

# The prevalence of underweight, overweight and obesity in a multiracial group of urban adolescent schoolchildren in the Cape Metropole area of Cape Town

Van Niekerk S-M,<sup>1</sup> PhD, Post-Doctoral Fellow; Grimmer K,<sup>1,2</sup> PhD, Professor Extraordinaire; Louw Q,<sup>1</sup> PhD, Professor  
<sup>1</sup>Physiotherapy Division, Faculty of Medicine and Health Sciences, Stellenbosch University

<sup>2</sup>International Centre for Allied Health Evidence (ICAHE)

Correspondence to: Sjan-Mari van Niekerk, e-mail: smvanniekerk@sun.ac.za

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## Abstract

**Objective:** The objective was to determine the prevalence of underweight, overweight and obesity in high school learners in the Cape Town area.

**Design:** A cross-sectional study was conducted.

**Setting:** High schools in the Cape Metropole Area of the Western Cape.

**Subjects:** A complex cluster sampling procedure was followed. Thirty-six students per school were selected from each randomly selected school. Thirteen- to 18-year-old pupils were eligible for inclusion.

**Outcome measures:** Height and weight measurements.

**Results:** The sample comprised 689 students. There were considerably more underweight adolescent boys than adolescent girls (17.3% boys to 9.9% girls), and double the frequency of overweight adolescent girls than adolescent boys (7.7% girls to 3.5% boys). The 14-year-old boys had the highest prevalence of underweight (55.2%), and the 17-year-old girls the highest prevalence of overweight (22%). The highest prevalence of obesity was found in 15-year-old boys (11.1%), who also demonstrated a relatively high prevalence of underweight (30.2%).

**Conclusion:** This study reported on a substantial percentage of underweight adolescents (27.1%). Noteworthy levels of overweight and obesity in adolescent girls added to the substantial prevalence of underweight in adolescent boys. Africa has enough to contend with in respect of transmissible diseases, without additional lifestyle-based health burdens.

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## Introduction

Unhealthy weight is a worldwide public health concern affecting adults and children.<sup>1</sup> Internationally, secular trends of body mass index (BMI) in children in developed countries suggest that the average weight of children is increasing, and the percentage of children who are overweight or obese is also growing.<sup>2-7</sup> The prevalence of underweight children has remained steady in many developing countries, while that of overweight is increasing, which means that there is a double burden on children's health in many cultures (underweight and overweight).<sup>8-11</sup> Obesity and malnutrition represent extremes on the spectrum of adiposity, and both are routinely quantified in terms of weight and height relative to the child's age.<sup>3</sup> Children who are under- or overweight for height are significantly more likely than normal weight-for-height children to suffer preventable diseases in adolescence and adulthood.<sup>12</sup>

Together, undernutrition-related diseases, infectious diseases and obesity-related diseases contribute substantially to the burden of disease in low- and middle-income countries.<sup>5</sup> Impaired cognitive development and poorer educational achievement are the adverse effects of undernutrition in childhood,<sup>13</sup> and can result in a high risk of obesity in adulthood.<sup>6,14</sup>

On the other hand, adolescent obesity is associated with serious health problems in adolescence and later adulthood, including a heightened risk of psychosocial morbidity, cardiovascular complications, type 1 and type 2 diabetes, morbidity, premature death and impaired social integration.<sup>15-17</sup> Thus, an international increase in the prevalence in overweight children in affluent societies will potentially result in increased health costs in the next decade. For this reason, international trends in childhood weight should be closely monitored, and early action taken to slow trends of overweight and obesity. However, there are barriers to monitoring these trends as a variety of definitions are in use.<sup>12,18-22</sup>

**Table I:** Prevalence of underweight, overweight and obesity in school learners according to age in various international countries

Author	Country	Prevalence				
		Sample size (n)	Age group (years)	Underweight (%)	Overweight (%)	Obese (%)
Lissau et al <sup>27</sup>	USA	2 068	13 and 15	-	25.5-31	10.8-15.5
	Ireland	826	13 and 15	-	14.2-24.7	2.8-7
	Southern portion of western Europe (Greece and Portugal)	3 761	13 and 15	-	12.5-28.9	3.5-10.8
	Nordic countries (Denmark, Finland and Sweden)	6 303	13 and 15	-	9.8-22.6	1.8-6.9
	Central portion of Western Europe (France, Germany and Belgium)	7 402	13 and 15	-	9.8-15.4	2.7-5.8
	Eastern European countries (Czech Republic, Austria, Lithuania and Slovakia)	7 891	13 and 15	-	8.1 -16.5	1.1- 6.1
	Israel	991	13 and 15	-	12.3-20.1	3.5-10.8
Önera et al <sup>26</sup>	Turkey	989	12 -17	12.8%	11	1
Janssen et al <sup>28</sup>	North American countries (Canada and the USA)	7 990	10-16	-	15.2-18.3	4.1-6.8
	Great Britain (England, Scotland and Wales)	8 904	10-16	-	13.1-16.7	3.0-5.7
	Southern portion of western Europe (Greece, Italy, Malta, Portugal and Spain)	14 298	10-16	-	14.8-16.3	2.2-7.9
	Nordic countries (Denmark, Finland, Norway and Sweden)	17 136	10-16	-	9.8-11.8	1.3-2.5
	Central portion of western Europe (Austria, Belgium, France, Germany, Netherlands and Switzerland)	33 488	10-16	-	7-10.9	0.8-1.9
	South-west corner of eastern Europe (Croatia, Hungary, Macedonia and Slovenia)	15 355	10-16	-	10.5-12.9	1.8-2.4
	Eastern European countries (Czech Republic, Estonia, Latvia, Lithuania, Poland, Russia and the Ukraine)	33 031	10-16	-	5.3-9.1	0.4-1.1
	Israel	4 200	10-16	-	9.3	1.8
Wang, Monteiro, Popkin <sup>29</sup>	USA	6 110	10-18	-	15.2	10.7
	Russia	6 883	10-18	-	7.4	3.2
	China	3 028	10-18	-	3	1.8

Anthropometry reporting weight-for-height measures is a common approach that is used to identify people at risk of nutritional disorders.<sup>23</sup> BMI is another measure. This was developed by Lambert Quetelet, a Flemish mathematician, in the 19<sup>th</sup> century,<sup>24</sup> calculated with the formula of weight (in kg) divided by height (in metres) squared. The classification of malnutrition (underweight) in later childhood and adolescents has been hampered because of lack of agreement on an appropriate threshold for international use.<sup>25</sup> Underweight has been classified according to various methods.<sup>12,18-22</sup> However, only recently Cole<sup>2</sup> proposed internationally comparable cut-off points to define underweight in children and adolescents.

We have summarised the international literature, published since 2000, with respect to underweight, overweight and obesity (Table I). There is a dearth of information in the literature on the prevalence of underweight in adolescents. Only Önera et al<sup>28</sup> report

on this topic. It is apparent that the USA has the highest prevalence of overweight and obesity, with more than double the percentage of adolescents considered to be obese than any other country.<sup>26</sup> Of the European countries and Israel, the highest prevalence of overweight was found in Greece and Portugal, and the lowest in Lithuania.<sup>26</sup> Janssen et al<sup>27</sup> described two trends in their findings. The first was that generally, lower levels of overweight were found in children in Central and Eastern Europe countries, whose economies suffered varying degrees of recession in a period of economic and political transition in the 1990s. The second trend was a higher prevalence of overweight in the southern countries of Europe, especially those outside of the former Eastern Bloc. The non-Eastern bloc countries surrounding the Mediterranean showed prevalence rates ranging from 20-40% for overweight children, while those in northern areas reflected rates of 10-20%.

**Table II:** Prevalence of underweight, overweight and obesity

Author	Country	Prevalence				
		Sample size (n)	Age group (years)	Underweight (%)	Overweight (%)	Obese (%)
Amstrong et al <sup>30</sup>	South Africa (national)	10 165	6-13	-	7.9-14.3	2.5-6
Department of Health <sup>31</sup>	South Africa (national)	2 377	15-24	-	9.7-19.7	1.8-11
Jinabhai et al <sup>32</sup>	South Africa (Western Cape)	1 272	13-17	2.6-18.4	4.2-20.8	0.9-4.2
Kimani-Murage et al <sup>33</sup>	South Africa (Elgin Court region)	904	15-20	8	8	4
Kruger <sup>34</sup>	South Africa (Potchefstroom)	1 257	10-15	-	6.3	1.6
Makgae et al <sup>35</sup>	South Africa (Elisras)	1 802	6-13	-	0-4.6	-
Monyeki, Kemper, Makgae <sup>15</sup>	South Africa (Elisras)	1 817	7-13	-	0-4.6	-
Matsha et al <sup>36</sup>	South Africa (Western Cape)	1 272	10-16	-	15.7	30.8
Naude et al <sup>37</sup>	South Africa (Potchefstroom)	280	13-18	-	8.8-12.1	3.4
Reddy et al <sup>38</sup>	South Africa (national)	9 224	13-19	9	16.9	4

Table II illustrates the prevalence of underweight, overweight and obesity in South African studies published since 2000. A large difference in the prevalence of underweight and overweight between regions in South Africa is

apparent from these data. Table II includes studies that reported on underweight, overweight and obesity, irrespective of age or gender.

Despite the fact that South Africa is a middle-income country in general, food insecurity remains a problem. Approximately 35% of households are considered to be food insecure.<sup>9</sup> This means that these households do not have the means to secure a steady or regular supply of food. Food variety and dietary diversity, associated with the nutritional status of South Africans, is limited in poor communities in South Africa,<sup>37-39</sup> such as the Cape Metropole in the Western Cape province.

Subsistence agriculture in the Cape Metropole area is hindered by small plot sizes and a high number of families living in apartment blocks in which growing vegetable gardens is not possible. People have to predominantly rely on purchased food in an area in which they have low purchasing power. This can result in food insecurity and consequent malnutrition.

National electrification in South Africa in the few years post-apartheid (as well as improvements in many families' income) has potentially contributed to a general increase in the availability of televisions at home. This may have led to decreased physical activity in Western Cape adolescents.<sup>24,37</sup> Decreased physical activity is also associated with the increased consumption of unhealthy foods that are promoted in television advertisements.<sup>40</sup>

This paper reports on the recently estimated prevalence of underweight, overweight and obesity in a randomly selected multiracial group of urban adolescent schoolchildren in the Cape Metropole area of Cape Town. The information updates that provided by Jinabhai et al<sup>32</sup> and Matsha et al<sup>36</sup> and highlights the fact that in-depth studies are needed in the different regions of South Africa to improve an understanding of the weight to height ratio of specific groups of adolescents, based on demographics.

## Method

### Ethics

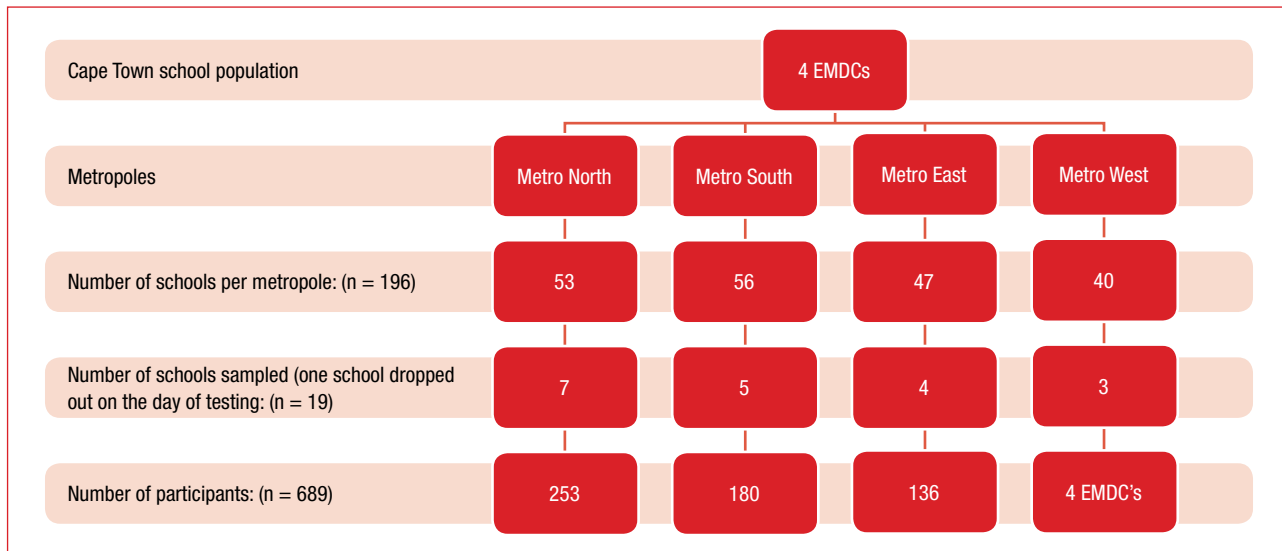
Approval for this study was provided by the Committee for Human Resources at Stellenbosch University and the Western Cape Department of Education. School permission and parental consent were obtained.

### Reference population

School students were sampled from four educational districts, known as Education Management Development Centres (EMDCs), which together make up the greater Cape Town school population. The four EMDCs are Metropole North, South, East and Central. The EMDCs consist of 196 secondary schools, with 18 925 multiracial high-school students in total.

### Sampling frame

A complex cluster sampling procedure was followed whereby 36 students per school were selected from randomly selected schools in the four EMDCs. Students in grade 8-12 were eligible



**Figure 1:** Sampling procedure to determine the number of participants needed per Education Management Development Centre

**Table III:** Number of study participants per age group

Participants	13 years	14 years	15 years	16 years	17 years	18 years	Total
Adolescent girls	54	52	64	57	59	61	347
Adolescent boys	49	57	63	59	56	58	342
Total (n)	103	109	127	116	115	119	689
Total (%)	14.92	15.79	18.40	16.81	16.66	17.39	100

for inclusion. The total number of schools selected in each EMDC was proportional to the size of the EMDC in the total Cape Town metropolitan population.

Twenty schools were consequently randomly cluster sampled from the school reference population. A sample of 720 students was sought from these schools.

Students in grade 8-12, aged 13-18 years who were enrolled in the randomly selected school, were eligible to take part in the study. No exclusion criteria were applied. Eligible students were invited to express their interest in participating in the study, and those who responded formed the student reference group. Three adolescent boys and three adolescent girls aged 13-18 years were then randomly sampled from this reference group from each of the randomly selected schools.

#### Measurement process

Three students were measured simultaneously by three research assistants using a standard protocol. Height was measured as the vertical distance from the floor to the top of the head.<sup>41-45</sup> Weight was measured with an electronic scale, to the nearest milligram. A T-square was used to measure height, and a standard bathroom scale to measure body weight. Information on student age, gender and school class was also collected.

#### Data handling and analysis

Subjects were classified as overweight or obese according to the absolute age- and gender-specific cut-offs for BMI according to

the International Obesity Task Force.<sup>2</sup> Thinness was determined according to the international cut-off points for thinness according to gender and age.<sup>3</sup>

Data were analysed using SPSS® for Microsoft® Windows® 8. Descriptive statistics were reported (mean, standard deviation and standard error of the mean) for height, weight and BMI per age and gender. The prevalence of underweight, overweight and obesity was reported in percentages, in age and gender categories. Comparisons were made between these data sets and the South African adolescent data sets, as well as international prevalence figures.

#### Results

Nineteen schools participated in the study. The total consenting sample comprised 689 students aged 13-18 years. Figure 1 illustrates the sampling procedure.

In total, 342 adolescent boys and 347 adolescent girls participated in the study. The percentage of students in the gender and age groups is described in Table III.

Table IV outlines the prevalence of underweight and overweight in the sample, according to age group. Almost 50% of the 13-year-old schoolchildren were underweight. The 15-year-old schoolchildren had the highest prevalence of obesity. If the combined prevalence of overweight and obesity is taken into consideration, the highest prevalence was found in the 18-year-old schoolchildren (19.1%).

Table V demonstrates that there were considerably more underweight adolescent boys than adolescent girls in the study (17.3% boys to

9.9% girls), and double the frequency of overweight adolescent girls compared to adolescent boys (7.7% girls to 3.5% boys).

Table VI outlines the prevalence of underweight and overweight adolescents in the sample, according to gender and age group. The highest prevalence of underweight was found in the 14-year-

**Table IV:** Prevalence of underweight, overweight and obesity in school learners according to age

Age (years)	Underweight (%)	Normal (%)	Overweight (%)	Obese (%)
13	48.1	6.7	5.8	5.8
14	42.2	45	10.1	2.8
15	26.2	57.1	8.7	7.9
16	19	65.5	12.1	3.4
17	17.4	65.2	15.7	1.7
18	21	58.8	13.4	6.7
Total	27.1	56.9	11.2	4.8

**Table V:** Prevalence of underweight, overweight and obesity in school learners according to gender

Gender	Underweight (%)	Normal (%)	Overweight (%)	Obese (%)
Adolescent boys	17.3	26.6	3.5	2.2
Adolescent girls	9.9	30.3	7.7	2.6
Total	27.1	56.9	11.2	4.8

**Table VI:** Prevalence of underweight, overweight and obesity in school learners according to age and gender (n = 687)

School learners	Underweight (%)	Normal (%)	Overweight (%)	Obese (%)
13-year-old girls	31.5	53.7	9.3	5.6
13-year-old boys	48	42	6	4
14-year-old girls	28	54	14	4
14-year-old boys	55.2	37.9	5.2	1.7
15-year-old girls	21.9	59.4	12.5	6.3
15-year-old boys	30.2	55.6	3.2	11.1
16-year-old girls	12.3	66.7	15.8	5.3
16-year-old boys	25.9	62.1	10.3	1.7
17-year-old girls	11.9	64.4	22	1.7
17-year-old boys	23.6	67.3	9.1	0
18-year-old girls	15.8	56.1	19.3	8.8
18-year-old boys	29.6	59.3	7.4	3.7

**Table VII:** Prevalence of underweight, overweight and obesity in school learners according to the socio-economic status of the school

Quintile	Number of schools	Number of students (n)	Underweight (%)	Normal (%)	Overweight (%)	Obese (%)
1	1	52	23.1	57.7	15.4	3.8
2	1	35	25.7	71.4	8.6	2.9
3	3	96	24	56.3	14.6	5.2
4	5	175	30.3	58.3	9.7	1.7
5	9	329	27.1	55.6	10.6	6.7

old boys (55.2%) and the highest prevalence of overweight in the 17-year-old girls (22%). The highest prevalence of obesity was found in the 15-year-old boys (11.1%), who also demonstrated a relatively high prevalence of underweight (30.2%).

Table VII provides information on the prevalence of underweight, overweight and obesity in school learners according to the socio-economic status of the school. Quintile 1 refers to the poorest schools and quintile five to the most affluent schools. More than 50% of the school learners were within the normal ranges of weight.

## Discussion

This study presents rare information on South African adolescents currently living in the Cape Metropole with regard to the existence of a double burden of malnutrition and underweight, and overweight or obesity. The study demonstrated that there was a higher prevalence of undernutrition in adolescent boys (specifically in 14-year-old boys) than in adolescent girls. This confirms the findings of other studies conducted on adolescents elsewhere in South Africa.<sup>32,38</sup>

However, our study reported on a substantial percentage of underweight adolescents (27.1%) in the Cape Metropole area in South Africa. This value has almost tripled in the past 10 years since the Reddy et al<sup>38</sup> study, and is nearly 10% more than that of the findings reported by Jinabhai et al.<sup>32</sup> This provides evidence of the importance of ongoing monitoring of the prevalence of underweight, overweight and obesity in South African adolescents, particularly as the genetic background of children changes, and the economics of the country stabilises. The data cited in this paper on the underweight, and overweight and obesity prevalence of adolescents in the Elgin Court region of Mpumalanga, and adolescents in the Cape Metropole region of the Western Cape, illustrate two very different scenarios. This might be because of differences in racial composition in these areas, and/or participants' access to food, and highlights the importance of having area-, or at least province-specific, data.

At national level, undernutrition (malnourishment), as a result of lowered economic productivity, is more likely to lead to poor educational outcomes, resulting in lower incomes, higher fertility rates and the potential for suboptimal care of the resultant children over time, thereby contributing to the intergenerational transfer of poverty.<sup>13,46</sup> However, it is notable that just over 50% of learners were within the normal range of weight in the school quintiles. This implies that half of the children in our sample had obtained an appropriate level of nutrition, and thus benefitted from positive

outcomes relating to good nutrition. The prevalence of children with normal weight compares to similar studies that were conducted in the Western Cape, but less so to the studies that incorporated a countrywide sample.<sup>36,37</sup>

It is likely that in our study, the differential prevalence of undernutrition according to gender was owing to a delay in pubertal growth in the adolescent boys, compared to that in the adolescent girls. This occurs when undernutrition is prevalent in a community.<sup>47</sup> Studies conducted on younger children indicate that disproportionate male undernutrition occurs in households with a low socio-economic status. The gender difference has no impact on households with a higher income.<sup>48</sup> Further investigations into potential gender differences in malnutrition in adolescence are required.

Noteworthy levels of overweight and obesity in adolescent girls added to the substantial prevalence of undernutrition in adolescent boys in this study. Generally, adolescent overweight or obesity is associated with many health problems, including a heightened risk of psychosocial morbidity, asthma, orthopaedic difficulties, cardiovascular complications, and type 1 and type 2 diabetes.<sup>16</sup> Furthermore, it is likely that overweight or obese adolescents become obese adults, and are therefore at increased risk of cardiovascular disease and other forms of morbidity, premature death, and impaired social, education and economic productivity.<sup>16,49</sup> Overreliance on energy-dense processed foods, purchased because of insufficient local food production, may be a factor in the development of adolescent overweight and obesity in the Western Cape region of South Africa. In addition, physical inactivity and sedentary lifestyles are associated with adolescent overweight and obesity,<sup>50</sup> with their attendant health issues. The potential role of human immunodeficiency virus (HIV) and acquired immune deficiency syndrome (AIDS) in the persistence of undernutrition in the study community must not be underestimated. The high prevalence of HIV/AIDS has an extensive effect on food security as it undermines the ability of households to provide for their basic needs.<sup>51</sup>

The higher reported prevalence of obesity in adolescent girls (than in adolescent boys) in our study is in keeping with many studies in other low- and middle-income countries,<sup>52</sup> and in South Africa in particular.<sup>30,31</sup> The South African Youth Risk Behaviour Survey documented the national prevalence of combined overweight and obesity of 21% in 13- to 19-year-old learners in high school; 7% in adolescent boys and 25% in adolescent girls.<sup>37</sup> Several factors may explain these gender differences. Biologically, energy needs differ in adolescent boys and girls, and also in relation to the rate of their growth. The timing of sexual maturation also varies, depending on gender.<sup>53</sup> Behavioural factors are important in explaining sex differences too. Generally, boys are more physically active than girls, especially in adolescence.<sup>34,37</sup> Concerns about body image, particularly in adolescent girls, may lead to problematic eating behaviour and the establishment of irregular meal patterns, which can result in increased weight gain.<sup>54</sup> It is interesting to note that both underweight and obesity were observed in the schools with relatively higher quintiles. This was an unexpected finding, but may

be reflective of the diverse backgrounds of children attending a specific school. However, it may also relate to preferential, abnormal eating habits which could lead to over- or underweight in high school learners. The reasons behind this finding should be explored in future studies.<sup>55</sup> Differential problematic eating behaviour according to gender has previously been reported in South African youth.<sup>55</sup>

This study did not collect data on food intake and physical activity patterns which may have provided information that could have explained our findings with regard to the prevalence of overweight and underweight in our sample population. The cross-sectional design of this study did not allow for a causal analysis of the mechanisms that contributed to weight outside of the normal range. However, based on the findings of our study, further targeted research should be undertaken to explore reasons for the continuing prevalence of the double burden of nutrition in Cape Metropole adolescents, and to investigate ways of addressing this.

## Conclusion

Africa cannot afford a new generation of unhealthy adults. The continent has enough to contend with in respect to transmissible diseases, without additional lifestyle-based health burdens. Therefore, it is important that the broader community is educated on eating and exercising well, as a healthy lifestyle is essential in underpinning improved and sustainable population health.

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