Risk factors of poor anthropometric status in children under five years of age living in rural districts of the Eastern Cape and KwaZulu-Natal provinces, South Africa

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Abstract

Objectives: Factors associated with children's anthropometric status were determined.

Design: Secondary analysis was done using data from a cross-sectional survey including children under five years of age (n = 2 485) and their mothers in rural districts of the Eastern Cape and KwaZulu-Natal provinces, South Africa.

Methods: Data generated by questionnaire and anthropometric indices were used to construct a logistic regression model, taking into account hierarchical relationships of risk factors to determine the odds of a child being stunted, underweight or overweight. Statistical significance was set at $p < 0.05$.

Results: Factors associated with stunting were child of male gender (odds ratio (OR) = 1.233), the mother's perception that child was not growing well (OR = 1.346), household receiving no food handouts (OR = 0.719) and mother not making important household decisions (OR = 0.760). Underweight was associated with child of male gender (OR = 1.432), low maternal education (OR = 1.720), mother's perception that child was not growing well (OR = 2.526), any current breastfeeding (children < 24 months: OR = 2.022), and prior gastrointestinal symptoms (OR = 1.527). Factors associated with child overweight were the household not having a regular source of income (OR = 1.473), low maternal education (OR = 0.595) and mother's perception that child is not growing well (OR = 0.361).

Conclusion: Boys were more likely to be stunted and/or underweight. Children of mothers with less than five years schooling were more likely to be underweight. A regular source of household income was associated with child overweight/obesity.

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Introduction

Child malnutrition, both under- and overnutrition, is associated with undesirable health[1,2] and socio-economic outcomes.[3] The nutritional status of South African children younger than nine years has not changed much over the past 15 years, as reflected by comparable rates reported by three national surveys.[4,5,6] The most recent national study reported 18% stunting, 9.3% underweight, 4.5% wasting and 14% combined overweight and obesity,[6] according to the National Centre for Health Statistics (NCHS) growth references. At these rates, undernutrition seems to be of low severity in South African children based on the World Health Organization (WHO) criteria for classifying the severity of child undernutrition in communities.[7] There are currently no criteria for classifying the severity of child overweight/obesity in populations.

Diet and health are the most significant proximate risk factors of child malnutrition but are themselves rooted in underlying (household issues, such as household food security, maternal and childcare practices, water and sanitation) and basic (societal issues, such as cultural, political, economic and societal systems) factors.[8] To address nutrition-related risk factors of children, malnutrition needs to be identified and evidence-based interventions, policies and programmes need to be implemented. The emergence of the double burden of malnutrition, a paradox associated with nutrition transition, may complicate interventions.[9]

South Africa is a diverse country and has a combination of low-, middle- and high-income groups. In 2007, 26% of the South African population lived below the international poverty line.[10] The KwaZulu-Natal (KZN) and Eastern Cape (EC) provinces accommodate about 35% of the total South African population.[10] In 1995, the South African Department of Health established the Integrated Nutrition Programme (INP). This programme coordinated an intersectoral approach to solving nutrition problems affecting nutritionally vulnerable groups, such as pregnant and lactating women and children younger than five years, as well as preventing increases in mortality due to non-communicable diseases in the country.[11] To achieve this, the INP aims to address the underlying socio-economic, environmental, educational and health-related causes of malnutrition. In its efforts to assist government in improving the nutritional status of South Africans, the Health System Trust (HST), a non-governmental organisation, undertook to implement an integrated project that was based on the INP principles in selected areas of the EC and KZN provinces.[12] Baseline anthropometric

assessment of children in these areas found stunting to be a public health problem. In the EC, 29% of the 12- to 24-month-old children and 30% of the 2- to 5-year-old children were stunted, while in KZN, 25% of the 12- to 24-month-old children and 22% of the 2- to 5-year-old children were stunted, according to NCHS growth references.[9] Reassessment of the anthropometric status of these predominantly breastfed children is encouraged by the WHO as it is likely to provide better estimates of child malnutrition levels. Both the EC and KZN provinces had an average breastfeeding rate of 78% and 77% for < 18-month-old children and 50% and 33% for 18– to < 24-month-old children, respectively.[9] Prost et al[13] found that risk factors determined by using the WHO child growth standards and the NCHS/WHO reference were comparable, although the strength of the association was higher with the WHO standards.

Methods

Objectives

The objective of this study was to identify the socio-economic, maternal and child factors associated with malnutrition in children younger than five years of age living in the EC and KZN provinces through secondary data analysis of the abovementioned baseline assessment. The anthropometric status of the children was reassessed using the WHO growth standards.[14]

Study population, design and methods

Secondary data analysis was done for questionnaire and anthropometric data collected as part of a cross-sectional survey that was conducted in the OR Tambo and Alfred Nzo districts of the EC and the Umkhanyakude and Zululand districts of KZN during 2003. Details of the study design, sampling and data collection are published elsewhere.[9] Anthropometric measurements (height and weight) were taken by trained field workers following standardised protocols. Data on socio-demographic indicators, dietary intake, child morbidity and childcare practices were collected through interviews, using structured questionnaires in the caregivers' local language. In the original study, a stratified random sample of 4 000 children aged 0–71 months and their caregivers was recruited. Of the 2 000 recruited children per province, questionnaire data were obtained for 1 794 children in the EC and 1 988 children in KZN. The final data set therefore consisted of 3 782 children and their caregivers. The study was approved by the ethics committee of the Medical Research Council and mothers gave written informed consent once the purpose and the nature of the study were explained to them.

For the secondary data analysis, children were selected from the original data set using the following inclusion criteria: children younger than five years; complete data on gender, date of birth, and weight and height measurements; and child accompanied by his/her mother for measurements and completion of the questionnaires. Data on household socio-economic and demographic indicators, childcare practices, perceived household food availability, child health, anthropometric measurements and child feeding practices were extracted from the original data set. Feeding practices were assessed using an unquantified food frequency questionnaire including food groups such as animal products (eggs, meat, chicken, fish and milk) and vegetables and fruit (carrots, pumpkin/butternut, spinach, imifino, mango and paw-paw). Categories were grouped as "seldom or never" or "at least four days per week".[9] A household wealth index was constructed from data on living conditions (access to electricity, main source of drinking water and type of toilet facility) and asset ownership (ownership of fridge, coal stove, electric stove, electric hot plate, gas stove, paraffin stove, television set, radio, kettle, motor car and cell phone). Categorical principal component analysis was then used to develop the wealth index for each of the households.

Data analysis

The anthropometric data of the children were assessed using the WHO Anthro software version 2®[14] and expressed as z-scores for each of the anthropometric indices of malnutrition against both the new WHO child growth standards and the older NCHS/WHO reference. A child was defined as stunted, underweight or wasted if his/her height-for-age (HAZ), weight-for-age (WAZ) or weight-for-height (WHZ) z-score was more than two standard deviations (SDs) below the reference median, respectively. A child was defined as overweight if his/her WHZ z-score or body mass index (BMI) for age (BAZ) was at least two SDs above the reference median. BAZ was only calculated for assessment of child overweight against the WHO child growth standards. Maternal BMI was calculated as weight (kg)/[height (m)^2]. The WHO criteria were used to classify mothers as underweight (BMI < 18.5), normal weight (18.5 ≤ BMI < 25) and overweight (BMI ≥ 25).[15]

To assess risk factors of child stunting, overweight and underweight, a multivariate analysis was performed using SPSS Version 17. The odds ratios (ORs) and their 95% confidence intervals (CIs) were calculated using logistic regression. Wealth index, maternal age, child age and maternal BMI were assessed as continuous variables, while all the other variables were assessed as categorical variables. The multivariate analysis took into account the hierarchical relationships between risk factors of malnutrition. The framework (see Figure 1) was developed during the preliminary assessments and in line with current international literature on child malnutrition.[16,17] According to the framework, distal factors (socio-economic status) may influence child nutritional status directly and/or indirectly (through their effect on intermediate and proximal factors). Intermediate factors (food security) may also influence child growth directly and/or indirectly through proximal factors. Proximal factors, however, exert a direct influence on nutritional status, while inherent factors (age and gender) are not influenced by any of the other risk factors.

In the first step of the multivariate analysis, age and gender were entered simultaneously and analysed using unconditional logistic regression. While keeping age and gender in the model, all distal factors were analysed using SPSS backwards conditional logistic regression. Factors were excluded from the model at a significance level of $p > 0.1$. The same analyses were repeated for intermediate and proximal factors. The OR from the equation corresponding to the level at which the risk factor was first entered into the model, in line with hierarchical association assumptions of such models, was reported in the results.[16,17]

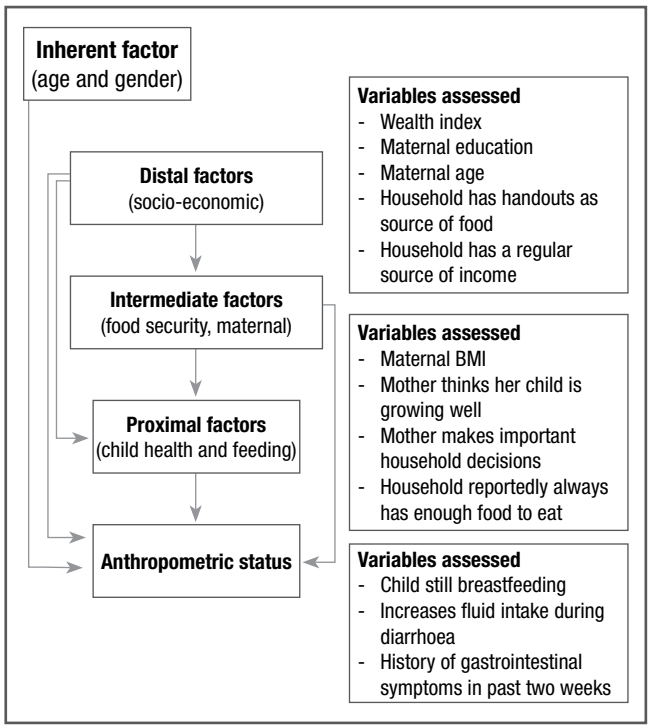

Figure 1: Conceptual framework of the multivariate analysis, taking into account the hierarchical relationship of the proposed risk factors for poor anthropometric status (Adapted from Wamani et al[16] and Chopra et al[17])

Results

Of the 3 782 children in the original data set, 2 680 children met the study criteria. The WHO Anthro version 2® programme recommends that all flagged z-scores (i.e. potentially incorrect or out-of-range values) in a nutrition survey analysis be excluded from further analysis.[18] Based on this recommendation, 195 children were excluded from further data analysis. Results for the remaining 2 485 children are reported. There was no statistically significant difference in the anthropometric status of the children by province. Results are, therefore, reported for the two provinces combined. Results for anthropometric outcomes are those assessed against the WHO child growth standards. The NCHS/WHO reference was only used to compare with the WHO standards in the prevalence of child malnutrition.

Characteristics of the study population

Figure 2 shows the age and gender distribution for the study sample. There were slightly more female (51.5%) than male (48.5%) children, and children aged 12.0–35.9 months were most represented in the study sample.

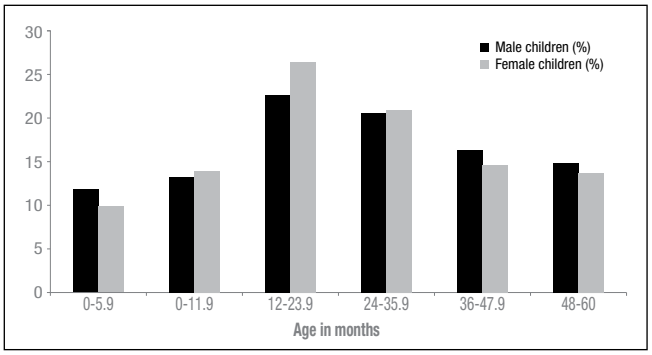

Figure 2: Age and gender distribution of children included in the study

The socio-economic characteristics of households are summarised in Table I. The median number of people per household was six (range: 2–18) and the number of children younger than six years was one (range: 1–6). Sixty-one per cent of the households had a toilet (mostly pit toilet), 25% had access to safe drinking water (tap/borehole) and 26% had electricity in the home (though only 5% used it for cooking).

Almost one-third of the households depended on grants/welfare (30.2%) and child support/maintenance (26.5%) as source of cash income (see Table I). These sources of cash income contributed significantly to the 72% of households having some kind of regular source of income. Shops were the main source of food, though 19% of households reported handouts (gifts, begged, borrowed or food aid/welfare) as a source of food for the month preceding the survey. Only 11% of the surveyed households reported that they always had enough food to eat. Sixty-four per cent and 61% of the households reported ownership of livestock and a home garden, respectively. Whereas a paraffin stove (64.9%) and radio (67.6%) were common commodities, a much smaller number reported ownership of a cellphone (27.2%), refrigerator (15.5%), coal stove (11.4%), electric stove/hotplate (14.7%), gas stove (13.6%), television set (18.3%) and motor car (7.1%).

Table I: Socioeconomic characteristics of the households (n = 2 485)

Variable name	%	Variable name	%
Median number of people per household	6.0	**Household assets**	
Median number of children < 6 years per household	1.0	Refrigerator	15.5
Has electricity in the house	25.9	Coal stove	11.4
Uses electricity for cooking	5.0	Electric stove	5.0
Has regular source of income	72.2	Hotplate	9.7
Mother has been schooled for > 5 years	74.8	Gas stove	13.6
Mother is married	43.4	Paraffin stove	64.9
Household reportedly always has enough food to eat	11.0	Electric kettle	11.2
Ownership of livestock	63.6	Television set	18.3
Ownership of home garden	61.1	Radio	67.6
Household obtains its food from:		Motor car	7.1
Shops	78.6	Cellphone	27.2
Handouts	19.0		
Livestock or home garden	19.9		

[a] Pit toilet 60.9%; flush toilet 0.2%
[b] Own tap water 9.8%; public tap 10.4%; borehole 5%

Anthropometric status of the children

Table II shows the prevalence of child malnutrition by age group as assessed against the WHO child growth standards and the NCHS/WHO reference. The prevalence of stunting, overweight and wasting was generally higher when using the WHO child growth standards as compared to the NCHS reference, which is in line with global reports.[19,20] This was especially so in undernutrition rates for children

Table II: Prevalence of child malnutrition based on the WHO growth standards and the NCHS reference

Age in months	PREVALENCE (%)								
	Stunting		Wasting		Underweight		Overweight		
	NCHS	WHO	NCHS	WHO	NCHS	WHO	NCHS	WHO[a]	WHO[b]
0–5.9 (n = 271)	5.9	11.4	1.5	4.4	0.4	3.0	19.2	20.3	17.3
6–12 (n = 341)	16.7	20.5	2.3	3.8	8.5	7.9	14.7	15	15.2
12–23.9 (n = 614)	28.0	30.9	4.4	3.1	11.6	7.3	11.2	14.0	20.4
24–60 (n = 1259)	26.8	33.4	3.1	3.3	10.9	8.0	5.2	10.8	14.1
All (n = 2485)	23.5	28.6	3.2	3.4	9.6	7.3	9.5	13.1	16.1

Stunting: HAZ < -2 SD of the median of the reference population
Underweight: WAZ < -2 SD of the median of the reference population
Wasting: WAZ < -2 SD of the median of the reference population
Overweight: WHZ or BAZ > 2 SD of the median of the reference population
WHO[a]: Prevalence of overweight based on WHZ and the WHO standards
WHO[b]: Prevalence of overweight based on BAZ and the WHO standards
Criteria for classifying severity of malnutrition in a population:
Stunting: low (< 20%); medium (20–29.9%); high (30–39.9%); very high (≥ 40%)
Wasting: low (< 5%); medium (5–9.9%); high (10–4.9%); very high (≥ 15%)
Underweight: low (< 10%); medium (10–19.9%); high (20–29.9%); very high (≥ 30%)

younger than six months. Using the WHO child growth standards, stunting was the most prevalent (28.6%) adverse anthropometric outcome, followed by combined overweight and obesity (16.1%). Of the stunted children (n = 711), 18.6% were underweight, while 23.6% were overweight (BAZ > 2 SD). Of the wasted children (n = 85), 20% were stunted and 61% were underweight. Children in the 0–5.9 months age group had the lowest prevalence of undernutrition and the highest prevalence of overnutrition. Using the WHO child growth standards and WHO criteria for classifying severity of undernutrition[7] in populations, stunting was of high severity, except in the first year of life, while underweight and wasting were of low severity in all the age groups. There is currently no criterion for classifying the severity of child obesity in populations.

Risk factors for child malnutrition

Only 85 children (52 male; 33 female) were classified as wasted. The mean age for wasted children was 24.5 months. Maternal age (32.2 ± 10.1 versus 30.2 ± 8.51 years), maternal education (less than five years schooling: 40% versus 24.6%) and the mother's perception that her child was growing well (73% versus 83%) differed significantly ($p < 0.05$) between wasted and non-wasted children. Multivariate analysis for determination of risk factors for wasting was not done because of the low number of children who were wasted (n = 85). Risk factors associated with child stunting, underweight and overweight after multivariate analysis are shown in Table III.

Risk factors for stunting

Risk factors associated with stunting (Table III) were child of male gender (OR = 1.233, 95% CI: 1.035–1.470), child age (OR = 1.015; 95% CI: 1.010–1.021) and the mother's perception that her child was not growing well (OR = 1.346; 95% CI: 1.051–1.722). On the other hand, household wealth index (OR = 0.864; 95% CI: 0.803–0.929), receiving no food handouts the month preceding the survey (OR = 0.719; 95% CI: 0.571–0.906), increasing fluids during diarrhoea (OR = 0.826; 95% CI: 0.682–0.999) and mother not making important household decisions (OR = 0.760; 95% CI: 0.618–0.934) were protective against stunting. The practice of increasing fluids during episodes of diarrhoea differed between the provinces (EC 10.7%; KZN 76.5%).

Risk factors for underweight

Risk factors associated with underweight (see Table III) included child of male gender (OR = 1.432; 95% CI: 1.055–1.945), child age (OR = 1.012; 95% CI: 1.003–1.022), low maternal education (OR = 1.720; 95% CI: 1.215 - 2.434), the mother's perception that her child was not growing well (OR = 2.526; 95% CI: 1.743- 3.660), currently not breastfeeding (for children < 24 months) (OR = 2.022; 95% CI: 1.155–3.538) and occurrence of gastrointestinal symptoms

Table III: Risk factors associated with stunting, underweight and overweight in children younger than five years

	Stunting			Underweight			Overweight		
Variable	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value
Mother's perception that child is not growing well	1.346	1.051–1.722	0.018	2.526	1.743–3.660	< 0.001	0.361	0.234–0.557	< 0.001
Male gender	1.233	1.035–1.470	0.019	1.432	1.055–1.945	0.021			
Child age	1.015	1.010–1.021	< 0.001	1.012	1.003–1.022	0.008	0.985	0.979–0.992	< 0.001
Wealth index	0.864	0.803–0.929	< 0.001	0.870	0.760–0.994	0.041	1.086	0.999–1.179	0.053
Increased fluid intake during diarrhoea	0.826	0.682–0.999	0.049						
Mother does not make important decisions	0.760	0.618–0.934	0.009						
Household did not receive food handouts	0.719	0.571–0.906	0.005						
Child is no longer being breastfed[a]				2.022	1.155–3.538	0.014			
Mother had less than five years education				1.720	1.215–2.434	0.002	0.595	0.437–0.809	0.001
Child had GI symptoms in past two weeks				1.527	1.095–2.128	0.013			
Household does not have a regular source of income				1.399	0.993–1.970	0.055	1.473	1.150–1.886	0.002
Maternal BMI							1.044	1.023–1.067	< 0.001

Stunting, underweight and overweight were determined using the WHO child growth standards as reference population
[a]Only assessed in children ≤ 24 months
OR = odds ratio
CI = confidence interval
GI = gastrointestinal (symptoms assessed were diarrhoea, vomiting and poor appetite)
BMI = body mass index

in the two weeks preceding the survey (OR = 1.527; 95% CI: 1.095–2.128). Gastrointestinal symptoms, as assessed by maternal recall, included diarrhoea, vomiting and poor appetite. Frequencies of gastrointestinal symptoms by province were 61% for the EC and 43% for KZN, as reported by the mothers. Household wealth index (OR = 0.870; 95% CI: 0.760–0.994) was associated with a lower risk of being underweight.

Risk factors for overweight

Risk factors associated with child overweight (see Table III) were higher maternal BMI (OR = 1.044; 95% CI: 1.023–1.067) and the household not having a regular source of income (OR = 1.473; 95% CI: 1.150–1.886). Child age (OR = 0.985; 95% CI: 0.979–0.992), low maternal education (OR = 0.595; 95% CI: 0.437–0.809) and the mother's perception that her child was growing well were associated with a lower odds that the child would be overweight (OR = 0.361; 95% CI: 0.234–0.557).

Discussion

Stunting and underweight in children under five were associated with socio-economic, maternal and child factors in the rural communities of the EC and KZN provinces. Except for the household not having a regular source of income, child overweight was also associated mainly with maternal factors. By using a hierarchical framework for the assessment of risk factors for child malnutrition, statistical significance was balanced with biological and social interpretation, and interactions between risk factors from the different levels of the framework were reduced. The cross-sectional study design does, however, not allow for causality inferences. A limitation of the study was the lack of data on birth weight, as this is consistently reported to be a strong predictor of both under- and overnutrition.[17,21]

Boys were more likely to be either stunted and/or underweight than girls. Several studies in sub-Saharan Africa have shown that male preschoolers were at higher risk of being stunted than their female counterparts.[22,23] The reason for this is unknown. Child gender was not associated with overweight in the current study. While conflicting results have been reported on the association between gender and overweight for preschoolers,[24,25] for older children, girls are at increased risk of overweight. [26]

The observed higher risk of being stunted and/or underweight with increase in age is similar to the findings of other local studies.[17,21] Shrimpton et al[27] report that growth faltering starts occurring shortly after birth and progresses until two years of age. The progression of growth faltering during the first two years of life is reflected in the increasing prevalence of stunting from 11.4% for children younger than six months to 20.5% at 6–12 months and 30.9% at 12–24 months in the current study. The period from prenatal to two years of age is recognised and adopted as the 'window of opportunity', which is the crucial period in prevention of and interventions for child undernutrition.[28,29] These interventions should, however, take note that, in the current study, child overweight was highest in children younger than 24 months and, at national level, children between the ages of one and three years are most vulnerable to undernutrition and overnutrition,[30] in order to avoid exacerbating overweight while addressing growth faltering.

Several studies have shown an association between household socio-economic status and child nutrition.[23,31,32] The observed association between the wealth index and all studied anthropometric outcomes was therefore expected. Shephard et al[33] show similarities in the variance explained in anthropometric outcomes when using individual measures of socio-economic status versus composite indices of socio-economic status (such as the wealth index used in the current study). The authors argue that using composite indices may help to make statistical models more prudent, but warn that it does not allow for the identification of specific components of the socio-economic status that are associated with child growth. Components included in the wealth index that were significantly associated with child malnutrition (positively with overweight and negatively with undernutrition) were electricity in the home and ownership of a refrigerator, coal stove, electric stove, electric hot plate, gas stove, television set, radio, motor car and cellphone (data not shown). The wealth index was used to determine whether anthropometric outcomes were associated with socio-economic status in the study population. The purpose was not to define the socio-economic status of the study population or to make policy recommendations in terms of specific socio-economic conditions for the improvement of child growth.

Although the aim of the study was not to identify specific socio-economic variables associated with anthropometric outcomes, it should be noted that 27.2% of the households had at least one cellphone. A more recent study done in the study area showed that in 2008 at least 80% of households owned a cellphone.[34] The most current National Food Consumption Survey indicates that cellphones were the most common form (61%) of communication for most of the households, but this was slightly less the case in formal rural areas (47%).[35]

Maternal education was not associated with child stunting. Low maternal education (less than five years) was associated with a lower risk for overweight and a higher risk for underweight. National data that included 1- to 9-year-old children showed that maternal education (seven years of schooling) was associated with a lower risk of children being stunted and a higher risk of children being obese.[33] Another study done in KZN, however, showed that children were less likely to be either stunted or underweight if their mothers had a minimum of five years of schooling.[17] According to the latter study, only 27% of the mothers had attained a minimum of five years of formal education, compared to 75% in the current study.

Children whose mothers had the perception that they were not growing well were more likely to be either stunted and/or underweight. A study that was done in Mexico reported that mothers' perceptions about the growth of their children differed significantly from the measured anthropometric status, particularly for stunted children.[36] Mothers can be educated and provided with more objective ways of knowing whether their children are growing well through, for example, the provision of community growth promotion services with education on child growth.[37,38] Stunting is not readily discernible by mothers, and including height measurements and the interpretation thereof as part of routine growth monitoring could potentially provide the mother with an objective perception of her child's growth.

The WHO recommends that children be exclusively breastfed for six months, followed by timely introduction of nutritious complementary foods at six months, with continued frequent on-demand breastfeeding up to two years and beyond.[39] Suboptimal breastfeeding rates were high in this study population,[9] and multivariate analysis for children younger than 24 months showed that children who were not being breastfed at the time of the survey were more likely to be underweight. Early introduction of complementary foods of low nutritional adequacy is common in South Africa.[40,41]

Children who reportedly had experienced gastrointestinal symptoms such as diarrhoea, vomiting and poor appetite during the two weeks prior to the survey were more likely to be underweight, but not stunted. Stunting is a chronic condition that develops over years and will therefore not be affected by the occurrence of gastrointestinal symptoms during the preceding two weeks. Underweight is more sensitive to the occurrence of current infections. There is a body of evidence linking stunting, wasting and underweight with childhood infections such as diarrhoea.[22,42,43] Intake of fluids during episodes of diarrhoea is crucial in child health, especially in reducing the risk of mortality. Fluid intake is especially important during episodes of diarrhoea, because it not only reduces the risk of undernutrition, but also improves child survival.[44]

According to the mothers, approximately 90% of the households in the study sample did not always have enough food to eat.[9] Nineteen per cent of the households reportedly received handouts (e.g. gifts, food aid, welfare, begged or borrowed) as a source of food in the month preceding the survey. This probably reflects a high level of current food insecurity in these households. Although not statistically significant, this study showed a trend towards a lower likelihood of a child being stunted from those mothers that reportedly did not receive food handouts during the previous month. A more in-depth targeted study is needed to determine the impact of food handouts such as food aid/welfare and donations by nongovernmental organisations on child nutrition.

Conclusion

Stunting and underweight were associated with risk factors from all the levels of the hierarchical model. Except for the effect of not having a regular income on overweight, both wasting and overweight were mainly associated with maternal factors. For attainment of optimal nutrition in these children, targeted short-term strategies addressing underlying risk factors and more long-term poverty alleviation strategies may be needed.

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References

1. Nannan N, Norman R, Hendricks M, et al. Estimating the burden of disease attributable to childhood and maternal undernutrition in South Africa in 2000. S Afr Med J 2007;97(8):733–9.
2. Lobstein T, Baur L, Uauy R. Obesity in children and young people: a crisis in public health. Obesity Reviews 2004;5(Suppl 1):4–85.
3. Abegunde DO, Mathers CD, Adam T, et al. The burden and costs of chronic diseases in low-income and middle-income countries. Lancet 2007;370(9603):1929–38.
4. South African Vitamin A Consultative Group (SAVACG). Anthropometric, vitamin A, iron and immunisation coverage status in children aged 6–71 months in South Africa, 1994. S Afr Med J 1996;86(4):354–7.
5. Labadarios D, Steyn NP, Maunder E, et al. The National Food Consumption Survey (NFCS): South Africa, 1999. Public Health Nutr 2005;8(5):533–43.
6. Labadarios D, Swart R, Maunder EMV, et al. Executive summary of the National Food Consumption Survey Fortification Baseline (NFCS-FB-I): South Africa, 2005. S Afr J Clin Nutr 2008;21(3)(Suppl 2):245–300.
7. Gorstein J, Sullivan K, Yip R, et al. Issues in the assessment of nutritional status using anthropometry. Bull World Health Organ 1994;72(2):273–83.
8. UNICEF. Strategy for improved nutrition of children and women in developing countries. Policy Review Paper E/ICEF/1990/1.6.
9. Smuts CM, Faber M, Schoeman SE, et al. Socio-demographic profiles and anthropometric status of 0–71-month-old children and their caregivers in rural districts of the Eastern Cape and KwaZulu-Natal provinces of South Africa. S Afr J Clin Nutr 2008;21(3):117–34.
10. Statistics South Africa. Community and Household Survey, 2007. Available from http://www.statssa.gov.za/publications/Report-01-00-01/Report-01-00-012005.pdf (Accessed 10/09/2010).
11. Integrated Nutrition Programme: a foundation for life. Issue 4. Pretoria: Department of Health; 2004.
12. Health Systems Trust. Integrated Nutrition Programme. Available from http://www.hst.org.za/generic/21 (Accessed 10/09/2010).
13. Prost MA, Jan A, Floyd S, et al. Implication of the new WHO growth standards on identification of risk factors and estimated prevalence of malnutrition in rural Malawian infants. PloS ONE 2008;3(7):e2684.
14. World Health Organization. WHO Anthro for personal computers version 2®. Available from http://www.who.int/childgrowth/software/en/index.html (Accessed 07/01/2009).
15. World Health Organization. Diet, nutrition and the prevention of the prevention of chronic diseases. Geneva: World Health Organization; 2003.
16. Wamani H, Astrøm AN, Peterson S, et al. Predictors of poor anthropometric status among children under 2 years of age in rural Uganda. Public Health Nutr 2006;9(3):320–6.
17. Chopra M. Risk factors for undernutrition of young children in a rural area of South Africa. Public Health Nutr 2003;6(7):645–52.
18. World Health Organization. WHO Anthro for personal computers manual. Available from http://www.who.int/childgrowth/software/en/index.html (Accessed 10/09/2010).
19. De Onis M, Onyango AW, Borghi E, et al. Comparison of the World Health Organization (WHO) Child Growth Standards and the National Centre for Health Statistics/WHO international growth reference: implications for child health programmes. Public Health Nutr 2006;9(7):942–7.
20. Nuruddin R, Meng, KL, Hadden, WC, Azam I. Comparison of estimates of under-nutrition for pre-school rural Pakistani children based on the WHO standards and the National Centre for Health Statistics (NCHS) reference. Public Health Nutr 2009;12(5):716–22.
21. Griffiths P, Madise N, Whitworth A, Matthews Z. A tale of two continents: a multilevel comparison of the determinants of child nutritional status from selected African and Indian regions. Health Place 2004;10(2):183–99.
22. Wamani H, Astrøm AN, Peterson S, et al. Boys are more stunted than girls in sub-Saharan Africa: a meta-analysis of 16 demographic and health surveys. BMC Pediatr 2007;7:17–26.
23. Zere E, McIntyre D. Inequities in under-five child malnutrition in South Africa. Int J Equity Health 2003;2. Available from http://www.equityhealthj.com/content/2/1/7 (Accessed 13/09/2010).
24. Irigoyen M, Glassman ME, Chen S, Findley SE. Early onset of overweight and obesity among low-income 1–5-year-olds in New York City. J Urban Health 2008;85(4):545–54.
25. Blomquist HK, Bergstrøm E. Obesity in 4-year-old children more prevalent in girls and in municipalities with a low socioeconomic level. Acta Paediatrica 2007;96(1):113–6.
26. Jinabhai CC, Reddy P, Taylor M, et al. Sex differences in under- and overnutrition among schoolgoing black teenagers in South Africa: an uneven nutrition trajectory. Trop Med Int Health 2007;12(8):944–52.
27. Shrimpton R, Victora CG, De Onis M, et al. Worldwide timing of growth faltering: implications for nutritional interventions. Pediatrics 2001;107(5):E75–E75.
28. World Bank. Repositioning nutrition as central to development: a strategy for large-scale action. Washington DC: World Bank; 2006.
29. Ruel MT, Menon P, Habicht J, et al. Age-based preventive targeting of food assistance and behaviour change and communication for reduction of child undernutrition in Haiti: a cluster randomized trial. Lancet 2008;371(9612):588–95.
30. Steyn NP, Labadarios D, Maunder E, et al. Secondary anthropometric data analysis of the National Food Consumption Survey in South Africa: the double burden. Nutrition 2005;21(1):4–13.
31. Jones LL, Griffiths PL, Adair LS, et al. A comparison of the socio-economic determinants of growth retardation in South African and Filipino infants. Public Health Nutr 2008;11(12):1220–8.
32. Wang Y, Zwang Q. Are American children and adolescents of low socioeconomic status at increased risk of obesity? Changes in association between overweight and family income between 1971 and 2002. Am J Clin Nutr 2006;84(4):707–16.
33. Sheppard ZA, Norris SA, Pettifor JM, et al. Approaches for assessing the role of household socioeconomic status in child anthropometric measures in urban South Africa. Am J Hum Biol 2009;21(1):48–54.
34. Schoeman SE, Faber M, Adams V, et al. Adverse social, nutrition and health conditions in rural districts of the KwaZulu-Natal and Eastern Cape provinces, South Africa. S Afr J Clin Nutr 2010, in press.
35. Swart R, Labadarios D, Kruger S, et al. General and socio-demographic factors impacting on nutritional status. In: Labadarios D, ed. National Food Consumption Survey Fortification Baseline (NFCS-FB): South Africa, 2005. Stellenbosch: University of Stellenbosch; 2007:15–120.
36. Turnbull B, Martínez-Andrade G, Huérfano N, et al. A contrast between mothers' assessment of child malnutrition and physical anthropometry in rural Mexico: a mixed methods community study. J Nutr Educ Behav 2009;41(3):201–6.
37. Alderman H. Improving nutrition through community growth promotion: longitudinal study of the nutrition and early child development program in Uganda. World Dev 2007;35(8):1376–89.
38. Walsh CM, Dannhauser A, Joubert G. The impact of a nutrition education programme on the anthropometric nutritional status of low-income children in South Africa. Public Health Nutr 2001;5(10):3–9.
39. World Health Organization. Global strategy for infant and young child feeding. Available from http://www.who.int/nutrition/topics/global_strategy/en/index.html (Accessed 13/09/2010).
40. Faber M. Complementary foods consumed by 6–12-month-old rural infants in South Africa are inadequate in micronutrients. Public Health Nutr 2005;8(4):373–81.
41. Faber M, Benadé AJS. Breastfeeding, complementary feeding and nutritional status of 6–12-month-old infants in rural KwaZulu-Natal. S Afr J Clin Nutr 2007;20(1):16–24.
42. Assis AMO, Barreto ML, Santos LMP, et al. Growth faltering in childhood related to diarrhea: a longitudinal community based study. Eur J Clin Nutr 2005 11;59(11):1317–23.
43. Black RE, Allen LH, Bhutto ZA, et al. Maternal and child undernutrition: global and regional exposures and health consequences. Lancet 2008;371(9608):243–60.
44. Sepúlveda J, Bustreo F, Tapia R, et al. Improvement of child survival in Mexico: the diagonal approach. Lancet 2006;368(9551):2017–27.