girls ($p<0.05$). Concerning PA, the boys had significantly higher ($p<0.05$) total METs (1286.72±317.47) than girls (397.28±30.14), suggesting that they were more active on average.

Table 5 presents the correlation matrix between the children's PA, fitness and risk factors of obesity when controlled for gender and province. Overall, the total METs of the sampled groups correlated positively with BMI (.86); SAR (.10) and SBJ (.01; $p<0.01$), but negatively related to SBP (-.08); DBP (-.17); %BF (-.67); WC (-.41); SUP (-.22); and predicted VO_2max (-.17; $p<0.05$).

The body composition results revealed that BMI associated positively with SBP (.06); SAR (.16) and SBJ (.03; p<01) whereas was negatively linked with DBP (-.15); %BF (-.67); WC (-.26); SUP (-.21) and predicted VO_2max (-.12; $p<0.05$).

Table 1. *BMI classification of combined sample of school children in MP and LP provinces by gender**

Weight classification (BMI categories)	**Boys (n=678)**	**Girls (n=683)**
Underweight (0-18.5)	334 (49.3)	682 (99.9)
Normal weight (18.5-25.0)	323 (47.6)	-
Overweight (25-30)	14 (2.1)	-
Obese (>30.0)	7 (1.0)	1 (0.1)

Table 2. BMI classification of combined sample of school children by provinces*

Weight classification (BMI categories)	**MP**	**LP**
Underweight (0-18.5)	503 (77.0)	513 (72.50)
Normal weight (18.5-25.0)	149 (22.8)	174 (24.60)
Overweight (25-30)	-	14 (2.0)
Obese (>30.0)	1 (0.2)	7 (1.0)

**Results are presented as frequencies (percentages).*

Table 3. BMI classification of school children in MP and LP provinces by gender*

Weight classification (BMI categories)	Boys		Girls	
	MP (n=319)	LP (n=359)	MP (n=334)	LP (n=349)
Underweight (0-18.5)	170 (53.3)	164 (45.7)	333 (99.7)	349 (100)
Normal weight (18.5-25.0)	149 (46.7)	174 (48.5)	-	-
Overweight (25-30)	-	14 (3.9)	-	-
Obese (>30.0)	-	7 (1.9)	1 (0.3)	-

**Results are presented as frequencies (percentages).*

Table 4. Descriptive data on body composition, fitness and physical activity measurements of LP and MP school children

Variables	Boys (n=678)	Girls (n=683)	p-value of the difference variables
	Mean± SD	Mean± SD	
Age (yrs)	11.17±1.29	10.88±1.27	0.006**
Body mass (kg)	39.69±8.79	29.04±4.39	0.000**
Stature (cm)	142.44±11.01	136.58±8.25	0.000**
Sitting height (cm)	71.93±5.23	68.88±4.73	0.000**
BMI ($m.kg^{-2}$)	19.38±3.12	15.49±1.04	0.000**
SBP	110.71±14.95	112.94±11.28	0.002**
DBP	75.53±12.53	79.40±12.80	0.000**
%BF	17.81±6.96	21.00±5.92	0.000**
WC	56.28±5.77	60.67±6.36	0.000**
SAR	40.47±7.09	39.77±6.49	0.059
SUP	18.28±6.23	20.38±5.46	0.000**
SBJ	117.32±14.71	117.76±19.11	0.627
VO_2max.	22.29±6.09	25.43±6.75	0.000**
Total METs	1286.72±317.47	397.28±30.14	0.000**

SD=standard deviation; BMI=body mass index; %BF= percent body fat; WC=waist circumference; SUP=sit-ups; SAR=sit and reach; SBJ=standing broad jump; VO_2max= maximum oxygen consumption; Total METs= total metabolic equivalents; p<0.01; p<0.001***

Table 5. Correlation matrix between physical activity, fitness and risk factors of obesity

Variables	Total MET	BMI	SBP	DBP	%BF	WC	SAR	SUP	SBJ	Predicted VO_2max
Total MET	-	.86**	-.08**	-.17**	-.67**	-.41**	.10**	-.22**	.01	-.17**
BMI	.86**	-	.06*	-.15**	-.67**	-.26**	.16**	-.21**	.03	-.12**
SBP	-.08**	-.06*	-	.42**	-.02	.02	.06*	-.11**	-.17**	-.03
DBP	-.17**	-.15**	.42**	-	.12**	.07**	.02	-.02	-.09**	.09**
%BF	-.67**	-.67**	-.02	.12**	-	.47**	-.14**	.19**	.02	.04
WC	-.41**	-.26**	.02	.07**	.47**	-	.04	.08	.02	.03
SAR	.10**	.16**	.06*	.02	-.14**	.04	-	-.34**	-.32**	-.07*
Sit-up	-.22**	-.21**	-.11**	-.02	.19**	.08**	-.34**	-	.47**	.13**
SBJ	.01	.03	-.17**	-.09**	.02	.02	-.32**	.47**	-	.06*
Predicted VO_2 max.	-.17**	-.12**	-.03	.09**	.04	.03	-.07*	.13**	.06*	-

Total METs= total metabolic equivalents; BMI=body mass index; SBP= systolic blood pressure; DBP= diastolic blood pressure; %BF= percentage body fat; WC=waist circumference; SAR=sit and reach; SUP=sit-ups SBJ=standing broad jump; Predicted VO_2max= predicted maximum oxygen consumption; Total METs= total metabolic equivalents

***. Correlation is significant at the 0.01 level (2-tailed).*

**. Correlation is significant at the 0.05 level (2-tailed).*

With regards to the hemodynamic variables, SBP correlated positively only with DBP (.42); WC (0.02) and SAR (.06) but was negatively related with total METs (-.8); BMI (-.06); %BF (-.02); SUP (-.11); SBJ (-.17) and predicted VO_2max (-.03; $p<0.1$); ($p<0.05$). Whereas DBP positively correlated with SBP (.42); %BF (.12); WC (.07); SAR (.02) and predicted VO_2max (.09), it negatively associated with total METs (-.17); BMI (-.15); SUP (-.02) and SBJ (-.09; $p<0.01$) ($p<0.05$). %BF positively associated with DBP (.12); WC (.47); SUP (.19); SBJ (.02) and predicted VO_2max (.04; $p<0.01$), but had negative correlation with total METs (-.67); BMI (-.67); and SAR (-.14; $p<0.05$). Except for total METs (-.41) and BMI (-.26; $p<0.05$), WC associated positively with all other variables, including SBP (.02); DBP(.07); %BF (.47); SAR (.04); SUP (.08); SBJ (.02) and predicted VO_2max (.03). Only %BF yielded substantial correlation ($p<0.01$).

Concerning the physical fitness parameters, SAR correlated positively with total METs (.10); BMI (.16; $p<0.05$); SBP (.06); DBP and WC (.02; $p>0.05$), but negatively with %BF (-.14); SUP (-.34); SBJ (-.32) and predicted VO_2max (-.07; $p<0.05$). SUP interrelated positively with %BF (.19); WC (.08); SBJ (.47) and predicted VO_2max (.13; $p<0.01$), but associated negatively with total METs (-.22); BMI (-.21); SBP (-.11); DBP (.-02; $p>0.05$); and SAR (-.34; $p<0.05$). SBJ positively correlated with total METs (.01); BMI (.03); %BF (.02); WC (.02); SUP (.47; $p<0.01$) and predicted VO_2max (.06; $p<05$), though negative correlation was observed with regards to SBP (-.17); DBP (-.09) and SAR (-.32; $p<0.05$). Predicted aerobic capacity positively correlated with DBP (.09; $p<0.05$); %BF (.04); WC (.03) and SUP (.13; $p<01$), however, it negatively associated with total METs (-.17); BMI (-.12); SAR (-.07; $p<0.5$) and SBP (-.03).

Discussion

The gender-related differences in body weight found in this study have been widely reported on South African [24-25, 34-35] and Portuguese [36] children. In a study conducted among school children in Mankweng and Toronto-Limpopo province, South Africa [27] it was found that 11.0% of the girls were overweight as compared with 9.1% of the boys. In contrast, our findings indicated that only 2.1% of the combined sample of MP and LP boys, but none of the girls, were overweight. Similar to the study conducted by [26], body fatness assessed by excessively high measures of %BF and WC rather than BMI, was more prevalent in girls than boys in the present study. Surprisingly, the results do not mimic the data on the children's BMI classification which indicated that more boys than girls in the combined samples were obese. This seeming contradiction supports the need to consider appropriate definitions and cut-off points for evaluation of obesity and body weight disorders in various population groups [37]. The findings of the present study also demonstrated high prevalence of underweight among the children. Recent studies on South African children have reported the co-existence of underweight and obesity in rural population groups undergoing nutrition transition [28, 37-38].

The present results which demonstrated that girls had a higher %BF and WC compared with boys suggest that girls are more at risk of being overweight and obese. This finding could be partly explained in the light of the fact that girls experience profound body composition changes at adolescence, due to the stimulation of their sex hormones and development of their reproductive organs that are often associated with biological maturation [8]. Although nutritional intake was not assessed in this study, it should not be ignored as a possible explanation for the gender-related disparities in body composition and PA found among the children.

The present study also examined the relationship between PA and risk factors of body weight disorders among the South African children. Using the IPAQ data, our findings showed that the boys (1286.72±317.47METs) had higher levels of PA than girls (397.28±30.14METs). While these results are not surprising, they contradict the data obtained for SUP, SBJ and aerobic capacity in which the girls had superior performances. When analysed in the context of rural environment, culture and traditions, it is expected that girls are limited indoors to partake in household chores in contrast to the boys who are often assigned physically demanding tasks like farming, cattle rearing and in some instances, hunting. In addition, the gendered role being performed by boys and girls could influence their nutritional intake and physical activity levels. This cultural analysis regarding role prescription in a rural African community is probably applicable to the cohort of children in this study.

The results of the present study are consistent with those of other studies [39-42] in which blood pressure was found to be positively correlated with stature, body mass, BMI, %BF and WC. Therefore, the present results showed a tendency for children with relatively high body composition measures to develop the propensity for elevated BP in future. These findings highlight the need for routine measurement of BP as part of physical examination in school children. In view of the fact that the relationship between PA and risk factors of body weight disorders in children is mediated by a multiplicity of factors such as growth and development, genetics, socio-cultural and environmental influences and dietary habits, it was not feasible to control the effects of these factors in this study.

The findings on physical performance variables indicated that the boys (40.47±7.09cm) were more flexible than the girls (39.77±6.49cm). The results contradict those reported in other studies [27, 33, 43] in which girls were found to perform better in the SAR test. However, this finding is consistent with those of studies involving Nigerian [43] and South African [26] children. The gender differences in the children's trunk and hamstring flexibility may be attributed to the girls' relatively high WC which could limit their performances in the flexibility test. Furthermore, ages 9 to 13 could be termed as pre-pubertal stage of life when many children, especially girls, typically have difficulties to perform the SAR test [44].

Limitations

The results of this study should be interpreted cautiously based on a number of limitations. Firstly, since the study sample was drawn from children and adolescents in two provinces only, it is not representative of school children in South Africa as a whole and therefore, cannot be generalised in this context. Secondly, certain socio-cultural beliefs, values and practices do apply in some rural South African communities whereby female children are discouraged from being physically active- a feature believed unfeminine, in preference to performing household chores. However, the socio-cultural factors were not assessed as they were beyond the scope of this study. Thirdly, it is possible that the boys overestimated their PA involvement in completing the IPAQ, which may explain the discrepant findings concerning the girls' superior performances in certain strength-related fitness tests. The above short-comings notwithstanding, the strength of this study lies in the fact that it was conducted using a fairly large sample of rural school children from two provinces, which could provide valuable baseline information that can form the bases of future studies on the relationship between body composition PA and health risk in children.

Conclusions and recommendations

This study assessed the relationship between PA and risk factors of weight disorders among primary school children in Limpopo and Mpumalanga provinces of South Africa. Since too much or too little percentage body fat is detrimental to health, low percentage of body fat can adversely affect metabolism and may indicate the presence of disease such as underweight physical inactivity and in some cases, overweight and obesity. The study demonstrates that underweight is prevalent among the sampled children, thus confirming the notion of co-existence of obesity with underweight in the country. In addition, the positive correlation of body composition with %BF and WC found in the study indicates possible future development of elevated BP. Also, gender difference regarding PA seem to suggest the prevalence of physical inactivity among the children, more especially girls which may consequently lead to sedentariness- a habit known to be associated with health risks. Granted that South Africa has an escalating level of obesity which may impact negatively on public health promotion in the country, greater attention should be given to aspects of body composition, PA and physical fitness components among children, so that findings could inform development of public health policy and practice.

More research should be done to evaluate the fitness and cardiovascular disease risk factors among children and adolescents since they are indicators of future adult disease patterns. In this regard, intervention measures should be devised to address the rising trend of overweight and obesity in children and adolescents as that would stem the prevalence of associated body weight disorders and health risks. Although a physically active lifestyle along with healthy eating habits in children and adolescents are feasible healthy options, the relationship between PA and risk factors of weight disorders among school children could also be confounded by growth and development factors. More research is therefore needed to evaluate the fitness and health risk factors among South African children and adolescents with a view to elucidating the influences of nutritional and biological factors.

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Conflict of interest
We have no conflicts of interests in this study.

Disclaimer
Any opinion, findings and conclusions or recommendations expressed in this material are those of the author(s), and therefore the NRF do not accept any liability in this regard.

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