

Nutritional health of young children in South Africa over the first 16 years of democracy

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Objectives. Malnutrition among young children is a major health problem in post-apartheid South Africa. Despite implementation of numerous health and nutrition programmes, these extensive efforts to alleviate the situation have not been adequately reviewed.

Methods. We provide an overview of various aspects of the current nutritional health status of young children. The reviewed data are from the time period 1994 - 2010, and were collected from literature databases and official reports, as well as our own experience with field research in various urban and rural parts of the country.

Results. Both smaller province-based studies as well as three large nationwide surveys conclude that many young South African children have inadequate nutritional status. Rates of stunting, micronutrient deficiencies and hunger and food insecurity are all unacceptably high. Coexisting HIV/AIDS and tuberculosis add to this burden. A gradual transition to a westernised diet characterised by energy-dense food has led to a worrying increase in overweight and obesity.

Conclusion. A major challenge for the South African health authorities is still the fight against childhood undernutrition and hunger, which in turn are rooted in poverty and social inequalities. The double burden of disease adds to the scale and complexity of this challenge.

Obstacles to the realisation of the right to food are usually linked to discrimination and poverty. The latter is perhaps best reflected in chronic hunger and undernutrition.¹ Malnutrition in early life is associated with an increased risk of degenerative diseases later in life and has a negative impact on learning capacity and physical development, with consequences for adult productivity and economic development. It is therefore an important cause of ongoing poverty. In the post-apartheid era since 1994, a major challenge has been to monitor the nutritional status of all South Africans, since data reported during the apartheid years often excluded the majority of the population, namely mainly black South Africans as well as coloureds and those of Asian/Indian descent.

Undernutrition is a major health problem in South Africa,² primarily affecting young children who live in rural areas of the country and whose parents have a low educational status, low or no income, and live under poor environmental conditions. An upliftment of the prevailing socio-economic conditions, together with proper implementation of appropriate policies and adequately resourced intervention programmes, are crucial in securing sustained improvement in both general and nutrition-related health among vulnerable groups in all of South Africa.

In this article we review the present situation, focusing first on socio-demographic factors and issues of inequality. We then present data related to nutritional status (anthropometry and micronutrients) among young children with hunger and the nutrition transition described in the context of nutritional health. We finally present a short summary of the current nutrition strategies in South Africa. Owing to the nature of the existing data, our aim has been to describe the actual situation using available information rather than to perform a comparative analysis of time-dependent changes in the post-apartheid era.

Materials and methods

Anthropometric and micronutrient data as well as information about selected nutrition intervention programmes were obtained through searching in the HighWire Press, MEDLINE and Cochrane databases for studies performed during the period 1 January 1994 to 30 June 2010. We used the following primary search strategy: South Africa AND children AND nutrition/nutritional status OR supplementation programmes AND review OR recommendation OR scientific statement OR guideline OR meta-analysis. Local journals published in southern African countries that are not listed in these international databases were also included, and reviews,

guidelines and recommendations as well as meta-analyses and original and meeting reports were examined. Abstracts were excluded. In addition, available official reports and papers pertaining to matters of nutritional health in South Africa were studied. Nutrition issues related to chronic and communicable and non-communicable diseases were excluded. This is not a secondary analysis of the data from various studies that have been conducted in South Africa, as the great variations in methods, sample size, geographical region, target group, age, etc. make this virtually impossible. Results and conclusions have therefore been obtained from various resources to provide a broad picture of childhood nutritional status in South Africa.

Socio-demographic features

To put the nutritional status of the country in perspective, relevant socio-demographic features are outlined here. The population in South Africa totals around 48.5 million, of whom about 80% are black, 10% white, 9% coloured, and the remaining 1% Asian (mainly Indian).³ Of these, approximately 18.7 million are children (<18 years).⁴

The nation is classified as a middle-income and developing country. The quality of the infrastructure, for example measured as standard of roads, access to Internet or coverage of cell phones, ranks among the highest in southern Africa. There are nine provinces, with large inter-provincial differences in income, employment and general standard of living. Even more pronounced are the socio-economic differences between urban and informal rural households.⁵⁻⁷ For many indicators of general welfare the Western Cape and Gauteng provinces are the most affluent. Unemployment exceeded 40% at the turn of the millennium and peaked at around 75% among the poorest in the black communities.⁵ In 2005, 55% of households had a monthly income below ZAR1 000 (1 ZAR ~ 0.1 US\$).^{5,8} The median monthly income of households that year by population group was ZAR1 400 for blacks, ZAR3 700 for coloureds, ZAR7 000 for Asians/Indians and ZAR10 000 for whites.

Reportedly, one-sixth of the population resides in shacks and in some provinces only one-third have their own tap water and flush toilet.⁹ More than 2.3 million children still live in shacks and 40% of children living in informal housing are <5 years old. These children are particularly vulnerable to burns and paraffin poisoning. Moreover, 30% of children live in over-crowded conditions, increasing their exposure to sexual abuse and communicable disease such as tuberculosis.⁴

Smuts *et al.* reported that about 50% of households in rural districts in the Eastern Cape and KwaZulu-Natal provinces used the local river as the main source of drinking water in 2003, and on average only 24% of these households had inside electricity.¹⁰ About 36% of children do not have access to drinking water on site, while 80% have access to electricity; however, many cannot afford the electricity rates and continue to use unsafe energy sources that carry a risk of burns or acute respiratory diseases.⁴ In 2008, nearly 7 million children lived in households without access to clean drinking water on site. There has been little improvement in children's access to water from 2002 to 2008. Racial inequalities persist: only 58% of black/coloured children had clean water at home in 2008, while over 95% of all other population groups had clean water on site.⁴

In 1994 the South African Vitamin A Consultative Group (SAVACG) found in a nationwide survey that less than a third of children under 6 years of age lived in a household with a working fridge,⁶ while according to the smaller study of particularly disadvantaged areas by Smuts *et al.*, a fridge was available to 22% of the households.¹⁰ Twenty-one per cent of South African households possessed a car in 2005, with wide variations between the ethnic groups: 86% of white households had a car, compared with only 9% of the black households.⁵ Moreover, the SAVACG survey revealed that in 1994 only 11% of South African children had mothers who had

completed the secondary level of education (high school).⁶ In 2003, 40% of the rural women in the Eastern Cape and KwaZulu-Natal provinces had completed secondary education.¹⁰ Although a formal comparison between the SAVACG survey and the smaller, regional-based studies is not feasible, the socio-demographic situation for many South Africans still appears bleak. In 2001, 48% of people over the age of 15 had not completed grade 9 (senior level of high school) and 12% had never attended school, with equal numbers of girls and boys attending high school. There are, however, concerns around the quality of education and the high level of violence in schools.

The 2008 General Household Survey indicated that there were nearly 4 million orphans in South Africa, i.e. equivalent to 21% of all children. Five per cent of children (860 000) were recorded as double orphans, whereas 63% were paternal orphans. The reasons for the high number of paternal orphans are the high mortality rates of men in South Africa, as well as the frequent absence of fathers in children's lives: 1%, or 185 000 children, have fathers whose vital status is reported to be 'unknown'. There is a concern that the numbers of children living in child-headed households will increase as the numbers of orphaned children increase due to the HIV/AIDS pandemic. Many argue that kinship networks are 'stretched to their limits' and are struggling to support orphaned children.⁴

Unsafe sex, alcohol harm, interpersonal violence and smoking are important drivers of mortality and morbidity in South Africa and contribute to the high burden of HIV, injury, violence and abuse in children.⁴ Life expectancy and infant mortality (death within the first year of life) are frequently used indicators of health. According to the World Health Organization (WHO), life expectancy in 2007 for South African women and men was 55 and 52 years, respectively.¹¹ During the period 2000 - 2006, the infant mortality rate rose from 50/1 000 to 56/1 000 live births.¹¹ Importantly, in 2007 the infant mortality rate among the poorest one-fifth of South Africans was 87/1 000 compared with 22/1 000 among the richest fifth of the population.¹²

Nutritional status

Growth and anthropometry

A number of studies during the past two decades have reported poor growth among children throughout South Africa. The nationwide SAVACG survey from 1994 concluded that nearly a quarter of children below 6 years were stunted (height for age <2 standard deviations (SD) from median reference values) and about 10% were underweight (weight for age <2 SD from median reference values).⁶ On a more positive note, severe wasting (weight for height <3 SD from median reference values) was found in only 0.4% of the children. Moreover, the SAVACG survey revealed that growth deficits in general were more prevalent in rural compared with urban communities. A cohort (*N*=162) study by Mamabolo *et al.* in 2005 revealed a 48% prevalence of stunting among 3-year-olds in central rural areas of Limpopo province,¹³ whereas in 2003 it was reported that the stunting rate among 3 765 under-5s was 16.5% in the more urbanised Western Cape.⁹

The next nationwide survey was performed in 1999. This was the National Food Consumption Survey (NFCS), which collected a larger dataset than the SAVACG survey, using similar procedures, and focused on 2 894 children aged 1 - 9 years.⁷ In this survey stunting was seen in about 20% of children, and about 10% remained underweight according to the references of the 1977 US National Center for Health Statistics. The national prevalence of obesity and overweight (body mass index (BMI) >25 kg/m²) combined was estimated at 17.1%, and was apparently more pronounced in urban compared with rural areas. Interestingly, the odds ratio of being overweight among the stunted children was nearly twice that of children of appropriate height.¹⁴ A secondary analysis of the NFCS data comprising 1 512 children aged 1 - 5 years using the 2006 WHO standards revealed that 20.1% were stunted, 6.8% were underweight, 20.6% were overweight and 9.5% were obese.¹⁵ The corresponding

values in this cohort based on the 1977 US National Center for Health Statistics were 17.1%, 9.7%, 5.9% and 13%, respectively.

The third and most recent nationwide survey, the National Food Consumption Survey-Fortification Baseline (NFCS-FB), was conducted in 2005 and included children aged 1 - 9 years.⁸ The proportions of children who were stunted and underweight were about 20% and 10%, respectively, whereas 14% were considered overweight or obese according to the references of the 1977 US National Center for Health Statistics.

Energy and micronutrients

With the use of a 24-hour recall and a food-frequency questionnaire, a major finding from the 1999 NFCS was that about 10% and 25% of children aged 1 - 3 years had an energy intake of less than half and two-thirds, respectively, of the US recommended requirements.⁷

In terms of micronutrient status, several shortcomings have been identified. For example, in the 1994 SAVACG survey one-third of children were anaemic, while about 20% had inadequate iron stores.⁶ The recent NFCS-FB reported that the frequencies of anaemia and low iron stores among children were about 33% and 14%, respectively.⁸ Data from the 1999 NFCS indicated that iron intake for 25 - 37% of the children was less than half of that recommended.⁷

Based on intake data, the 1999 NFCS found that the risk of zinc deficiency was prevalent among South African children, however biochemical markers of zinc were not reported.⁷ Moreover, Oelofse *et al.* have shown that micronutrient deficiency was reportedly more common among the black population group compared with other ethnic groups in the Western Cape province in a sample of 60 children aged 6 - 12 months.¹⁶ Similar results were obtained in rural compared with urban communities in North West province.¹⁷

Adequate status of folic acid was reported in the 2005 NFCS-FB.⁸ Similarly, iodine deficiency disorders seem to have been eliminated in most of South Africa, although there were concerns that the median urine iodine concentration could be too high among young children and their mothers in some provinces, e.g. the Northern Cape.⁸ Whether this reflects too-high dietary intakes, or has unfavourable health consequences, is unknown.

Vitamin A deficiency has long been recognised as a major problem among disadvantaged South Africans. In 1994 the SAVACG survey showed that one-third of the children had marginal vitamin A stores (serum retinol <20 µg/l),⁶ and in 1999 half of the children had a vitamin A intake less than two-thirds of the recommended amount.⁷ Despite implementation of extensive vitamin A supplementation programmes since 2002, reports have shown poor coverage in most provinces and a few studies have reported better, but still insufficient, coverage rates in the Western Cape.¹⁸⁻²⁰ The 2005 NFCS-FB found that two-thirds of the children had poor vitamin A status.⁸ Although there have been concerns about maternal and childhood vitamin A supplementation in areas with high HIV/AIDS prevalences,²¹ the coverage rates need to be improved, at least in some parts of the country. Recently, however, the wisdom and validity of the current practice of giving children between the ages of 6 months and 5 years regular vitamin A supplements has been challenged.²² It is argued that universal supplementation with medicinal doses of vitamin A is an example of countries accepting an almost exclusively donor-imposed programme. Many now believe that the policy of universal donor-driven capsule distribution is not sustainable and that coverage will rapidly decline once the current major donors (Canadian International Development Agency, United States Agency for International Development and United Nations Children's Fund) stop their funding. The best way to prevent deficiency of vitamin A and a range of other nutrients and protective factors in infants and young children is breastfeeding, and a major reason for vitamin A deficiency in the second half of the last century is believed to be a reduction in breastfeeding. Sustainable food-based strategies

should be the first priority for populations with energy, vitamin and micronutrient deficiencies, favouring locally available foods and taking into account local food habits, while supplementation may be required to reinforce dietary approaches in severely deficient populations.

Hunger and food security

To quantify hunger is a challenging task, and questionnaires are often used to determine this state. The 1999 NFCS found that about 50% of South African households experienced hunger and only 25% were food secure, as assessed with a validated questionnaire.⁷ Furthermore, there were large differences regarding both hunger and food security (as measured by hunger) between urban and rural residences, the latter being more affected. The national estimates of hunger and food security from 1999 have persisted, and the figures for hunger and food security were found to be about 50% and 20%, respectively, in the NFCS-FB using the same questionnaire as in the NFCS.⁸

Nutrition transition

Urban populations, especially in developing countries, while still facing food insecurity, underweight and micronutrient deficiencies, often show signs of dietary excess with overweight, obesity and non-communicable diseases as a consequence.²³ This phenomenon is caused by a shift from traditional diets rich in whole grains and starch-rich foods low in animal fat and sugar to a more Western diet characterised by the opposites, and is thoroughly discussed in the literature as the nutrition transition or the double burden of disease.²⁴⁻²⁶ The coexistence of under- and overnutrition is also identified in South Africa, affecting especially the black population and poor urban areas^{14,27,28} as they abandon the traditional African diet, resulting in a decrease in carbohydrate and fibre and an increase in fat intake.²⁷ In addition, a decline in the level of physical activity among children may contribute to the increasing prevalence of overweight and obesity.²⁹ The high ranking of both elevated BMI and childhood and maternal underweight on the list of causes of death reflects the uneven development of South African society, which has been called the 'protracted bipolar health transition'.³⁰⁻³² Interestingly, a subgroup analyses of the NFCS-FB concluded that overweight and obese women were significantly less likely to have stunted or underweight children, whereas underweight women and stunted women were significantly more likely to have underweight and stunted children.³³

Nutrition interventions in South Africa

Several nutrition intervention programmes have been implemented in the past to alleviate malnutrition among young children in South Africa. These programmes were reorganised to be more integrated and comprehensive with the establishment of the Integrated Nutrition Programme (INP) after 1994, and included health facility-based, community-based and nutrition promotion strategies.³⁴ The two strategies with the highest budget allocations within the INP were the Protein Energy Malnutrition (PEM) scheme and the Primary School Nutrition Programme (PSNP).

The aim of the PEM scheme was to combat malnutrition among children aged under 6 years through food supplementation. The main aims of the PSNP, one of the Presidential Lead Projects of 1994, were to address short-term hunger and improve active learning capacity of children in the classroom. Impact evaluation of the PEM scheme and the PSNP was limited, but various investigations revealed inadequate management of these programmes, among other things due to a lack of capacity, inappropriate targeting, poor infrastructure in rural areas of the country and budgetary problems.³⁴

The PEM scheme was later incorporated into the Health Facility Based Nutrition Programme (HFBNP) of the INP. After various name and product changes this is now the Nutrition Therapeutic Programme (NTP), with the aims of correcting undernutrition with targeted nutrition supplements as well as providing nutrition education and counselling.³⁵

There have been anecdotal accounts of improved school attendance and classroom performance as a result of school feeding in the PSNP. However, a cabinet decision was taken to transfer the programme from the INP to the Department of Education in 2004, and the name changed to the National School Nutrition Programme.³⁶

Initiatives to develop schools as centres of teaching, learning, care and support, drawing heavily on early efforts to establish health-promoting schools, are promising.⁴ The evidence clearly shows that school feeding, especially in low-income countries, has significant positive effects on growth in terms of weight gain, school attendance and cognitive performance.³⁷ However, a recent review indicated that the efficacy of school feeding programmes is influenced by a multitude of variables, and the authors suggest that feeding should be focused on pupils with documented nutritional deficiencies and implemented in partnership with the local community.³⁸

Other strategies within the INP include food fortification; micronutrient supplementation, with a specific focus on vitamin A supplementation; growth monitoring and promotion; nutrition and health education with the use of, among others, the South African food-based dietary guidelines; and the Baby Friendly Hospital Initiative (BFHI) and Infant and Young Child Feeding Policy, which promote exclusive and continued breastfeeding and appropriate introduction of complementary foods at 6 months.³⁸

Few national data on breastfeeding rates are available in South Africa. According to the nationwide South African Demographic and Health Survey, from 2003 the initiation rate of breastfeeding is a seemingly high 87%, but supplementation of breastmilk starts very early and very few babies are exclusively breastfed (0 - 3 months 11.9% and 4 - 6 months 1.5%).³⁹

Other studies, mostly performed to investigate infant feeding practices in the context of HIV/AIDS in smaller communities or areas, have reported that exclusive breastfeeding rates are low and that mothers tend to introduce solids and other complementary foods or liquids too early.^{40,41} In line with this, a study in a rural community in the KwaZulu-Natal reported in 1999 that almost all mothers initiated breastfeeding, but solid foods were introduced after 3 months.⁴² A recent study conducted in the same province concluded that by 14 weeks of age 76.1% of infants were given mixed feeds.⁴³ Of note, the rate of exclusive breastfeeding was reportedly low among mothers of high socio-economic status living in the Cape Metropole of the Western Cape province, with 80% opting for formula feeding after birth.⁴⁴ Importantly, the low prevalence of exclusive breastfeeding is not unique to South Africa, but is reported in many parts of the world, including developed countries. This stresses the importance of renewed global efforts to improve the rate of this potentially life-saving intervention in early life and risk-reducing measure for development of certain diseases of lifestyle in later life.⁴⁵

Despite commendable efforts by the INP and large amounts of funds allocated to execute the programmes, no comprehensive evaluation of the mentioned interventions has yet been done at a national level.

Conclusion and recommendations

In reviewing the nutritional situation of South African children during the 16 years after the downfall of the apartheid regime, it is clear that the majority of the country's children live in poverty. A major obstacle to improvement in the quality of life for many of them, in particular coloureds and blacks, is poor nutritional health. In this review we have presented findings obtained in smaller geographical areas as well as data from population-based studies throughout the country. Collectively, the findings document inadequate nutritional status, especially among young children. Specifically, impaired growth, reflected in high rates of stunting and underweight, and food insecurity, reflected in a high frequency of daily experienced hunger, support this conclusion. Added to this are clinically relevant deficiencies in intake of certain micronutrients such as iron, zinc and

vitamin A, as well as low breastfeeding rates. A worrying prevalence of overweight and obesity, now even higher than stunting when using the new WHO standards, has also been noted among young children, probably caused by a transition to dietary intake of more energy-dense food. These findings were supported by the 2008 issue of the *South African Health Review* as well as internationally at the Countdown 2008 Conference held in Cape Town to address how countries are progressing towards achieving the Millennium Development Goals.^{46,47}

To reduce the prevalence of malnutrition requires an interdisciplinary and multisectoral approach, using multiple synergistic interventions at all levels of causation as described in the UNICEF conceptual framework on the causes of malnutrition.⁴⁸ Examples of strategies to address the immediate, underlying and basic causes of malnutrition have been described in detail by Swart and co-workers and include promotive strategies (focusing on underlying and basic causes of malnutrition that might involve intersectoral actions and public health policies, including sectors such as trade and agriculture); preventive strategies focusing on addressing immediate levels of causation as well as underlying causes; and therapeutic and rehabilitative strategies focusing on addressing the immediate levels of causation.⁴⁷ Improved agricultural practices, coupled with improved access to food and good hygienic practices, must be an essential part of the synergistic interventions to fight malnutrition. Another key issue is to improve the accurate implementation of current nutritional supplementation programmes and nutrition strategies such as the promotion of exclusive breastfeeding, growth monitoring and promotion, dietary diversification, food fortification/biofortification, and community-based nutritional rehabilitation. Special attention should be paid to vulnerable groups such as pregnant and lactating women, young children, those living with HIV/AIDS, and socially excluded and unemployed groups.

Poverty and poor purchasing power are, however, the main cause of food insecurity and malnutrition.⁴⁹ The security of a household's livelihood depends on three types of capital: physical capital (such as land, machines, working capital and savings, as well as human and social resources), human capital or labour force (depending on a person's health, training, education and skills), and social capital (referring to relations with other members of the group the individual is relying on). Poverty arises when one or more of the three types of capital strongly limit the possibilities of ensuring one's livelihood.⁴⁹ In the longer-term perspective, a more holistic strategy therefore needs to be developed that focuses on these types of capital, including education, skills development, job creation, gender equality and alleviation of poverty.

Lastly, the international nutrition system (including international and donor organisations, academia, civil society and the private sector) has been described as fragmented and dysfunctional, and it has been suggested that the international community needs a new global governance structure that will provide greater accountability and participation for civil society and the private sector.⁵⁰ Furthermore, enhancement of linkages with national processes is required with improved reflection of country priorities in international normative guidance, donor funding, research and training programmes.⁵⁰

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References

1. Kracht, U. Whose right to food? Vulnerable groups and the hungry poor. In: Barth Eide W, Kracht U, eds. *Food and Human Rights in Development*. Vol. I. Antwerp: Intersentia, 2005.
2. Maunder EM, Khosa S. A case for national training in nutrition and human rights in South Africa. In: Barth Eide W, Kracht U, eds. *Food and Human Rights in Development*. Vol. II. Antwerp: Intersentia, 2005.
3. Statistics South Africa. www.statssa.gov.za (accessed 30 July 2009).

4. Kibel M, Lake L, Pendlebury S, Smith C, eds. *South African Child Gauge 2009/2010*. Cape Town: Children's Institute, University of Cape Town, 2010.
5. Higgs NT. Measuring and understanding the well-being of South Africans: Everyday quality of life in South Africa. *Social Indicators Research* 2007;81:331-356.
6. Labadarios D. The South African Vitamin A Consultative Group (SAVACG). *Children Aged 6 to 71 Months in South Africa, 1994: Their Anthropometric, Vitamin A, Iron and Immunization Coverage Status*. Cape Town: Isago, 1995.
7. Labadarios D, Steyn NP, Maunder E, et al. The National Food Consumption Survey (NFCS): South Africa, 1999. *Publ Health Nutr* 2005;8:533-543.
8. Labadarios D, Swart R, Maunder EMW, et al. Executive summary of the National Food Consumption Survey Fortification Baseline (NFCS-FB-I), South Africa, 2005. *South African Journal of Clinical Nutrition* 2008;21:245-300.
9. Zere E, McIntyre D. Inequalities in under five child malnutrition in South Africa. *Int J Equity Health* 2003;2:7.
10. Smuts CM, Faber M, Schoeman SE, et al. Socio-demographic profiles and anthropometric status of 0 to 71-month old children and their caregivers in rural districts of the Eastern Cape and KwaZulu-Natal provinces of South Africa. *South African Journal of Clinical Nutrition* 2008;21:117-124.
11. World Health Organization. *World Health Statistics*. Geneva: WHO, 2009. apps.who.int/whosis/database/life_tables/life_tables.cfm (accessed 30 July 2009).
12. UNDP Human Development Report 2007/2008 – South Africa HDI rank – 121. hdr.undp.org/en/media/HDR_20072008_EN_Indicator_tables.pdf (accessed 21 May 2010).
13. Mamabolo RL, Alberts M, Steyn NP, Delemarre-van de Waal HA, Levitt NS. Prevalence and determinants of stunting and overweight in 3-year-old black South African children residing in the Central Region of Limpopo Province, South Africa. *Publ Health Nutr* 2005;8:501-508.
14. Steyn NP, Labadarios D, Maunder E, Nel J, Lombard C. Secondary anthropometric data analysis of the National Food Consumption Survey in South Africa: the double burden. *Nutrition* 2005;21:4-13.
15. Bosman L, Herselman MG, Kruger HS, Labadarios D. Secondary analysis of anthropometric data from a South African national food consumption survey, using different growth reference standards. *Matern Child Health J* (in press).
16. Oelofse A, Van Raaij JM, Benade AJ, Dhansay MA, Tolboom JJ, Hautvast JG. Disadvantaged black and coloured infants in two urban communities in the Western Cape, South Africa differ in micronutrient status. *Publ Health Nutr* 2002;5:289-294.
17. Kruger HS, Kruger A, Vorster HH, Jooste PL, Wolmarans P. Urbanization of Africans in the North West province is associated with better micronutrient status: The transition and health during urbanization study in South Africa. *Nutr Res* 2005;25:365-375.
18. Du Plessis LM, Najaar B, Koornhof HE, Labadarios D, Petersen L. Evaluation of the implementation of the vitamin A supplementation programme in the Boland/Overberg region of the Western Cape province. *South African Journal of Clinical Nutrition* 2007;20:126-132.
19. Hendricks M, Beardley J, Bourne L, Mzamo B, Golden B. Are opportunities for vitamin A supplementation being utilised at primary health-care clinics in the Western Cape province of South Africa? *Publ Health Nutr* 2007;10:1082-1088.
20. Iversen PO, Høisæther EA, Morseth M, Herselman M. Diverging opinions of supplementation programmes between mothers of small children and staff at primary health clinics in the Western Cape Province of South Africa. *Publ Health Nutr* 2011;14:923-930.
21. Fawzi WW. The benefits and concerns related to vitamin A supplementation. *J Infect Dis* 2006;193:756-759.
22. Latham M. The great vitamin A fiasco. *World Nutrition* 2010;1:12-45.
23. Murray CJ, Lopez AD. Evidence-based health policy-lessons from the Global Burden of Disease Study. *Science* 1996;274:740-743.
24. Popkin BM. The nutrition transition and its health implications in lower-income countries. *Publ Health Nutr* 1998;1:5-21.
25. Popkin BM. The nutrition transition and obesity in the developing world. *J Nutr* 2001;131:871S-873S.
26. Popkin BM. An overview on the nutrition transition and its health implications: the Bellagio meeting. *Publ Health Nutr* 2002;5:93-103.
27. Bourne LT, Lambert EV, Steyn K. Where does the black population of South Africa stand on the nutrition transition? *Publ Health Nutr* 2002;5:157-162.
28. Vorster HH. The emergence of cardiovascular disease during urbanisation of Africans. *Publ Health Nutr* 2002;5:239-243.
29. Kruger R, Kruger HS, MacIntyre UE. The determinants of overweight and obesity among 10- to 15-year-old schoolchildren in the North West Province, South Africa – the THUSA BANA (Transition and Health during Urbanisation of South Africans; BANA, children) study. *Publ Health Nutr* 2006;9:351-358.
30. Bradshaw D, Groenewald P, Laubscher R, et al. Initial burden of disease estimates for South Africa, 2000. *S Afr Med J* 2003;93:682-688.
31. Bradshaw D, Schneider M, Dorrington R, Bourne DE, Laubscher R. South African cause-of-death profile in transition – 1996 and future trends. *S Afr Med J* 2002;92:618-623.
32. Norman R, Bradshaw D, Schneider M, et al. A comparative risk assessment for South Africa in 2000: towards promoting health and preventing disease. *S Afr Med J* 2007;97:637-641.
33. Steyn NP, Labadarios D, Nel J, Kruger HS, Maunder EM. What is the nutritional status of children of obese mothers in South Africa? *Nutrition* (in press).
34. Behr A. Community nutrition in context. In: Steyn NP, Norman T, eds. *Community Nutrition Textbook for South Africa: A Rights-based Approach*. 1st ed. Cape Town: Medical Research Council of South Africa, 2008.
35. Department of Health. Provincial Government of the Western Cape, South Africa. *Implementation Policy Guidelines for Nutrition Therapeutic Programme*. Draft document, 2011.
36. Department of Health. South Africa. *Integrated Nutrition Programme: A Foundation for Life*. Issue 3. 2002.
37. Kristjansson E, Robinson V, Petticrew M, et al. School feeding for improving the physical and psychosocial health of disadvantaged elementary school children. *Cochrane Database Syst Rev* 2007;(1):CD004676.
38. Greenhalgh T, Kristjansson E, Robinson V. Realist review to understand the efficacy of school feeding programmes. *BMJ* 2009;335:858-861.
39. Department of Health. South African Demographic and Health Survey (SADHS). 2003. www.doh.gov.za/docs/index.html (accessed 13 January 2009).
40. Bland RM, Rollins NC, Coutousdis A, Coovadia HM. Breastfeeding practices in an area of high HIV prevalence in rural South Africa. *Acta Paediatr* 2002;91:704-711.
41. Coutousdis A, Pillay K, Spooner E, Kuhn L, Coovadia HM. Influence of infant-feeding patterns on early mother-to-child transmission of HIV-1 in Durban, South Africa: a prospective cohort study. *South African Vitamin A Study Group. Lancet* 1999;354:471-476.
42. Faber M, Benade AJ. Nutritional status and dietary practices of 4-24-month-old children from a rural South African community. *Publ Health Nutr* 1999;2:179-185.
43. Ghuman MR, Saloojee H, Morris G. Infant feeding practices in a high HIV prevalence rural district of KwaZulu-Natal, South Africa. *South African Journal of Clinical Nutrition* 2009;22:74-79.
44. Sowden M, Marais D, Beukes R. Factors influencing high socio-economic class mothers' decision regarding formula-feeding practices in the Cape Metropole. *South African Journal of Clinical Nutrition* 2009;22:37-44.
45. Matji JN. Promotion, protection and support of exclusive breast-feeding (EBF) – how to change a normative behaviour into reality? *South African Journal of Clinical Nutrition* 2009;22:6-7.
46. South Africa in the spotlight (Editorial). *Lancet* 2008;371:1215.
47. Swart R, Sanders D, McLachlan M. Nutrition: A primary health care perspective. In: Barron P, Roma-Reardon J, eds. *South African Health Review 2008*. Durban: Health Systems Trust, 2008.
48. UNICEF. *Strategy for Improved Nutrition of Children and Women in Developing Countries*. New York: United Nations Children's Fund, 1990.
49. Beerlandt H, Huysman S. Analysis of Target Groups. Manual for Bottom-up-Approach in Food Security Interventions, 1999. International Fund for Agricultural Development/Belgian Survival Fund, 1999.
50. Morris SS, Cogill B, Uauy R. Effective international action against undernutrition: why has it proven so difficult and what can be done to accelerate progress? *Lancet* 2008;371:608-621.