

Overweight, obesity and underweight in rural black South African children

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Abstract

Background: The objective was to estimate the prevalence of overweight, obesity and underweight conditions among rural black children in South Africa. A cross-sectional study was undertaken. The setting was Mankweng and Toronto, both rural settlements in Capricorn district, Limpopo province, South Africa.

Participants were 1 172 school children (541 boys and 631 girls) aged 10-16 years.

Method: The prevalence of overweight, obesity and underweight was examined, using the Centers for Disease Control and Prevention (CDC) body mass index (BMI) cut-off points. Height and body weight were measured using standard techniques. Results were analysed with student t-test statistics, with probability level set at p-value ≤ 0.05 .

Results: The percentage of children who were at risk of overweight were higher in girls (11%) than boys (9.1%), whereas obesity occurred more among the boys (5.5%), compared with the girls (4.4%). Applying the CDC cut-off points of 5th < percentile to define underweight, 25 (4.6%) and 35 (5.2%) of boys and girls respectively were underweight.

Conclusion: Similar to previous studies, this study indicates that overweight and obesity are high among South African children, even in rural settings. The study also demonstrates that underweight is prevalent among the sampled children. This supports the notion of a double burden of disease in developing countries.

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Introduction

A current estimate of childhood overweight and obesity showed that in 2010, 43 million children (35 million in developing countries) were overweight or obese, and 92 million were at risk of becoming overweight. Worldwide, the prevalence of childhood overweight and obesity increased from 4.2% in 1990, to 6.7% in 2010. It is projected that this trend would reach 9.1% or ≈ 60 million in 2020.¹

The estimated prevalence of childhood overweight and obesity in Africa in 2010 was 8.5%, and is expected to reach 12.7% in 2020.¹ In Africa,²⁻⁴ reported increasing rates of overweight and obesity of 17.1%-22.8%, among South African children, is expected.⁵

The consequences of childhood obesity are enormous, and include the subsequent development of chronic non-communicable diseases, psychological dysfunction, and excess adiposity in adulthood.^{6,7} Adolescence is a critical period for the onset of obesity,^{8,9} and for obesity-associated morbidity in later life.¹⁰ Therefore, it is important to study this condition, especially in children and

adolescents. However, most studies highlighting the prevalence of overweight and obesity among South African children and adolescents are limited to urban settings, and feature participants from privileged socio-economic backgrounds.^{2,3,11-13} Few studies have been conducted in South Africa on the prevalence of overweight and obesity, and focusing on black or adolescent children, in rural and underprivileged socio-economic settings. It is envisaged that findings from this study might inform public policy concerning the design of possible intervention strategies that could help to prevent and manage the surging prevalence of overweight and obesity in South African children.

There is no published data concerning the prevalence of overweight, obesity and underweight among rural school children in Mankweng and Toronto, Limpopo province. Therefore, this study aims to fill this research gap by examining the prevalence of overweight, obesity and underweight among rural South African adolescents aged 10-16 years, who attend primary and secondary schools in these regions.

Method

Sample size and sampling procedure

The sample size included a total of 1 172 rural black school children (541 boys and 631 girls) aged between 10-16 years, residing in Mankweng and Toronto settlements. The participants were selected from seven schools in the Capricorn district, which was purposively chosen from among other districts because many schools in the area granted permission for the data to be collected. It was also more feasible to conduct the research in schools in this district with the assistance of trained field workers, who were nursing and kinesiology students at the University of Limpopo, situated in the district. It was more appropriate to collect the data from the same district because the schools were in a rural location, and the pupils had a similar socio-economic background.

A multi-stage, stratified sampling method was used in the study. This included a random sampling technique used in 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 on the school register, and then, depending on the pupil population density (schools with over 700 pupils were included in the sampling procedure), four schools were subsequently randomly chosen 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. A simple ballot system was used to select four classes, whose pupils were eventually assessed. Using the official class registers, a stratified random sample of children was drawn from each class, according to their age category and gender. Specifically, those who were present at the time of data collection, and those aged 10-16 years were assessed. The participants' ages were verified from school register. A total of 1 335 children were selected to participate in the study. However, due to absenteeism and incomplete data on 163 participants, 1 172 participants (541 boys and 631 girls), eventually completed the tests, and their data used in the final statistical analysis.

Ethical clearance

The Central Higher Degrees Committee of Tshwane University of Technology, Pretoria, and other relevant provincial regulatory authorities, namely the Department of Education (DOE), Limpopo office; and DOE, district office Capricorn, granted ethics approval for the research to be carried out. An information leaflet and informed consent form were administered to the head teachers, pupils, and the parents and guardians who agreed to the study being carried out.

Measurement procedure

Eight trained research assistants, who were postgraduate students at the Department of Nursing, and School of Education (kinesiology unit), University of the Limpopo, participated in the data collection. The researchers conducted a specialised training workshop for the research assistants, to enable them to competently measure the dependent variables in the study. At the workshop, each assistant was trained to perform a specific task, e.g. measure the weights and heights of the participants, in order to control for measurement

variability and measurement procedure at a designated workstation, e.g. skinfold measurement. Each workstation was headed by a team leader, who coordinated prescribed data collection procedures. The study was carried out between March and April 2010.

Anthropometry

Height and body weight were measured according to the protocol of the International Society for the Advancement of Kinanthropometry.¹⁴ The height of barefoot participants was measured to the nearest 0.1 cm. Participants stood upright against a mounted stadiometer. A digital weighing scale, calibrated regularly to the nearest 0.1 kg (every 20 measurements), was used to measure the weight of lightly dressed (underwear and T-shirt) participants, using a portable digital scale (Tanita HD 309®, Creative Products, MI, USA). Body mass index (BMI) was calculated from weight in kilogrammes/height² (kg/m²).

The intra-observer reliability of anthropometric measurements was determined by examining technical error of measurement (TEM) and interclass correlation coefficient (r) (Pearson's method),¹⁵ based on data obtained from repeated measurements of a small sample of participants (n = 20). The interclass correlation coefficient was 0.97 and 0.98 for weight and height, respectively. The reliability coefficients fell within acceptable ranges when compared with those published in other research studies.¹⁶

Defining overweight, obesity and underweight

The CDC's BMI charts¹⁷ were used to classify the participants according to weight categories, i.e. underweight, overweight and obesity. Based on this, a BMI between 85th-95th percentiles for age and gender was considered at risk of overweight, and a BMI at, or above, the 95th percentile, was considered to be obese.¹⁸ Underweight was defined as a BMI lower than the fifth percentile for age and gender.

Data analysis

Means and standard deviations were calculated for body weight, height and BMI, across gender and age groups. Differences in the mean body weight, height, and BMI, were evaluated for boys and girls according to their age group, using independent t-test samples. All analyses were conducted with the Statistical Package for the Social Sciences® (SPSS), version 18.0 (SPSS, Chicago, IL, USA). The level of significance was set at p-value ≤ 0.05.

Results

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. All the anthropometric variables were significantly different in both genders, with the girls having significantly higher mean values for height and body weight, compared to the boys (Table I).

Girls were taller than boys by 2.4 cm, 4.8 cm, 4.4 cm, 3.3 cm and 1.7 cm for age groups 10, 11, 12, 13 and 14-16 years, respectively. Expectedly, height increased with age in both genders (Table II).

Girls weighed more than boys, by 0.5 kg, 2.8 kg, 3.6 kg, 4.6 kg and 5 kg for ages 10 to 14-16 years, respectively. Except at age 10 years, there was a significant difference in the mean values of body weight

Table I: Anthropometric measurements of the participants according to gender

Variable	Boys (n = 541)	Girls (n = 631)	Combined (n = 1 172)	p-value
	Mean ± SD ^a	Mean ± SD	Mean ± SD	
Age (years)	12.5 ± 1.3	12.2 ± 1.2	12.3 ± 1.2	0.452
Height (cm)	140.5 ± 13.6	143.2 ± 12.2	141.9 ± 12.9	0.001 ^b
Body weight (kg)	40.5 ± 9.9	43.6 ± 10.8	42.1 ± 10.5	0.001 ^b
Body mass index (kg/m ²)	20.7 ± 5.2	21.3 ± 5.2	21.1 ± 5.3	0.052 ^b

a = standard deviation, b = statistically significant (p-value ≤ 0.05)

Table II: Height of South African boys and girls, according to age groups

Age (years)	Boys	Girls	Height (kg)		p-value
			Boys (mean ± SD ^a)	Girls (mean ± SD)	
10	26	42	132.9 ± 8.0	135.3 ± 10.4	0.313
11	110	147	131.0 ± 12.9	135.8 ± 12.0	0.002 ^b
12	150	162	136.3 ± 12.4	140.7 ± 11.9	0.002 ^b
13	133	194	145.2 ± 10.8	148.5 ± 9.0	0.003 ^b
14-16	122	86	150.6 ± 10.4	152.3 ± 8.1	0.199

a = standard deviation, b = statistically significant (p-value ≤ 0.05)

Table III: Body weight of South African boys and girls, according to age groups

Age (years)	Boys	Girls	Height (kg)		p-value
			Boys (mean ± SD ^a)	Girls (mean ± SD)	
10	26	42	35.4 ± 9.7	36.4 ± 9.1	0.803
11	110	147	35.6 ± 7.0	38.4 ± 11.1	0.021 ^b
12	150	162	38.5 ± 9.0	42.1 ± 9.3	0.001 ^b
13	133	194	42.0 ± 10.1	46.6 ± 9.6	0.001 ^b
14-16	122	86	46.7 ± 9.5	51.7 ± 8.9	0.001 ^b

a = standard deviation, b = statistically significant (p-value ≤ 0.05)

at 11 to 14-16 years. As expected, body weight increased with age in both boys and girls, with means ranging from 35.4 ± 9.7 kg to 46.7 ± 9.5 kg in boys, and 36.4 ± 9.1 kg to 51.7 ± 8.9 kg in girls (Table III).

The linear trend in body weight in boys and girls, according to age, is shown in Figure 1.

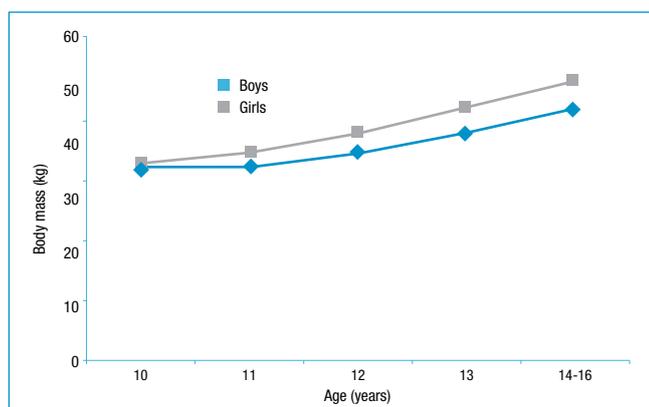


Figure 1: Age differences in body weight of rural black South African children

There was inconsistent variation in BMI across age and gender. While there were no significant gender differences in BMI at age groups 10, 11, and 12 years, girls at ages 13-16 years exhibited significantly higher mean BMI values compared to the boys (Table IV).

Table IV: Body mass index of South African boys and girls according to age groups

Age (years)	Boys	Girls	Body mass index (kg/m ²)		p-value
			Boys (mean ± SD ^a)	Girls (mean ± SD)	
10	26	42	20.4 ± 5.5	20.2 ± 6.6	0.908
11	110	147	21.3 ± 6.1	21.1 ± 7.0	0.781
12	150	162	21.1 ± 6.0	21.5 ± 4.9	0.517
13	133	194	20.0 ± 4.4	21.1 ± 4.1	0.013 ^b
14-16	122	86	20.7 ± 4.0	22.3 ± 3.8	0.002 ^b

a = standard deviation, b = statistically significant (p-value ≤ 0.05)

The Centers for Disease Control and Prevention (CDC) BMI-based cut-off points¹⁹ were used to screen for body weight disorders among the sample children. The prevalence of overweight, obesity and underweight among the children, according to gender and age, is shown in Table V.

Table V: Prevalence of obesity, overweight and underweight among the samples, according to age and gender

Age (years)	n	Centers for Disease Control and Prevention			
		Underweight n (%)	Normal n (%)	Overweight n (%)	Obesity n (%)
Boys					
10	26	1 (3.8)	21 (80.8)	2 (7.7)	2 (7.7)
11	110	6 (5.5)	80 (72.7)	15 (13.6)	9 (8.2)
12	150	11 (7.3)	110 (73.3)	18 (12.0)	11 (7.3)
13	133	6 (4.5)	117 (88.0)	7 (5.3)	3 (2.3)
14-16	122	1 (8)	109 (89.3)	7 (5.7)	5 (4.1)
Total	541	25 (4.6)	437 (80.8)	49 (9.1)	30 (5.5)
Girls					
10	42	6 (14.3)	30 (71.4)	4 (9.5)	2 (4.8)
11	147	11 (7.5)	114 (77.6)	12 (8.2)	10 (6.8)
12	162	7 (4.3)	122 (75.3)	24 (14.8)	9 (5.6)
13	194	9 (4.6)	159 (82.0)	22 (11.3)	4 (2.1)
14-16	86	0 (0.0)	76 (88.4)	7 (8.1)	3 (3.5)
Total	631	33 (5.2)	501 (79.4)	69 (11.0)	28 (4.4)

In both genders, the number of children at risk of overweight and obesity increased with age, peaking at age 12, and declined thereafter. The percentage of children who were at risk of overweight were higher in girls (11%) than boys (9.1%), whereas obesity occurred more among the boys (5.5%), compared with the girls (4.4%). Applying the CDC cut-off points of < 5th percentile to define underweight, the results showed that 25 (4.6%) and 35 (5.2%) boys and girls were underweight, respectively.

Discussion

Obesity is a growing health problem globally, and the World Health Organization (WHO) has emphasised the importance of monitoring the prevalence of overweight and obesity in different populations. In this study, the findings indicate that overweight and obesity among the children increased with age, peaking at age 12 years.

The present study also showed that the prevalence of obesity was lower in girls than boys, a finding that is consistent with previous studies,¹⁹⁻²¹ but contrasts with other studies who noted an opposite trend,²²⁻²⁵ or no relationship.²⁶

The proportion of children who were at risk of overweight was higher in girls (11%) than boys (9.1%), whereas obesity occurred more among the boys (5.5%), compared with the girls (4.4%). It may be possible that concerns about body image dissatisfaction and eating disorders, which are more characteristic of maturing girls than boys, and which are strengthened by media pressures that place strong emphasis on being thin,²⁷ are a reason for the lower incidence of obesity among the girls.

Nevertheless, the high prevalence of overweight and obesity among the sample is disturbing. A strong link between childhood obesity and cardiovascular diseases has been established,^{28,29} reinforces the likelihood that these obese children will grow up to be obese adults, at risk of acquiring hypertension, angina pectoris, non-insulin-dependent diabetes mellitus, and hypercholesterolaemia.¹⁹

The higher prevalence of overweight noted in our study (7.8%) is consistent with results reported in other regions of the country.^{3,13,30,31} This finding contradicts the expectation that the rural black children in this study should be fit, and consequently maintain a healthy body weight, as rural dwellers often carry out physically demanding tasks. There is increasing evidence that children and adolescents are overweight because of decreased physical activities, sedentary lifestyles, altered eating patterns, and increased dietary fat content.³² However, the present study did not evaluate dietary habits and physical activity, which could have facilitated further enquiry in this regard. The present findings appear to suggest that rural life does not necessarily encompass physically demanding tasks anymore,³³ and this may be a contributory factor to the higher incidence of obesity in rural areas. A review of research on rural-urban differences has shown that a higher prevalence of obesity in rural areas may be attributed to the lower socio-economic status of rural populations.³³ This assumption might hold true with regard to the sample in our study, as the latter was conducted in public schools. Most children who attend public schools in South Africa, especially those from rural areas, seem to originate from low socio-economic backgrounds.

Using the CDC cut-off points of <5th percentile to define underweight, 4.6% and 5.2% of boys and girls respectively, were underweight (Table V). By contrast, a study by Kiman-Murage et al,³⁴ on rural South African children, reported the prevalence of underweight to be significantly higher in boys, than in girls. What these findings suggest is that in our sample, overweight co-exists with underweight. The same observation has been noted in several other developing countries.^{26,34,35} Alongside malnutrition, such countries have to grapple with the burden of other diseases. Although no empirical data exist on nutritional intake and food practises in the rural regions of Mankweng and Toronto, the experience of one of the authors (VKM), who lived in the region for over 20 years, seems to suggest that poverty and lower levels of education of the children's parents, could

significantly impact on their dietary intake. Many of the children do not eat breakfast before attending school, and don't consume three full meals a day. Despite the anecdotal nature of this explanation, it should not be ignored as a possible explanation of nutritional intake among the children.

Given the adverse health,^{7,36-39} psychosocial,⁴⁰⁻⁴² and economic^{43,44} consequences of overweight and obesity, and that childhood obesity tracks to adulthood,^{7,13,40} developing strategies to prevent overweight and obesity among children should be a priority. This is particularly relevant to South Africa, which is undergoing socio-economic transformation, with increasing urbanisation,^{3,12,45} coupled with attendant lifestyle habits that tend to promote sedentariness and patronage of fast-foods restaurants, possible determinants of overweight and obesity among children and adolescents in this country.

The results of this study need to be interpreted with the understanding that the study is limited in several aspects. It is appropriate to assume that the sampled population represents the adolescent children in Mankweng and Toronto, but not reflective of the provincial, or national level. Given the area and size of the sample, care must be taken not to generalise this study's findings. The cross-sectional nature of the study limits inferences about causality and its direction. Pubertal status may have influenced stature and body mass, and subsequent BMI for age, but this was not assessed in the present study. Additionally, the cut-off points for CDC that were used to screen body weight disorders in this study, are derived based on an arbitrarily set BMI value, which reflects changes in BMI that occur with age in boys and girls. Although BMI is commonly used in estimating overweight and obesity, it does not indicate variations in fat and fat-free mass.²⁵ Nevertheless, BMI as a proxy measure of overweight or obesity during childhood, is a strong predictor of obesity and coronary heart disease risk factors in young adults,^{46,47} which emphasises the importance of our data from a preventive viewpoint.

The strength of this study is based on the fact that it was conducted using a fairly large sample of rural black schoolchildren. Therefore, this was an opportunity to collect information in an understudied region that can now be compared with results of previous studies carried out in South Africa, concerning childhood overweight and obesity,^{2-4,13} although with varying methodological and geographical settings.

Conclusion

Similar to previous studies,^{2-4,13} the research results of this study indicate a high prevalence of overweight and obesity among rural South African children. The study also demonstrates that underweight is prevalent among the sampled participants, confirming the notion of a "double burden of disease" in developing countries.

Intervention strategies are needed to curb the increasing prevalence of overweight, obesity, and underweight, among the children. As

such, there is need to promote healthy lifestyles through the mass media and within school settings. Parents should be educated on the need to monitor the eating habits of their children, and encourage participation in physical activities, both at school and at home.

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