Body mass index, overweight, and blood pressure among adolescent schoolchildren in Limpopo province, South Africa

Índice de massa corpórea, sobrepeso e pressão arterial em escolares na província de Limpopo, África do Sul

Índice de masa corporal, sobrepeso y presión arterial en adolescentes de la província de limpopo, sudáfrica

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ABSTRACT

Objective: To evaluate the relationship between body mass index, overweight, and blood pressure among South African rural children and adolescents.

Methods: The sample involved 1,172 schoolchildren (541 boys and 631 girls) aged 10 to 16 years. Stature, body mass, and skinfolds were measured using standard procedures. Overweight was defined by body mass index for gender and age. Blood pressure was monitored in each child three times using validated electronic devices (Omron HEM-705 CP, Device, Tokyo, Japan). Hypertension was determined as the average of three separate blood pressure readings, in which the systolic or diastolic blood pressure was ≥90th percentile for age and sex. Descriptive statistics were calculated for all variables.

Results: The prevalence of overweight was 5.5% for boys and 4.4% for girls. The children who had systolic blood pressure >90th percentile ranged from 2.3 to 5.9%. The likelihood of hypertension development among children is noticeable at age 10 for both boys and girls (0.2 and 0.1%, respectively), and ranged from 0.2 to 1.7% for boys and 0.1 to 1.2% for girls. Collectively, the prevalence of hypertension was 4.1 and 2.8% for boys and girls, respectively. Blood pressure correlated positively with stature, body mass, body mass index, body fat, and sum of skinfolds (p<0.001).

Conclusions: Blood pressure increased with age in both genders. The routine measurement of blood pressure, as part of physical examinations of schoolchildren, is crucial for early prevention and intervention programs.

Key-words: overweight; body mass index; subcutaneous fat; blood pressure; South Africa.

RESUMO

Objetivo: Avaliar a relação entre índice de massa corporal, sobrepeso e pressão arterial em crianças e adolescentes da área rural da África do Sul.

Métodos: A amostra abrangeu 1.172 escolares (541 meninos e 631 meninas) com idades entre 10 e 16 anos. Estatura, massa corporal e dobras cutâneas foram medidas por meio de procedimentos padrão. O sobrepeso foi definido pelo índice de massa corporal para idade e sexo. A pressão arterial foi monitorada três vezes em cada criança com o uso de aparelhos eletrônicos validados (Omron HEM-705 CP, Omron, Tóquio, Japão). A hipertensão foi determinada como a média de três leituras da pressão arterial, em que a sistólica ou a diastólica foi igual ou acima do percentil 90 para idade e sexo. Estatísticas descritivas foram calculadas para todas as variáveis.

Resultados: A prevalência de sobrepeso foi de 5,5% para meninos e 4,4% para meninas. A taxa de crianças com pressão arterial acima do percentil 90 variou de 2,3 a 5,9%. A probabilidade do desenvolvimento de hipertensão em crianças é perceptível aos dez anos, tanto para os meninos (0,2%) quanto para as meninas (0,1%), e oscilou de 0,2 a 1,7% para o sexo masculino e de 0,1 a 1,2% para o feminino. Considerando-se a amostra total, a prevalência de hipertensão foi de 4,1% para os meninos e 2,8% para as meninas. A pressão arterial apresentou

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correlação positiva com estatura, massa corporal, índice de massa corporal, gordura corpórea e soma das dobras cutâneas ($p<0,001$).

Conclusões: A pressão arterial aumentou com a idade tanto para os meninos quanto para as meninas. A medição da pressão arterial de rotina, como parte do exame físico em escolares, é crucial para fins de prevenção e medidas de intervenção precoces.

Palavras-chave: sobrepeso; índice de massa corpórea; gordura subcutânea; pressão arterial; África do Sul.

RESUMEN

Objetivo: Este estudio evalúa la relación entre índice de masa corporal, sobrepeso y presión arterial en adolescentes rurales sudafricanos.

Métodos: La muestra incluyó a 1.172 niños de 10-16 años de edad (541 del sexo masculino y 631 del sexo femenino). La estatura, la masa corporal y los pliegues cutáneos se midieron utilizando procedimientos estándares. El sobrepeso se definió según el índice de masa corporal para sexo y edad. Se monitorizó la presión arterial por tres veces en cada niño utilizando aparatos electrónicos validados (Omron HEM-705 CP, Omron, Tokio, Japón). Se determinó la hipertensión cuando los promedios de la presión sistólica o diastólica, calculados con base en las tres mediciones de presión arterial, fueron ≥percentil 90 para edad y sexo. Se calcularon estadísticas descriptivas para todas las variables.

Resultados: La prevalencia de sobrepeso fue del 5,5% en los niños y 4,4% en las niñas. El porcentaje de adolescentes con presión arterial sistólica >percentil 90 osciló entre el 2,3 y el 5,9%. La probabilidad de desarrollo de hipertensión entre los jóvenes fue notable a los 10 años tanto en los niños como en las niñas (0,2 y 0,1%, respectivamente) y osciló entre el 0,2 y el 1,7% en los niños y entre el 0,1 y el 1,2% en las niñas. Colectivamente, la prevalencia de hipertensión fue del 4,1 y el 2,8% en niños y niñas, respectivamente. La presión arterial estuvo positivamente correlacionada con estatura, masa corporal, índice de masa corporal, grasa corporal y suma de pliegues cutáneos (p=0,00).

Conclusiones: La presión arterial se elevó con la edad tanto en los niños como en las niñas, y estuvo positivamente correlacionada con estatura, masa corporal, índice de masa corporal, grasa corporal y suma de pliegues cutáneos. La medición de rutina de la presión arterial como parte del examen físico de escolares es crucial para la prevención precoz y la implementación de programas de intervención.

Palabras clave: Sobrepeso; índice de masa corporal; grasa subcutánea; presión arterial; Sudáfrica.

Introduction

Adolescent obesity is on the rise and is associated with adverse health effects. Excessive body weight, including overweight and obesity, together with hypertension, represents major threats to civilization in the 21st Century[1]. Recent data from the US suggest that the level of blood pressure (BP) and the incidence of hypertension in children and adolescents is rising[2]. Global prevalence of hypertension in children stands at 1-3%[3]. The increased prevalence of hypertension in school-aged children may possibly be attributed to the rising prevalence of overweight individuals. The BP may also be affected by other factors including age, exercise, and emotions[4]. However, the impact of weight gain on BP is neither consistent across age groups, nor is it the same between men and women[5].

Several International multi-centre studies, e.g. the advanced data from vital and health statistics study[6], the CASPIAN study[7], and other researchers[1,8-14] have shown a positive relationship between overweight, obesity, unhealthy lipid profiles, high insulin levels, and hypertension in both children and adolescents. In South Africa studies conducted on Ellisras[15] and Tshannda[16] rural school children in Limpopo province have also reported an increasing prevalence of risk factors in metabolic and cardiovascular diseases (CVDs) among children. The Bradshaw and Steyn[17] study reported CVDs to be one of the top ten leading causes of death in South Africa. Because high BP in children is a predictor of adult BP levels[18], identifying children and adolescents who are at increased risk of developing essential hypertension as adults[19] is important. Such findings will thus inform public policy and perhaps become an impetus to design and implement appropriate intervention strategies. Hence, the purpose of this study was to evaluate the relationship between body mass index, overweight, and BP among South African rural adolescents in Limpopo province of South Africa.

Methods

The sample size included a total of 1,172 school children (541 boys and 631 girls) aged 10-16 years, residing at the Mankweng and Toronto settlements. Both settlements are under the auspices of the Capricorn district of Limpopo province. The participants were selected from seven schools in the Capricorn district. It was not feasible to get a representative sample, for the study sample was based upon the cooperation and willingness of the targeted schools to participate in the research. Capricorn district was chosen because many schools in the area granted permission for the data to be collected. Further, it was more feasible to conduct the research in schools in the Capricom District with the assistance of trained field workers who were also nursing and kinesiology students at the University of Limpopo which is situated in the district. It was also more appropriate to collect the data in this same district because the schools were in a rural location and the pupils have similar socio-economic backgrounds. The population relies mainly on subsistence farming and very meagre financial support from the males of the families who work as migrant labourers in the mining sectors in the South and Gauteng. The home language of 52.1% of the provincial population is Sepedi, 22.4% of the population speak Xitsonga, while 15.8% speak Tshivenda. These three tribes constitute the major tribal population in the province. Most of these tribes live in remote areas and are characterized by poverty, illiteracy, and nutritional problems.

A multi-stage stratified sampling method was used in the study including a random sampling technique of the primary schools within the district. To select a sample, the schools in the two circuits (i.e. Mankweng and Toronto), were numbered serially based upon the school register and depending upon the pupil population density (only schools with more than 700 pupils were included in the sampling procedure). Four schools were subsequently chosen at random from each of the circuits. However, a school in the Toronto circuit declined to participate in the study and was therefore excluded. In each school, the classes were listed numerically (e.g. grades 5A, 5B, 5C, etc.) and a simple ballot system was used to select four classes whose pupils were eventually assessed. Also, using official class registration lists, a stratified random sample of children was drawn from each class according to their age and gender. Specifically, those who were aged 10-16 years, had no disability, and was not suffering from any serious ailment that could impair anthropometric or physical fitness testing were measured. Also, only children who were present on the day of measurement were included.

The Central Higher Degrees Committee of Tshwane University of Technology, Pretoria, South Africa, and other relevant provincial regulatory authorities (namely the Department of Education (DoE), Limpopo office, and the DoE, district office, Capricorn), granted ethics approval for the research to be carried out. Information leaflets and informed consent forms were administered to the head teachers, pupils, and their parents or guardians who consented that the study go forward. In addition, children who were minors were briefed on the nature and procedures of the study and were asked for their consent to participate in the study

Eight trained research assistants, post-graduate students in the Department of Nursing and School of Education (Kinesiology Unit), University of Limpopo, participated in the data collection. A specialized training workshop was conducted for the research assistants by the researchers to enable them to competently measure the dependent variables in the study. At this workshop, each assistant was trained to perform a specific task – a measurement procedure at a designated work station (e.g. anthropometric measurement). Each work station had a team leader who coordinated prescribed data collection procedures. The data were collected from March to April of 2010. Before data collection commenced, the pupils filled out the demographic section of the data form indicating their age and gender.

Resting blood pressure (RBP) was measured three times at five minutes intervals using an Electronic Blood Pressure Monitor (Omron HEM-705 CP Device, Tokyo, Japan) according to standardized guidelines[20]. The children were seated with the arm cuff and zero indicators on the monitor at the level of the examiner's eye. All the readings were taken in duplicate on the right arm. Appropriate cuff sizes were used with the cuff width approximately 40% of mid arm circumference. In this position the cuff bladder covers 80 to 100% of the arm circumference at approximately two thirds of the length of the upper arm without overlapping. The procedure was explained to the participants before the measurement and the cuff inflated and deflated once. The first BP measure was not used in data analysis. The readings at the first and third BP monitors were taken as systolic and diastolic BP (SBP and DBP), respectively. The average of the two BP measurements were recorded and included in the statistical analysis. Hypertension was determined as the average of three separate BP readings where the SBP or DBP was ≥90th percentile for age and sex[21]. From the BP measurements, the mean arterial pressure (MAP) was derived using the formula: $MAP = DBP + \frac{1}{3}(SBP - DBP)$[22].

Height and body weight were measured according to the protocol of the International Society for the Advancement of Kinanthropometry (ISAK)[23]. Height was measured to the nearest 0.1 centimetres (cm) in bare feet with participants standing upright against a mounted stadiometer. Weight was measured to the nearest 0.1 kilogram (kg) with participants lightly dressed (underwear and T-shirt) using a portable digital scale (Tanita HD 309, Creative Products, MI, USA). The body mass index (BMI) was calculated from weight in kilograms height^{-2} (kg m^{-2}). A Harpenden (John Bull) calliper with inter-jaw pressure of 10g/mm^2 was used to measure skinfolds (subscapular and triceps) to the last 0.2mm. The calculation of the percentage of body fat (%BF) was based on the sum of the triceps and subscapular skinfolds (ΣTS) using the equation of Slaughter *et al*[24]. This equation is internationally accepted for use with children from various ethnic groups. For boys (all ages) %BF=1.2 (ΣTS) - 0.008 $(ΣTS)^2$ - 3.2. For girls (all ages) %BF=1.33 (ΣTS) - 0.013 $(ΣTS)^2$ - 2.5; where ΣTS is the sum of triceps and subscapular skinfolds.

Data were analyzed using descriptive statistics. The parametric t-test was applied to test significance levels at $p<0.05$ between sexes, while the F-test was used to test the significance level of the variables across the five age groups. Pearson's correlation test was used to investigate the relationship between the anthropometric measurements and BP among the children. The Statistical Package for the Social Sciences (SPSS) was used for the analyses. The statistical significance was set at $p<0.05$.

Results

Hemodynamic and anthropometric data were collected from 541 boys (48.2 %) and 631 (51.8 %) girls. The mean age of the participants was 12.3±1.2 years. Except for SBP, DBP, MBP, and pulse rate, all other anthropometric and hemodynamic variables were significantly different in both sexes, with the girls having significantly higher mean values for body mass, stature, triceps, subscapular, and resting heart rate (RHR) compared to the boys (Table 1).

Both SBP and DBP increased with age in both sexes (Table 2). For both, there was no significant difference ($p≥0.05$) in the means of those aged 10–13 years compared to the 14–16 year olds. The mean values of SBP and DBP were significant ($p≤0.05$) only at ages 14–16 years. Mean arterial blood pressure (MAP) was 75.3±33.0mmHg for boys and 75.5±31.2mmHg for girls. In this regard, there was no significant difference in RHR between boys and girls. Similarly, there was no age difference regarding the MAP of both sexes (Table 2).

Shown in Figure 1 are the proportions of the children with SBP and DBP >90th percentile used to define hypertension in this category. The proportion of children in the >90th percentile increased with age. The children had SBP >90th percentile range from 2.3 to 5.9%.

Although SBP and DBP pressures did not significantly correlate with age ($p>0.05$), statistically significant ($p<0.05$) positive correlations were observed with stature, body mass, BMI and body fat (Table 3). Shown in Table 4[25] is the distribution of the prevalence of hypertension and the prevalence of overweight among the children according to sex and age. The prevalence of hypertension ranged from 0.2–1.7% to 0.1–1.2% in boys and girls, respectively. In both sexes, children at risk of overweight increases with age, peaking at age 12, with a decline thereafter. The percentage of children who were overweight were higher in boys (5.5%) compared with the girls (4.4%).

Discussion

The present study examined the relationship between BMI, overweight, and BP among adolescents attending schools in Limpopo, South Africa. High BP is a serious cardiovascular risk factor. It is also associated with lesions of target organs[26-29]. The incidence of hypertension among our sample was 4.1 and 2.8% in boys and girls, respectively. The values vary among the ages, the highest being 1.2 and 1.7% in boys at the ages of 13 and 14–16 years, respectively. The prevalence of hypertension found

Table 1 - Anthropometric and hemodynamic measurements of the participants according to gender

	Boys (n=541)	Girls (n=631)	Total (n=1172)	*p*-value
	Mean±SD	Mean±SD	Mean±SD	
Age (years)	12.5±1.3	12.2±1.2	12.3±1.2	0.452
Stature (cm)	140.5±13.6	143.2±12.2	141.9±12.9	0.001
Body mass (kg)	40.5±9.9	43.6±10.8	42.1±0.5	0.001
Triceps (mm)	10.7±7.1	14.5±7.4	12.7±7.5	0.001
Subscapular (mm)	7.6±5.7	10.3±6.1	9.1±6.1	0.001
Body mass index (kg/m²)	20.7±5.2	21.3±5.2	21.1±5.3	0.052
Sum of skinfold (mm)	18.2±12.6	24.8±13.2	21.8±13.4	0.001
Body fat (%)	14.9±7.9	20.4±6.4	17.9±7.7	0.001
SBP (mmHg)	113.0±34.1	114±31.4	113.0±32.7	0.448
DBP (mmHg)	71.5±34.3	71.0±33.1	71.2±33.6	0.809
Resting heart rate	83.1±48.5	88.7±42.8	86.1±45.5	0.037
Mean arterial blood pressure	85.3±33.0	85.5±31.2	85.4±32.0	0.929
Pulse rate	41.6±19.5	43.5±19.7	42.6±19.6	0.094

SD: standard deviation; SBP: systolic blood pressure; DBP: diastolic blood pressure in this study varies with other studies reported in the literature, with one study reporting lower values[29], others almost similar values[13,30], while a majority of the studies had disproportionately higher prevalence rates of hypertension (Table 5).[1,12,13,27-37]

The likely reasons for the difference between the prevalence of hypertension in this study and those reported in the literature might be the use of different age groups, differing research methods and definitions of BP, as well as differences in reported prevalence and risk estimates. It is possible too, that geographical location may account for the difference in distribution of BP. It has been reported that regional difference exists in the BP among paediatric and adult populations from various geographic areas of the world – India, US, China, and Nigeria[11,38-42]. However, the high prevalence of hypertension in boys compared with girls might not be unconnected with the social and cultural lifestyle of females (in general) who are expected to stay at home and carry out household chores. This then calls for a greater interest and concerted effort in the investigation of early risk factor development and their health - related outcomes[16], especially in children and adolescents.

The prevalence of hypertension among the adolescents in this present study was 3.5%, and was consistent with the findings of other studies indicating that BP increases with age[11,36]. The implication of this observation is disturbing, granted that children who are obese are at greater risk for high BP at adulthood and the possibility of developing CVDs later in life. The onset of these diseases affects mostly the vital organs of the body (heart, brain, and kidneys), leading to mortality with the primary cause being heart attack, heart failure, stroke, and others[43]. Therefore, there is a need to identify and prevent high BP as soon in life as

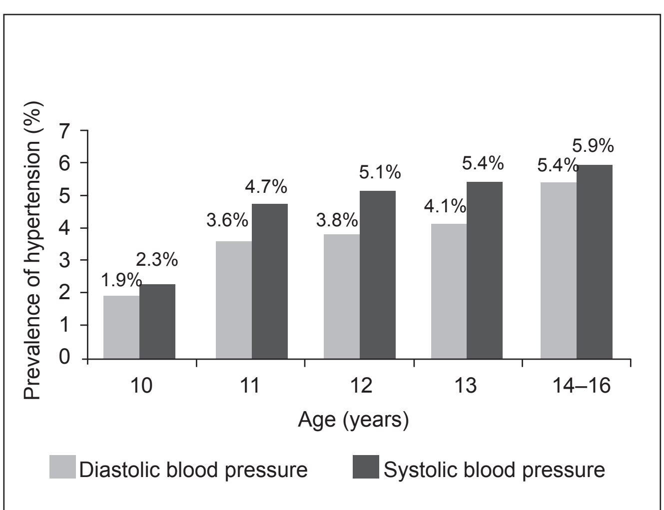

Figure 1 - Prevalence of hypertension >90th percentile among the children

Table 2 - Systolic, diastolic and mean arterial blood pressure of South African boys and girls according to age groups

Age (years)	Boys (n)	Girls (n)	Systolic blood pressure (mmHg)			Diastolic blood pressure (mmHg)			Mean arterial blood pressure (mmHg)		
			Boys (Mean±SD)	Girls (Mean±SD)	*p*-value	Boys (Mean±SD)	Girls (Mean±SD)	*p*-value	Boys (Mean±SD)	Girls (Mean±SD)	*p*-value
10	26	42	105.2±32.2	103.6±30.3	0.280	62.8±29.8	61.1±30.2	0.826	73.6±27.6	75.3±28.7	0.810
11	110	147	109.6±34.3	108.4±32.6	0.311	63.4±38.1	63.2±39.8	0.971	76.2±37.4	76.8±38.6	0.908
12	150	162	112.0±38.8	113.1±38.8	0.678	69.1±33.1	62.0±36.2	0.451	72.6±32.4	75.8±32.9	0.378
13	133	194	119.6±28.9	116.0±29.0	0.453	70.8±32.3	70.6±30.0	0.957	75.0±30.2	75.7±28.7	0.838
14-16	122	86	127.3±19.6	120.7±18.4	0.021*	73.3±35.6	71.1±20.2	0.003*	78.6±33.7	72.3±18.1	0.114

SD: standard deviation; *Statistically significant ($p \leq 0.05$)

Table 3 - Relationship of systolic and diastolic blood pressure with age, stature, body mass, body mass index and body fat in Pearson correlation analysis

Variables	SBP (mm Hg)		DBP (mm Hg)	
	r	*p*-value	r	*p*-value
Age (years)	0.19	0.06	0.22	0.25
Stature (cm)	0.50	0.00	0.45	0.04
Body mass (kg)	0.49	0.00	0.46	0.00
BMI (kg/m^2)	0.40	0.00	0.47	0.03
Body fat (%)	0.57	0.00	0.53	0.00
Sum of skinfolds (mm)	0.55	0.00	0.51	0.00

BMI: body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure; r: linear correlation

possible. The increasing trend of high BP among adolescents in a rural environment also points to a change in lifestyle that has been implicated in the causation of the increasing prevalence of hypertension in sub-Saharan African cities, and that may also be creeping into the non-urban areas[11]. This trend calls for a modification of lifestyle from birth to adulthood. Adopting a healthy diet, lower salt intake, and partaking in physical activity would help to maintain normal BP values in both children and adolescents. As postulated by Halpern[5], measures of lifestyle change should always be implemented as early as possible, as it is easier for children to change life habits than adults. A controlled consumption of salt from the early months of life, fighting excess weight from the first year of life, and always encouraging the practice of physical activity in children and

Table 4 - Prevalence of hypertension and overweight among South African children according to age and gender

Age (years)	Gender		Hypertension		Overweight	
	Boys	Girls	Boys	Girls	Boys	Girls
	n	n	%	%	%	%
10	26	42	0.2	0.1	7.7	4.8
11	110	147	0.4	0.2	8.2	6.8
12	150	162	0.6	0.5	7.3	5.6
13	133	194	1.2	0.8	2.3	2.1
14–16	122	86	1.7	1.2	4.1	3.5
Total	541	631	4.1	2.8	5.5	4.4

Hipertension: The average SDP and DPB ≥90th percentile for age and sex; Overweight: Internationally recommended body mass index cut-off points in children[25]

Table 5 - Prevalence of hypertension in literature compare with the present study

Country	Sample age	Prevalence (%)	Reference
India	5–16	18.2	Itagi *et al*[1]
Turkey	14–18	4.4	Nur *et al*[12]
Mexico	12–15	3.9	Sanchez-Zamorano *et al*[13]
Germany	4–18	2.9	Kilmm *et al*[27]
Argentina	4–18	3.4	Lodolo *et al*[28]
Brazil	6–18	6.9	Simonatto *et al*[29]
Papua New Guinea	8–16	5.1	Ampofo *et al*[30]
South Africa	6–13	7.5	Makgae *et al*[31]
South Africa	6–13	0−5.8 (boys)	Monyeki *et al*[32]
		3.1−11.5 (girls)	
Tunisia	15–19	5.2	Aounalian-Skhiri *et al*[33]
South Africa	10–15	17.2	Schutte *et al*[34]
New Delhi	14–25	20.0 (boys)	Misra *et al*[35]
		13.2 (girls)	
Eritrea	15–24	7.7 (boys)	Mufunda *et al*[36]
		2.9 (girls)	
United States	14–19	9.9	Triano *et al*[37]
South Africa	10–16	3.5	Presente estudo

adolescents (combined with healthy eating habits[5] are feasible healthy options.

Consistent with other studies[11-13,36], the present research demonstrated a significant (p=0.001) positive correlation of BP with stature, body mass, BMI, body fat, and sum of skinfolds. A direct correlation between body mass and BP has been documented at five years of age[44], and it was reported that BP increases with body mass[45], thus implying some physiological relationships between these dependent measures.

The MAP is an indication of the rate of perfusion of blood through the arteries and veins to the organs. Normal values range from 70–110mmHg. A lower MAP is indicative of ischemia[22]. Regardless of age and gender the mean MAP values for the children in our study were within normal limits.

However, significant differences were found in the resting HR values among the older boys and girls (i.e. 13–16 year-olds) with the girls having consistently higher values. This suggests that the boys were more fit than the girls in that age category. Similar RHR values have been reported for South African[46] and Nigerian[47] children of comparable age.

The results of this research should be interpreted bearing in mind the limitations of the study. It is appropriate to assume that the sampled population represents the adolescent children in Mankeng and Toronto, but is not reflective of province or national level. In this regard, and given the area and size of the sample, the generalisation of the study's findings must be viewed with caution. BP were measured only at one visit, at difference with the National High Blood Pressure Education Program (NHBPEP) criteria that require BP to be measured at least on three occasions. This disparity could have affected the estimate of the hypertension prevalence in the sampled children. In our analysis, however, BP was mainly considered as a continuous variable thereby minimizing misclassification problems. Additionally, salt intake and urinary sodium excretion of the participants were not assessed, nor were the birth weights of the children taken in to consideration as most of them were born in rural hospitals or clinics where accurate records are hardly kept. Again, if we consider the socio-economical circumstances and the environmental risks these children are exposed to during childhood (and even before birth), which could be included in the analysis as risk factors, they also may have contributed to the results obtained in the estimate of the children's BP[48]. However, the role of these confounding variables was not part of our investigation. Therefore, the data should be interpreted with caution. For example, it would have been interesting to examine the association between nutrition, physical activity, and the other risk factors as well as the ability of these variables to predict the prevalence of hypertension among older children (i.e. 14–16 years of age). Also, it should be noted that this age range, that of childhood, marks the period in which significant biological changes occur. However, in view of the sensitivity of assessing biological maturation in the South African context, it was not feasible to evaluate the children's maturation status using standard indices, such as Tanner's.

In conclusion, BP increased with age among the boys and girls in our study, and this is positively correlated with stature, body mass, BMI, body fat and the sum of skinfolds. Boys were more predisposed to hypertension than girls, particularly at 11 and 12 years of age. These findings highlight the need for routine measurement of BP as part of periodic physical examinations in school children. More research should be done to evaluate the fitness among children and adolescents as well as CVDs risk factors since these are indicators of disease patterns in adulthood. In this regard, intervention measures should be instituted to address the rising trend of overweight and obesity in both children and adolescents. Such preventive measures would stem the prevalence of the associated disorders, including hypertension.

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