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Overweight among children decreased, but obesity prevalence remained high among women in South Africa, 1999–2005

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Abstract

Objective: The aim of the present study was to assess anthropometric status in South African children and women in 2005 in order to document temporal trends in selected anthropometric parameters.

Design: Heights and weights were measured in a cross-sectional study of children aged 1–9 years and women aged 16–35 years. The WHO reference values and BMI cut-off points were used to determine weight status.

Setting: South Africa, representative sample based on census data.

Subjects: Children (*n* 2157) and women (*n* 2403).

Results: Stunting was the most common nutritional disorder affecting 21·7% of children in 1999 and 20·7% in 2005. The difference was not statistically significant. Underweight prevalence remained unchanged, affecting 8·1% of children, whereas wasting affected 5·8% of children nationally, a significant increase from 4·3% of children in 1999. Rural children were most severely affected. According to the international BMI cut-off points for overweight and obesity, 10% of children nationally were classified as overweight and 4% as obese. The national prevalence of overweight and obesity combined for women was 51·5%. The prevalence of overweight in children based on weight-for-height *Z*-score did not change significantly (8·0% to 6·8%, $P = 0{\cdot}138$), but the combined overweight/obesity prevalence based on BMI cut-off points (17·1% to 14·0%, $P = 0{\cdot}02$) decreased significantly from 1999 to 2005.

Conclusions: The double burden of undernutrition in children and overweight among women is evident in South Africa and getting worse due to increased childhood wasting combined with a high prevalence of obesity among urban women, indicating a need for urgent intervention.

Keywords
Overweight/obesity
Stunting
Anthropometry
Children
Women
South Africa

The prevalence of malnutrition continues to be high in Africa, with 30–40% of children under the age of 5 years in Sub-Saharan Africa being stunted[1]. Secondary data analysis of the nationally representative South African National Food Consumption Survey (NFCS) 1999 indicated that stunting was the most prevalent nutritional problem among children aged 12–108 months[2]. Growth faltering starts around the age of 3–6 months among children living under conditions of lack of food, clean water and sanitation and poor access to health services, and continues until environmental conditions improve when catch-up growth occurs[3]. In an African study the prevalence of stunting was 22% in the 0–6 month age group, it increased to 56% by the fourth year, but dropped to 25% at the age of 10 years[4]. This pattern of progressive stunting followed by catch-up growth has been reported in most world regions[5]. Stunting is associated with developmental delay and is a predictor of mortality in children under the age of 5 years[6]. Catch-up growth appears to be beneficial in most cases, but could increase the risk for the metabolic syndrome in low-birth-weight infants[7]. It is unknown if such risk applies to children who recover from stunting during early childhood[3].

An increasing prevalence of overweight has been reported in developing countries, including South Africa[8,9]. Secondary analyses of the NFCS in 1999 showed that 17·2% of children aged 12–108 months were overweight or obese[2]. The South African National Demographic and

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Health Survey (DHS) in 1998 indicated that 9·6% of women aged 15–24 years were obese. Furthermore, nationally 30·1% of all women were obese and 26·1% were overweight. Obesity is a public health problem in South Africa and is associated with increased risk of non-communicable diseases[10].

The aim of the present study was to assess anthropometric status in a nationally representative sample of children aged 1–9 years and women aged 16–35 years in South Africa in 2005, in order to document temporal trends in selected anthropometric parameters.

Methods

The fieldwork for the present survey was completed between February and May 2005 by trained fieldworkers in all provinces of South Africa. First, 2498 households were screened from 226 randomly selected enumerator areas (based on 2001 census data), and 2469 households were used for data analysis. Households were excluded due to refusal, the child not being of appropriate age, or incomplete questionnaires. The overall response rate for sampled households was 91%. The birth date of the child was obtained from clinic cards, if available, or at least the birth year was obtained from the mother or caregiver. Households were selected from rural and urban areas based on census data. Urban areas were defined as a classification based on dominant settlement type and land use. Cities, towns, townships and suburbs, as well as informal settlements, hostels, institutions and smallholdings within or adjacent to any formal urban settlement, were classified as urban. All areas not classified as urban were defined as rural areas[11]. The study protocol was approved by the Committee on Human Research of the University of Stellenbosch and written informed consent was obtained from the mother or caregiver of each child.

The child or woman was weighed with minimum clothing using calibrated electronic scales (Precision Health; A&D Company, Saitama, Japan). Young children were placed in the mother's arms, they were weighed together and the weight of the woman was subtracted. The supine length of the child was determined on a wooden measuring board (ShorrBoard 420; QuickMedical, Issaquah, WA, USA) with a second fieldworker to keep the legs straightened, the feet flat against the footboard and the head in the Frankfort plane against the headboard. The standing height of children older than 2 years and women was taken with the person barefoot and the head in the Frankfort plane, using a calibrated free-standing aluminium stadiometer with a drop-in rod (Model HS; Scales 2000, Wandsbeck, South Africa) and BMI was calculated. Standard methods were employed and the average of two readings was recorded[12].

The anthropometric data of the children were compared with the WHO 2006 and 2007 reference values using WHO Anthro version 3·0·1 and WHO AnthroPlus version 1·0 software (WHO, Geneva, Switzerland). In order to compare the results of the present study with the data of the previous South African NFCS 1999, the 1999 data were reanalysed using the WHO Anthro version 3·0·1 and WHO AnthroPlus version 1·0 software[2]. For each child, a *Z*-score was calculated for weight-for-height (W/H), weight-for-age (W/A) and height-for-age (H/A). Extreme W/A *Z*-scores (WAZ) or H/A *Z*-scores (HAZ) less than −6 or greater than +6, or W/H *Z*-scores (WHZ) less than −4 or greater than +4, were first verified for accuracy. Where no error was detected, such indicators were excluded from analysis. For women, heights below 120 cm and BMI $<10\,kg/m^2$ or $>70\,kg/m^2$ were excluded. For the present study sixty-six women and 312 children were excluded from the analysis either because of missing values or incorrect entries. In the children, underweight was defined as WAZ <-2, stunting as HAZ <-2 and wasting as WHZ <-2[1]. BMI cut-off points proposed for international use were also used to define overweight and obesity among the children, with a BMI corresponding to $25·0\,kg/m^2$ for each age–sex group as the cut-off point for overweight and a BMI corresponding to $30·0\,kg/m^2$ for each age–sex group as the cut-off point for obesity[13]. Among women underweight was defined as BMI $<18·5\,kg/m^2$, overweight as BMI between 25·0 and $29·9\,kg/m^2$ and obesity as BMI $\geq 30·0\,kg/m^2$[14].

Statistical analysis

The Bonferroni test for multiple comparisons of mean values was used to test for differences between age groups for HAZ, WAZ and WHZ, respectively. The χ^2 test was used to test for relationships between stunting, underweight and overweight among age groups and area of residence, respectively. The χ^2 test was also conducted to test for differences between the 1999 and 2005 study populations in the percentage distribution of stunted/non-stunted, underweight/not underweight, wasted/non-wasted and overweight/not overweight children. All statistical analyses were done using the SAS/STAT statistical software package version 9·2 (2008; SAS Institute, Inc., Cary, NC, USA).

Results

The anthropometric status of the children in 1999 and 2005 is presented by age group in Tables 1 and 2, and by urban/rural location in Tables 3 and 4, respectively. At the national level, stunting (HAZ <-2) was the most common nutritional disorder affecting 21·7% of children in 1999 and 20·7% of children in 2005 (Fig. 1). In 2005, stunting affected almost a quarter (23·9%) of children in rural areas and 18·2% of children in urban areas (Table 4). A similar pattern emerged for the prevalence of underweight (WAZ <-2), affecting 8·1% of children nationally, 8·5% of children from rural areas and 7·8% of children from urban areas. Wasting (WHZ <-2) was less prevalent nationally (5·8%; Table 2).

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Table 1 The anthropometric status of children aged 1–9 years nationally and by age group (mean *Z*-score and prevalence with two-sided confidence limits for the mean), National Food Consumption Survey 1999, according to WHO 2006/2007 *Z*-scores

	1–3 years (*n* 1160)		4–6 years (*n* 993)		7–9 years (*n* 462)		Total sample (*n* 2615)	
Anthropometric parameter	Mean	95 % CI	Mean	95 % CI	Mean	95 % CI	Mean	95 % CI
Height-for-age *Z*-score	$-1{\cdot}13^{b}$	−1·24, −1·02	$-0{\cdot}88^{a}$	−1·00, −0·75	$-0{\cdot}72^{a}$	−0·87, −0·56	−0·91	−1·01, −0·82
Weight-for-age *Z*-score	$-0{\cdot}25^{a}$	−0·34, −0·17	$-0{\cdot}46^{b}$	−0·59, −0·36	$-0{\cdot}51^{b}$	−0·65, −0·38	−0·41	−0·48, −0·33
Weight-for-height *Z*-score	$0{\cdot}50^{a}$	0·42, 0·59	$0{\cdot}11^{b}$	0·00, 0·22	$-0{\cdot}15^{c}$	−0·29, −0·01	0·17	0·08, 0·26
% Height-for-age *Z*-score < −2	30·1	27·5, 32·6	19·9	16·6, 23·1	14·3	11·1, 17·5	21·7	19·7, 23·7
% Weight-for-age *Z*-score < −2	6·8	5·2, 8·3	7·7	5·8, 9·5	9·5	6·8, 12·1	7·9	6·6, 9·1
% Weight-for-height *Z*-score < −2	2·3	1·5, 3·1	4·2	2·9, 5·5	6·7	4·3, 9·1	4·3	3·3, 5·2
% Weight-for-height *Z*-score > +2	11·3	9·3, 13·4	6·7	4·6, 8·8	5·8	2·9, 8·7	8·0	6·3, 9·8

[a,b,c]Mean values within a row with unlike superscript letters were significantly different, Bonferroni multiple comparison test ($P < 0{\cdot}05$).

Table 2 The anthropometric status of children aged 1–9 years nationally and by age group (mean *Z*-score and prevalence with two-sided confidence limits for the mean), National Food Consumption Survey 2005, according to WHO 2006/2007 *Z*-scores

	1–3 years (*n* 836)		4–6 years (*n* 739)		7–9 years (*n* 582)		Total sample (*n* 2157)	
Anthropometric parameter	Mean	95 % CI	Mean	95 % CI	Mean	95 % CI	Mean	95 % CI
Height-for-age *Z*-score	$-1{\cdot}01^{b}$	−1·12, −0·89	$-0{\cdot}98^{b}$	−1·08, −0·88	$-0{\cdot}80^{a}$	−0·91, −0·69	−0·94	−1·01, −0·87
Weight-for-age *Z*-score	$-0{\cdot}33^{a}$	−0·42, −0·26	$-0{\cdot}61^{b}$	−0·69, −0·52	$-0{\cdot}49^{b}$	−0·62, −0·37	−0·47	−0·53, −0·41
Weight-for-height *Z*-score	$0{\cdot}27^{a}$	0·17, 0·36	$0{\cdot}00^{b}$	−0·10, 0·09	$-0{\cdot}05^{b}$	−0·16, −0·07	0·09	0·03, 0·15
% Height-for-age *Z*-score < −2	28·8	25·6, 32·1	16·8	13·9, 19·6	13·9	11·0, 16·8	20·7	18·9, 22·5
% Weight-for-age *Z*-score < −2	6·5	4·9, 8·0	8·0	5·7, 10·3	10·7	8·0, 13·3	8·1	6·8, 9·4
% Weight-for-height *Z*-score < −2	6·2	4·7, 7·8	6·0	4·3, 7·7	5·2	3·3, 7·0	5·8	4·8, 6·9
% Weight-for-height *Z*-score > +2	9·8	7·8, 11·8	4·2	2·9, 5·5	5·8	3·7, 7·9	6·8	5·7, 7·9

[a,b]Mean values within a row with unlike superscript letters were significantly different, Bonferroni multiple comparison test ($P < 0{\cdot}05$).

Table 3 The anthropometric status of children aged 1–9 years in rural and urban areas (mean *Z*-score and prevalence with two-sided confidence limits for the mean), National Food Consumption Survey 1999, according to WHO 2006/2007 *Z*-scores

	Rural (*n* 1309)		Urban (*n* 1306)		*P* value for difference between rural and urban children
Anthropometric parameter	Mean	95 % CI	Mean	95 % CI	
Height-for-age *Z*-score	−1·09	−1·20, −0·98	−0·78	−0·93, −0·63	<0·0001*
Weight-for-age *Z*-score	−0·60	−0·67, −0·54	−0·25	−0·38, −0·12	<0·0001*
Weight-for-height *Z*-score	0·04	−0·05, 0·13	0·27	0·14, 0·41	<0·0001*
% Height-for-age *Z*-score < −2	27·5	24·7, 30·3	17·2	14·3, 20·1	<0·0001†
% Weight-for-age *Z*-score < −2	10·3	8·3, 12·3	6·0	4·4, 7·6	0·0003†
% Weight-for-height *Z*-score < −2	6·0	4·4, 7·7	2·9	1·8, 3·9	0·0004†
% Weight-for-height *Z*-score > +2	6·1	4·8, 7·4	9·5	6·5, 12·4	0·005†

* *t* test.
† χ^2 test.

The prevalence of overweight (WHZ > +2) was 7·1 % in the urban areas (Table 4) compared with the national average of 6·8 % (Table 2) in 2005. When the BMI cut-off points proposed for international use were used to define overweight and obesity[13], 10 % of children nationally were classified as overweight and 4 % as obese (Fig. 1). Combined overweight/obesity prevalence was similar in children living in rural areas (13·6 %) and in children from urban areas (14·3 %). Nationally 4·6 % of women aged 16–35 years were underweight, 26·6 % were overweight and 24·9 % obese. The prevalence of obesity among women was significantly higher in urban areas than in rural areas (26·8 % *v.* 22·5 %, $\chi^2 = 5{\cdot}9$, $P = 0{\cdot}015$).

The prevalence of stunting decreased with age from 28·8 % in children aged 1–3 years to 16·8 % in those aged 4–6 years and further to 13·9 % in children aged 7–9 years. An opposite pattern emerged for the prevalence of underweight, with a higher percentage of underweight in older children. The prevalence of wasting remained fairly stable in all age groups (Table 2). The prevalence of overweight and obesity based on the international cut-off points for BMI[13] was the highest in the age group 1–3 years (19·3 %), compared with 10·3 % in the 7–9 year age group.

There were trends for the prevalence of underweight and wasting to increase from 1999 to 2005 in children

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Table 4 The anthropometric status of children aged 1–9 years in rural and urban areas (mean *Z*-score and prevalence with two-sided confidence limits for the mean), National Food Consumption Survey 2005, according to WHO 2006/2007 *Z*-scores

Anthropometric parameter	Rural (*n* 956)		Urban (*n* 1201)		*P* value for difference between rural and urban children
	Mean	95 % CI	Mean	95 % CI	
Height-for-age *Z*-score	−1·07	−1·18, −0·96	−0·84	−0·92, −0·75	0·0001*
Weight-for-age *Z*-score	−0·51	−0·59, −0·43	−0·45	−0·53, −0·36	0·22*
Weight-for-height *Z*-score	0·15	0·07, 0·23	0·04	−0·05, 0·13	0·06*
% Height-for-age *Z*-score< −2	23·9	20·7, 27·0	18·2	16·1, 20·2	0·001†
% Weight-for-age *Z*-score< −2	8·5	6·7, 10·3	7·8	6·0, 9·6	0·58†
% Weight-for-height *Z*-score< −2	4·9	3·5, 6·3	6·6	5·1, 8·1	0·10†
% Weight-for-height *Z*-score > +2	6·5	5·0, 8·0	7·1	5·5, 8·7	0·58†

*t test.
†χ^2 test.

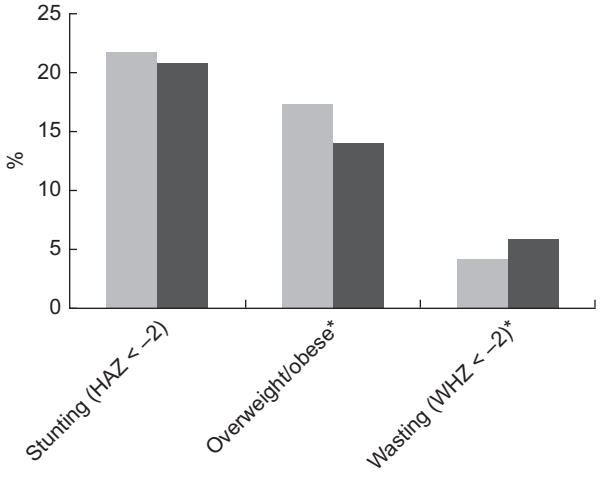

Fig. 1 Comparison of the prevalence of stunting, overweight/obesity and wasting among South African children aged 1–9 years from two nationally representative studies: National Food Consumption Survey 1999 (▭) and National Food Consumption Survey 2005 (■). *Prevalence was significantly different between surveys: $P < 0{\cdot}05$ (overweight/obesity based on BMI)

from urban areas, and to decrease in rural areas (Tables 3 and 4). Nationally the prevalence of overweight based on WHZ (8·0 % to 6·8 %), as well as on BMI cut-off points (17·1 % to 14·0 %), decreased. Taking the limitations of a comparison of 1999 *v.* 2005 national data into account, there were statistically significant decreases in the prevalence of overweight based on BMI nationally ($\chi^2 = 5{\cdot}32$, $P = 0{\cdot}02$) and among urban children ($\chi^2 = 6{\cdot}04$, $P = 0{\cdot}01$). There were trends of a reduction in the prevalence of stunting ($\chi^2 = 3{\cdot}3$, $P = 0{\cdot}07$), underweight ($\chi^2 = 1{\cdot}8$, $P = 0{\cdot}18$) and wasting ($\chi^2 = 1{\cdot}1$, $P = 0{\cdot}28$) among rural children. However, there was an increase in the prevalence of wasting nationally (4·3 % to 5·8 %, $\chi^2 = 5{\cdot}45$, $P = 0{\cdot}02$) and among urban children (2·9 % to 6·6 %, $\chi^2 = 17{\cdot}9$, $P = 0{\cdot}001$). Anthropometric indicators for women were compared with results of the DHS 1998, although the age groups for the DHS were different (15–24 years and 25–34 years, respectively). The percentage distribution between underweight, normal weight, overweight and obese subgroups was similar in the present study and the DHS for the age groups older than 25 years, but a higher prevalence of combined overweight/obesity was found for the age group 16–25 years in the present survey than in the DHS for women aged 15–24 years[10] (42·2 % *v.* 29·6 %).

Discussion

In the present survey the public health significance of the prevalence of underweight (<10 %) was low, with a medium significance of the prevalence of stunting (20·0–29·9 %) and wasting (5·0–9·9 %) according to the internationally suggested cut-off points[15]. The findings of the present study indicate small changes with some improvement since 1999. The prevalence of stunting was still the highest in rural areas, but the best improvement was noted since 1999 in these areas[2]. The findings clearly indicate that the 1–3 year age group was the most severely affected by chronic undernutrition, having almost a twofold higher prevalence of stunting than the 7–9 year age group. The small, but consistent, overall tendency for a lower prevalence of stunting with time indicates a step in the right direction towards the Millennium Development Goal of reducing the incidence of child malnutrition. However, the relevant indicator chosen by the UN for the first Millennium Development Goal is halving of the prevalence of underweight among children under 5 years of age. The present findings indicate that since 1995 there has been virtually no change in the overall prevalence of underweight in the country. Although not at levels of public health significance, current levels of undernutrition in South Africa are significantly higher than the acceptable 'normal' prevalence of 3 % (<3rd percentile). Income differentials and socio-economic inequalities have an important effect on growth of children in South Africa[16]. The increased prevalence of wasting in urban areas since the NFCS 1999 is of concern[2]. This increase may be associated with migration from rural to urban areas, and subsisting on marginal incomes under poor living conditions[9]. Furthermore, the impact of HIV/AIDS on the anthropometric nutritional status of the children is unknown. The prevalence of HIV infection in

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South African children 2–14 years old was estimated to be 2·5 % in 2008[17]. It should be noted that the present study excluded orphans, the majority of whom may have been orphaned due to AIDS; thus many children who could be expected to be particularly malnourished have been excluded.

On the other side of the spectrum, the prevalence of overweight based on WHZ showed a trend of a decrease when compared with the findings of the NFCS in 1999[2]. Based on the BMI cut-off points[13] the prevalence of overweight/obesity in the present survey was significantly lower (14·0 % *v.* 17·1 % in 1999). The trend of a lower prevalence of overweight among the children is encouraging, but difficult to explain, because no obesity prevention programmes targeting children younger than 9 years have been implemented in South Africa. An explanation may be that both these cut-off points take height into account and it is possible that the lower overweight prevalence may reflect an increase in height relative to weight. Improved linear growth may be the consequence of improved health services to pregnant women and infants, for example growth monitoring and vitamin A supplementation[18]. An increase in the prevalence of obesity with development seems universal, with adverse effects of overweight among adolescents on serum lipids, insulin and blood pressure[19]. The incidence of obesity and related chronic disease is escalating more rapidly in developing countries than in industrialized countries[20].

It is suggested that stunting is not reversible in resource-poor areas[21]. In the present survey, the prevalence of stunting in children aged 1–3 years was greater than in older children. The implication of this indication that stunting may be reversed with age must be treated with caution, as the data from the current survey and the 1999 NFCS are both cross-sectional data studying different groups of children at the different ages at the same point in time. However, this replicates the finding of the 1999 NFCS, also reporting a decline in the prevalence in stunting with age. International data[5] and data from the longitudinal South African Birth-to-Twenty Study showed a similar decline in the prevalence of stunting with age[22]. Explanations for an improvement in the anthropometric status of older children might reflect the lower dependency of this group on adults. School-age children are also exposed more often to alternative feeding programmes such as the National School Nutrition Programme[18].

South African children aged 1–9 years appear to have a more favourable nutritional status than children elsewhere in Africa and Asian countries[1,21–25]. In some African countries the prevalence of stunting increased or remained stable during the 1990s[1,24]. However, South Africa is likely to be faced with the problem of stunting for some years in the future. The improvement of the nutritional status and health care for young children should still be prioritised, especially in rural areas where the prevalence of stunting exceeds 20 %. The finding that the youngest children were more severely affected by stunting than the older children has important implications in terms of prioritising and implementing intervention programmes. The most adverse impact of undernutrition on growth of children occurs during the first two years[3]. The prevalence of stunting can be significantly reduced with improvements in socio-economic conditions and health care[4,5,15,25]. Food supplementation helps to reverse stunting when provided during the period of maximum growth deficit[25]. Evidence from longitudinal studies indicates that early stunting was seldom due to energy deficiency, but rather to multiple micronutrient deficiencies. Successful interventions included correction of micronutrient deficiencies known to inhibit linear growth[25]. Promotion of exclusive breast-feeding up to the age of 6 months, followed by appropriate complementary feeding, should be key components of nutrition education[25]. Food fortification is one of the successful strategies to alleviate micronutrient undernutrition in children[25]. Current national South African programmes include food fortification, vitamin A supplementation, growth monitoring and providing supplemental food to children with growth faltering[18]. These programmes might have helped to prevent deterioration of the nutritional status of children since 1999. Increased household income possibly had a beneficial impact on the nutritional status of young children[25].

The prevalence of obesity among young South African women is still unacceptably high. The trend of higher levels of obesity in urban areas in the DHS 1998 survey[10] has been confirmed in the present survey. The increasing rate of urbanisation in South Africa could adversely impact on the prevalence of obesity and its health effects in future, and increase the demand for health services[9,26]. Attempts to prevent obesity at community level and identify high-risk individuals in primary health-care services may relieve the burden of disease treatment at hospital level[26]. Community-based programmes using a lifestyle approach should include both dietary interventions and physical activity, but the overburdened public health system may not have the necessary resources to implement such programmes. Prevention of overweight among pre-school and school-aged children will probably be more practical and cost-effective. Promotion of exclusive breast-feeding may contribute to a lower prevalence of overweight among older children[27]. Changes in the school environment, such as re-introduction of Physical Education in schools and regulation of school tuck-shops or sponsorship of school activities by the food industry, may help to decrease intakes of sweetened cold drinks and high-energy snacks and may eventually decrease the prevalence of overweight in schoolchildren[28].

Growth monitoring and promotion at primary health-care level needs to be strengthened by improving skills of health professionals in length measurement. Stunted and overweight children can only be targeted if their length or height is measured, and height and BMI assessed according

to cut-off points. Health-care workers should become more involved in the monitoring of these children and provide the necessary nutrition support. A proper recording system is essential to ensure follow-up and scheduling of home visits to patients who drop out of programmes and those identified to be at risk of deteriorating. Nutritionists should become involved in training of staff in child care centres on menu planning, food purchasing, preparation and hygiene in order to promote normal child growth.

In summary, the findings of the present national study indicate a double burden of undernutrition and overweight, with 8·1 % of children aged 1–9 years underweight, 20·7 % stunted and 14·0 % overweight/obese. Furthermore, children aged 1–3 years were most severely stunted, as were those from rural areas. The latter two groups in particular should be targeted for intervention. The high prevalence of obesity among urban women indicates an urgent need for intervention.

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