Child health and nutrition

Katharine Hall (Children's Institute), Nadine Nannan (Burden of Disease Research Unit, Medical Research Council) and Winnie Sambu (Children's Institute)

Section 27 of the Constitution of South Africa provides that everyone has the right to have access to health care services. In addition, section 28(1)(c) gives children "the right to basic nutrition and basic health care services".[1]

Article 14(1) of the African Charter on the Rights and Welfare of the Child states that "every child shall have the right to enjoy the best attainable state of physical, mental and spiritual health".[2]

Article 24 of the UN Convention on the Rights of a Child says that state parties should recognise "the right of the child to the enjoyment of the highest attainable standard of health and to facilities for the treatment of illness and rehabilitation of health". It obliges the state to take measures "to diminish infant and child mortality" and "to combat disease and malnutrition".[3]

The infant mortality rate and under-five mortality rate

The infant and under-five mortality rates are key indicators of heath and development. They are associated with a broad range of bio-demographic, health and environmental factors which are not only important determinants of child health but are also informative about the health status of the broader population.

The infant mortality rate (IMR) is defined as the probability of dying within the first year of life, and refers to the number of babies under 12 months who die in a year, per 1,000 live births during the same year. Similarly, the under-five mortality rate (U5MR) is defined as the probability of a child dying between birth and the fifth birthday. The U5MR refers to the number of children under five years old who die in a year, per 1,000 live births in the same year.

This information is ideally obtained from vital registration systems. However, under-reporting of births and deaths renders the South African system inadequate for monitoring purposes. For example, the vital registration data reported by Statistics South Africa in 2009 showed a stark increase in the number of under-five deaths, more than doubling from under 35,000 in 1997 to over 78,000 in 2006.[4] However it is not possible to determine the extent to which this observed increase was the result of improved death registration, as opposed to an increase in the actual number of deaths.

Like many middle-income countries, South Africa is reliant on alternative methods, such as survey and census data, to measure child mortality. Despite several surveys which should have provided information to monitor progress in child survival, the lack of reliable data since 2000 has led to considerable uncertainty around the level of child mortality. This lack of reliable survey data, together with incomplete vital registration, has made it very difficult to track South Africa's progress towards the Millennium Development Goal (MDG) 4,which requires a two-third reduction in the U5MR by 2015.[5]

The 2007 Community Survey included questions to women of reproductive age about the number of children they had given birth to, and the number of surviving children. Such information can be used to estimate child mortality rates using demographic models. The survey results provided information on the level of under-five mortality from which to estimate the extent of under-registration of infant and 1– 4-year-old deaths. Importantly, this showed improvement in overall registration of deaths under age five, from 50% in 1997 to about 90% in 2006.[6]

In the absence of any more recent survey data, great achievements have been made in the development of a rapid mortality surveillance system (RMS) based on the deaths recorded on the population register by the Department of Home Affairs.[7]

The RMS data have been recommended by the Health Data Advisory and Coordinating Committee because corrections have been made for known biases. In other words, the indicators shown in table 3a are representative of the national trends by age. The vital registration data are adjusted for under-reporting and the recent RMS estimates allow evaluation of annual trends. They suggest the IMR was 46 per 1,000 in 2006 and decreased to 30 per 1,000 in 2011. During the same period the under-five mortality rate decreased from 69 per 1,000 to 42 per 1,000, which equates to a 10% annual rate of reduction.

Table 3a: Child mortality indicators, rapid mortality surveillance system, 2009 – 2011

INDICATOR	2009	2010	2011
Under-five mortality rate per 1,000 live births	56	53	42
Infant mortality rate per 1,000 live births	40	37	30

Source: Bradshaw D, Dorrington RE & Laubscher R (2012) *Rapid Mortality Surveillance Report 2011*. Cape Town: Medical Research Council.

The decline in infant- and under-five mortality has occurred mostly amongst HIV-related deaths and is consistent with the findings of a 2012 evaluation of the prevention of mother-to-child transmission (PMTCT) programme, where observed national transmission rates at six weeks after birth had dropped to below 3%.[8] Although dependent on a range of inter-related factors, it is generally assumed that, in the absence of any intervention, vertical transmission ranges between 25% and 30%. The South African Every Death Counts Working Group has identified an additional five categories of death requiring action to achieve the health-related MDGs: non-HIV deaths due to pregnancy, childbirth complications, newborn illness, childhood infections and malnutrition.[9]

The successes in the PMTCT programme and the improvement in completeness of registration over the past decade signify commendable progress. However, if South Africa is committed to the health targets enshrined in the MDGs, it should prioritise the collection of detailed pregnancy histories through a national survey. This information is necessary in order to understand the changes in the relative contribution of the neonatal, post-neonatal and child components which together make up under-five mortality. Such a survey would not only provide provincial mortality profiles (which are much needed as the 2000 estimates are seriously out of date),[10] but would also help to determine the extent of provincial under-reporting of births and deaths.

In the spirit of South Africa's progress towards improving child survival, it is essential to build equitable and sustainable administrative systems across the provinces, which will lay the basis for improved delivery in all public sector initiatives that affect the survival and development of children.

HIV prevalence in pregnant women

The HIV status of pregnant women is vitally important for children. Around 70% of maternal deaths in South Africa are due to HIV,[11] and half of under-five child deaths are related to HIV[12].

The HIV prevalence amongst pregnant women is the proportion of pregnant women (aged 15 – 49 years) who are HIV positive. The majority of children who are HIV positive have been infected through mother-to-child transmission. Therefore the prevalence of HIV amongst infants and young children is largely influenced by the HIV prevalence of pregnant women and interventions to prevent mother-to-child transmission (PMTCT).

The PMTCT programme had a notoriously slow start in South Africa, with only an estimated 7% of pregnant women receiving HIV counselling and testing in 2001/02. Following legal action by the Treatment Action Campaign, the Department of Health was ordered to make PMTCT services available to all pregnant women. By 2005 the proportion of pregnant women who were routinely tested was still below 50%. By 2009 HIV testing was almost universal.[13] The most recent evaluation of the PMTCT programme shows that transmission rates have declined to 2.7%.[14]

HIV prevalence is measured in the National HIV and Syphilis Prevalence Survey which targets pregnant women aged 15 – 49 years who attend a public health facility. The most recent publicly available estimate, for 2011, is 29.5%. Prevalence rates increased steadily from 1% in 1990 when the first antenatal prevalence survey was conducted, to 25% in 2000 and 30% in 2005, and have remained at around this level since. Results are reported in five-year age bands, and show that HIV-prevalence rates are consistently high amongst women in their early 30s (a prevalence rate of 42% in 2011) followed by those in their late 30s (40%). Prevalence rates amongst women in their 30s have continued to rise slightly in recent years, while rates amongst women in their early and late 20s have declined slightly and now stand at 36% in the 25 – 29 age group, and 25% for women aged 20 – 24 years.

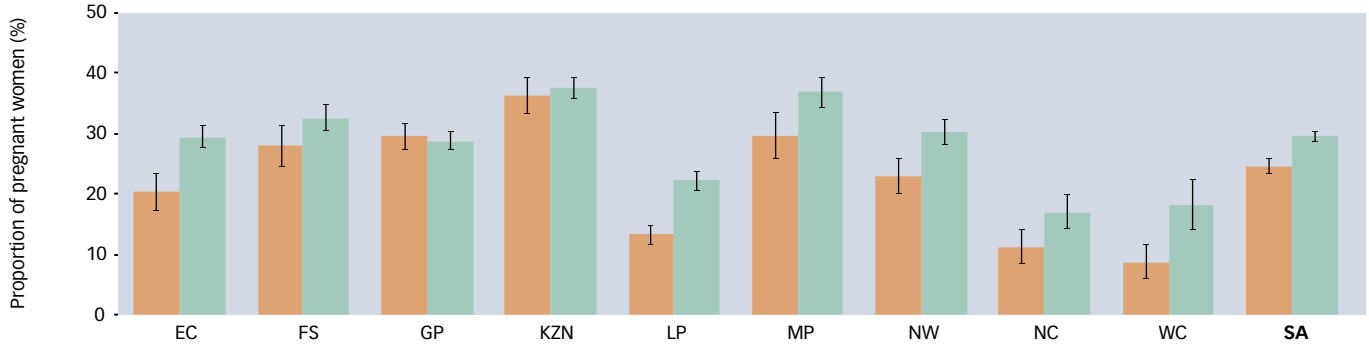
There are substantial differences in HIV prevalence between South Africa's provinces. KwaZulu-Natal has consistently had the highest HIV rates, with prevalence in excess of 35% since 2002. In contrast, the Western Cape has had relatively low prevalence, although the rate has increased by nearly 10 percentage points to 18% over the 12-year period since 2000. Other provinces with relatively low HIV prevalence are the Northern Cape and Limpopo, with HIV-prevalence levels at 17% and 22% respectively in 2011.

These inter-provincial differences are partly a reflection of differences in HIV prevalence between different racial and cultural groups. For example, male circumcision is believed to be a major factor explaining inter-regional differences in HIV prevalence within Africa,[15] and its prevalence differs substantially between South Africa's provinces[16]. Other factors such as differences in urbanisation, migration, socio-economic status and access to HIV-prevention and treatment services could also explain some of the differences in HIV prevalence between provinces.

Although HIV testing is almost universal in public health facilities, the antenatal prevalence survey does not include pregnant women who attend private health facilities, or women who deliver at public health facilities without having made a booking visit. Women with higher socio-economic status (proxied by post-secondary levels of education) and those seeking antenatal care in the private health sector have a relatively low prevalence of HIV.[17] Thus the surveys, which are conducted only in public health facilities, are likely to over-estimate HIV prevalence in pregnant women generally.

Table 3b: HIV prevalence in pregnant women attending public antenatal clinics, by province, 2000 & 2011

(Y-axis reduced to 50%)



	EC	FS	GP	KZN	LP	MP	NW	NC	WC	SA
2000	20,2%	27,9%	29,4%	36,2%	13,2%	29,7%	22,9%	11,2%	8,7%	24,5%
2011	29,3%	32,5%	28,7%	37,4%	22,1%	36,7%	30,2%	17,0%	18,2%	29,5%

Sources: Department of Health (2001; 2012) *National HIV and Syphilis Prevalence Survey 2000; National HIV and Syphilis Prevalence Survey 2011*. Pretoria: DoH.

The number and proportion of children living far from their health facility

This indicator reflects the distance from a child's household to the health facility they normally attend. Distance is measured through a proxy indicator: length of time travelled to reach the health facility, by whatever form of transport is usually used. The health facility is regarded as "far" if a child would have to travel more than 30 minutes to reach it, irrespective of mode of transport.

The health of children is influenced by many factors, including nutrition, access to clean water, adequate housing, sanitation and a safe environment. Primary health care facilities provide important preventative and curative services such as immunisation and antiretroviral therapy, and increased access to such facilities could substantially reduce child illness and mortality. Primary health care facilities are also a key location to provide caregivers with support, information and appropriate referral. In South Africa, primary health care in the public sector is free for everyone, while secondary and tertiary level care is free to children under six years, disabled children, grant beneficiaries and pregnant women. Patients who are not in these categories are charged on a sliding scale, depending on their income. Despite efforts to ensure that essential health services are affordable, the cost of reaching a health care facility can still be a barrier, with potentially severe consequences for children.

A review of international evidence suggests that universal access to key preventive and treatment interventions could avert up to two-thirds of under-five deaths in developing countries.[18] Preventative measures include promotion of breast- and complementary feeding, micronutrient supplements (vitamin A and zinc), immunisation, and the prevention of mother-to-child transmission of HIV, amongst others. Curative interventions provided through the government's integrated management of childhood illness strategy include oral rehydration, infant resuscitation and the dispensing of medication.

According to the UN Committee on Economic, Social and Cultural Rights, primary health care should be available (in sufficient supply), accessible (easily reached), affordable and of good quality.[19] In 1996, primary level care was made free to everyone in South Africa, but the availability and physical accessibility of health care services remain a problem, particularly for people living in remote areas.

Physical inaccessibility poses particular challenges when it comes to health services because the people who need these services are often unwell or injured, or need to be carried because they are too young, too old or too weak to walk. Physical inaccessibility can be related to distance, transport options and costs, or road infrastructure. Physical distance and poor roads also make it difficult for mobile clinics and emergency services to reach outlying areas. Within South Africa, patterns of health care utilisation are influenced by the distance to the health service provider: those who live further from their nearest health facility are less likely to use the facility. This "distance decay" is found even in the up-take of services that are required for all children, including immunisation and maintaining the clinic card (Road-to-Health booklet).[20]

A quarter (24%) of South Africa's children live far from the primary health care facility they normally use, and over 90% attend the facility closest to their home. Amongst households with children, only 8% do not usually attend their nearest health facility, and within the poorest 40% of households, only 5% do not use their nearest facility, while 17% of children in upper quintile households (the richest 20%) travel beyond their nearest health facility to seek care. The main reasons for attending a more distant health service relate to choices based on perceptions of quality: preference for a private doctor, long waiting times at clinics and the non-availability of medicines.[21]

In total, 4.4 million children travel more than 30 minutes to reach their usual health care service provider. This is a significant improvement since 2002, when 36% (or 6.4 million children) lived far from their nearest clinic.

It is encouraging that the greatest improvements in access have been made in provinces which performed worst in 2002: the Eastern Cape (where the proportion of children with poor access to health facilities dropped from 53% in 2002 to 31% in 2011), KwaZulu-Natal (down from 48% to 35%), Limpopo (from 42% to 32%) and North West (from 41% to 30%) over the 10-year period. Provinces with the highest rates of access are the largely metropolitan provinces of Gauteng (10%) and the Western Cape (8%).

There are also significant differences between population groups. Over a quarter (27%) of African children travel far to reach a health care facility, compared with only 3% – 8% of Coloured, Indian and White children. Racial inequalities are amplified by access to transport: if in need of medical attention, 93% of White children would be transported to their health facility in a private car, compared with only 7% of African children and 28% of Coloured children.

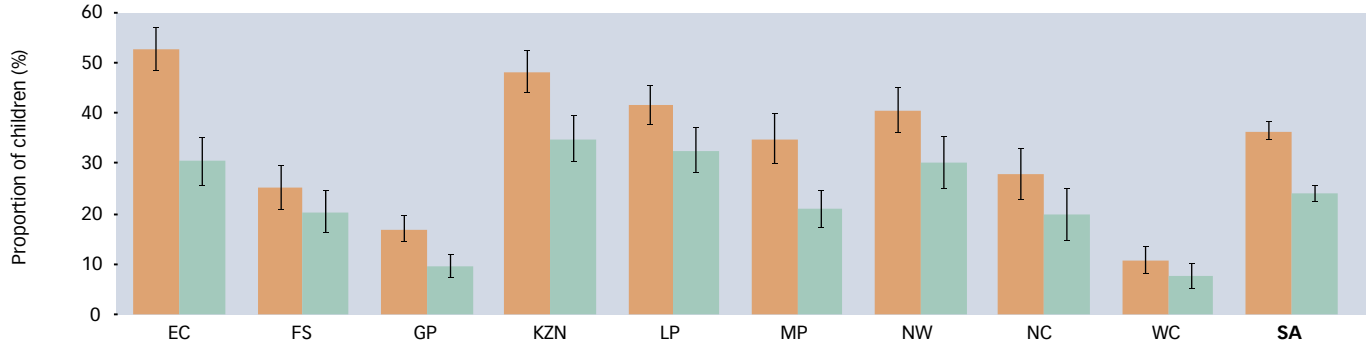
Poor children bear the greatest burden of disease, partly due to poorer living conditions and limited access to services including health facilities. A third of children (34%) in the poorest 20% of households have to travel far to access health care, compared with only 5% of children in the richest 20% of households.

There are no significant differences in patterns of access to health facilities when comparing children of different sex or age groups.

The decline in households reporting lengthy travel to their health facilities is largely the result of a sudden drop from 37% in 2010 to 24% in 2011. Indeed, this indicator has been fairly bumpy for the past four years. This is partly the result of a question change between 2008 and 2009, but in the absence of a clear reason for the more recent changes, these figures should be regarded with some caution.

Figure 3a: Children living far from their health facility, by province, 2002 & 2011

(Y-axis reduced to 60%)



	EC	FS	GP	KZN	LP	MP	NW	NC	WC	SA
2002	52,7%	25,2%	16,9%	48,2%	41,5%	34,8%	40,5%	27,9%	10,8%	36,4%
	1,494,000	249,000	464,000	1,847,000	1,039,000	454,000	580,000	84,000	172,000	6,382,000
2011	30,5%	20,3%	9,5%	34,8%	32,4%	20,9%	30,1%	19,9%	7,6%	23,9%
	819,000	215,000	317,000	1,468,000	727,000	308,000	386,000	86,000	138,000	4,438,000

Sources: Statistics South Africa (2003; 2012) *General Household Survey 2002; General Household Survey 2011*. Pretoria: Stats SA.
Analysis by Katharine Hall, Children's Institute, UCT.

The number and proportion of children living in households where there is reported child hunger

Section 28(1)(c) of the Bill of Rights in the Constitution gives every child the right to basic nutrition. The fulfilment of this right depends on children's access to sufficient food. This indicator shows the number and proportion of children living in households where children are reported to go hungry "sometimes", "often" or "always" because there isn't enough food. Child hunger is emotive and subjective, and this is likely to undermine the reliability of estimates on the extent and frequency of reported hunger, but it is assumed that variation and reporting error will be reasonably consistent so that it is possible to monitor trends from year to year.

The government has introduced a number of programmes to alleviate income poverty and to reduce hunger, malnutrition and food insecurity, yet 2.5 million children (14%) lived in households where child hunger was reported in 2011. There was a significant drop in reported child hunger, from 30% of children in 2002 to 16% in 2006. Since then the rate has remained fairly consistent, suggesting that despite expansion of social grants, school feeding schemes and other efforts to combat hunger amongst children, there may be targeting issues which continue to leave households vulnerable to food insecurity.

There are large disparities between provinces and population groups. Although the Northern Cape has the smallest child population, it has the highest rates of reported child hunger, at 36% in 2010 and 34% in 2011. These estimates deviate from previous years when hunger rates in that province fell within the national average. Either there has been a significant increase in household food insecurity in the Northern Cape, or misreporting from within the very small provincial population has caused this sudden spike in 2010 and 2011.

Other provinces with relatively large numbers of children and high rates of child hunger are the Eastern Cape (18%) and KwaZulu-Natal (16%), which collectively have over a million children living in households which report having insufficient food for children. These provinces reported high rates of child hunger throughout the 10-year monitoring period, although the proportion of children experiencing hunger has declined substantially over the period. Child hunger rates are lowest in Limpopo (4%) and Gauteng (10%). Gauteng is a relatively wealthy and urbanised province and performs well on most child indicators. By contrast, Limpopo has a large rural child population with high rates of unemployment and income poverty, yet reported child hunger has remained well below the national average.

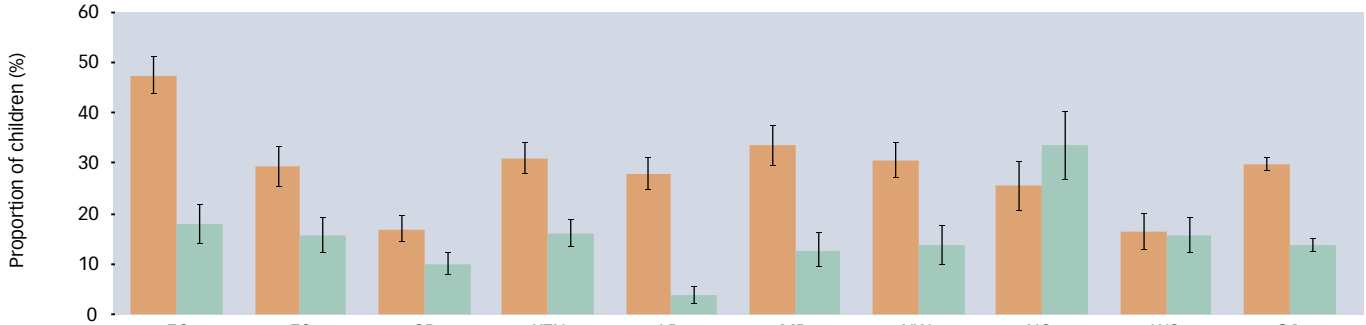
Hunger, like income poverty and household unemployment, is most likely to be found among African children. In 2011, some 2.4 million African children lived in households that reported child hunger. This equates to 15% of the total African child population, while relatively few Coloured (12%) children lived in households where child hunger was reported, and the proportions for Indian and White children were below 1%.

Although social grants are targeted to the poorest households and are associated with improved nutritional outcomes, child hunger is still most prevalent in the poorest households: 21% of children in the poorest quintile go hungry sometimes, compared with 1% in the wealthiest quintile of households.

There are no significant differences in reported child hunger across age groups. It should be remembered that this is a household-level variable, and so reflects children living in households where children are reported to go hungry often or sometimes; it does not reflect the allocation of food within households.

Figure 3b: Children living in households where there is reported child hunger, by province, 2002 & 2011

(Y-axis reduced to 60%)



	EC	FS	GP	KZN	LP	MP	NW	NC	WC	**SA**
2002	47,4%	29,2%	17,0%	30,9%	27,9%	33,4%	30,5%	25,4%	16,3%	29,7%
	1,346,000	290,000	465,000	1,186,000	698,000	437,000	436,000	77,000	260,000	5,203,000
2011	17,9%	15,7%	10,0%	16,2%	3,8%	12,8%	13,7%	33,5%	15,6%	13,7%
	480,000	166,000	333,000	682,000	85,000	188,000	176,000	146,000	283,000	2,537,000

Sources: Statistics South Africa (2003; 2012) *General Household Survey 2002; General Household Survey 2011*. Pretoria: Stats SA.
Analysis by Katharine Hall, Children's Institute, UCT.

Malnutrition in children: stunting, wasting and underweight

The effects of poor nutrition on children are far reaching. It is estimated that more than 200 million children under five years globally will not realise their full cognitive development due to poverty, lack of proper care, poor health and inadequate nutrition.[22] Research suggests that poor nutrition affects the educational outcomes of children, adult working capacity and economic productivity.[23] Under-nutrition in childhood could therefore lead to lower wages in adulthood, perpetuating intergenerational cycles of poverty and exacerbating poverty rates.

Globally, undernutrition contributes to more than a third of deaths in children under five.[24] A local study of child deaths in audited hospitals indicated that 34% of children who died between 2005 and 2009 were severely malnourished and another 30% were underweight for their age.[25] Early childhood is a critical period for growth and development, and nutritional deficits may be irreversible after the second year.[26] The effects of early undernutrition are long-reaching, and are associated with life-threatening diseases such as diabetes, cardiovascular disease and hypertension in adult life.[27]

UNICEF distinguishes between the immediate, underlying and basic causes of malnutrition.[28] Immediate causes of malnutrition include inadequate dietary intake and illness. This can lead to a potentially vicious cycle of illness and malnutrition, where malnutrition impairs children's immunity leading to recurrent bouts of illness, which further undermine children's nutritional status.[29] Underlying causes include household food insecurity, inadequate maternal care, poor access to services and unhealthy living environments, which in turn are driven by the unequal distribution of resources in society.[30]

Efforts to monitor malnutrition in South Africa are constrained by the shortage of regular and reliable anthropometric data (measures of height and weight, for example). Nationally representative surveys that have yielded usable data on the height and weight of children are the Project for Statistics on Living Standards and Development (PSLSD) of 1993, the Demographic and Health Survey of 1998, the National Food Consumption Survey of 2005 and the National Income Dynamics Study (NIDS) of 2008.

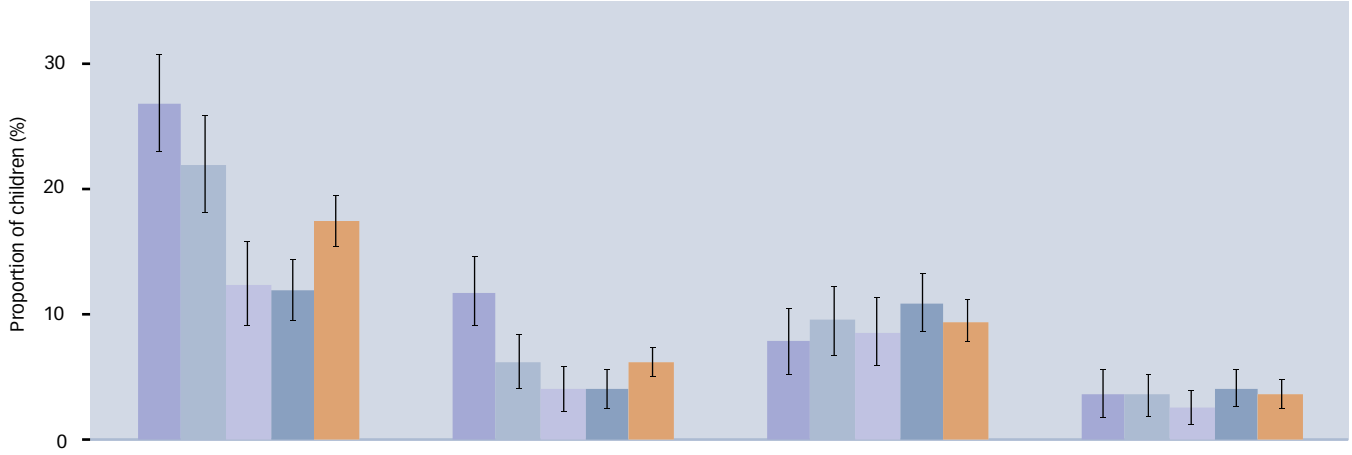
It is notoriously difficult to collect anthropometric data of good quality. Statistics South Africa's Living Conditions Survey of 2008/09 collected anthropometric data from a large sample but did not publish it because the quality was too poor. Subsequent iterations of the NIDS panel survey have collected anthropometric data, but although changes in children's nutritional status over time are plausible,[31] the representivity of the sample diminishes after the first wave. The analyses presented here are therefore based on the most recent reliable and nationally representative data: NIDS 2008. A more recent survey, the South African National Health and Nutrition Examination Survey,[32] was undertaken in 2012, and may provide more up-to-date data for analysis of child anthropometry. The data have not yet been made available.

Unless otherwise specified, the results below are based on analyses of NIDS (2008) and the PSLSD (1993) by Winnie Sambu of the Children's Institute, UCT. In both cases, the malnutrition rates have been derived based on the World Health Organisation's Child Growth Standards.[33]

Stunting is defined as low height-for-age and is associated with chronic undernutrition. It arises if a child's height-for-age measurement is less than two standard deviations from the globally accepted reference cut-off point. When the child's height-for-age measurement is less than three standard deviations from the globally accepted norm, then the child suffers from severe stunting.

Figure 3c: Stunting and underweight rates in early childhood, 2008

(Y-axis reduced to 30%)



	Stunting	Servere stunting	Underweight	Severe underweight
6 mths – 2 yrs	26,9%	11,8%	7,9%	3,7%
	718,000	316,000	210,000	99,000
3 – 4 yrs	22,0%	6,2%	9,5%	3,6%
	427,000	121,000	185,000	69,000
5 – 6 yrs	12,5%	4,1%	8,6%	2,5%
	250,000	82,000	172,000	51,000
7 – 9 yrs	11,9%	4,1%	10,9%	4,2%
	385,000	131,000	352,000	134,000
Total ECD age group	17,4%	6,2%	9,4%	3,6%
	1,716,000	615,000	929,000	353,000

Source: Southern Africa Labour and Development Research Unit (2012) *National Income Dynamics Study 2008, Wave 1* [dataset]. Version 4.1. Cape Town: Southern Africa Labour and Development Research Unit, UCT [producer]; DataFirst [distributor]. Analysis by Winnie Sambu, Children's Institute, UCT.

Stunting is associated with poor socio-economic conditions, poor nutrition and increased risk of frequent and prolonged exposure to infectious diseases.[34] The national rate of stunting for children aged below 10 years in 2008 was approximately 17%. About 6% were severely stunted. Stunting rates appear to decrease with age. For younger children (below three years), low height-for-age is an indication of on-going failure to thrive, while for older ages it indicates children who have previously failed to grow.[35]

In 2008, stunting rates are higher amongst boys (19%) than girls (16%) and higher in rural areas than urban areas. Twenty-four per cent of children living in rural formal areas (commercial farms) and 19% of children in tribal authority areas (former homelands) are stunted.

A comparison between 1993 and 2008 data shows that stunting rates in children under five have reduced from 30% to 25%. Results from the 2012 SANHANES-1 suggest that this may have reduced further, to 22%.[36] Normally, a decrease in the stunting rates of a country is seen as an indicator of improvement in its socio-economic conditions.[37] In 1993, stunting rates amongst children from households in the poorest quintile (40%) were five times higher than the rates recorded amongst children in the wealthiest quintile (8%). In 2008, stunting rates were still highest in the poorest quintile, but the gap between the income quintiles had narrowed: 21% of children in the poorest quintile were stunted, compared to 12% of children in the richest quintile.

Wasting is also referred to as acute malnutrition, and is defined as low weight-for-height. Normally, a healthy child is expected to gain 2 – 3 kg of body weight every year. A child whose weight-for-height measurement is less than two standards deviation from the globally accepted reference cut-off point is considered to be wasted. Severe wasting occurs when the child's weight-for-height measurement is less than three standard deviations from the globally accepted norm. Wasting is caused by infection and inadequate nutrition. It can change rapidly depending on the availability of food and the presence of illness, and is therefore a measure of acute (rather than chronic) malnutrition.[38]

In 2008, 4.8% of children under five years were wasted, and 2% severely wasted. Wasting rates were highest in urban informal areas (8%) followed by the former homelands (4%). No statistically significant differences in wasting were found amongst male and female children. The incidence of wasting and severe wasting has declined since 1993, when the rates were 9% and 4% respectively.

Underweight – A child is considered underweight if the child's weight-for-age measurement is less than two standard deviations from the globally accepted reference cut-off point, or three standard deviations in the case of severe underweight. Underweight is an indicator of both chronic and acute malnutrition.[39] In 2008, nearly 10% of children aged six months to nine years were underweight. About 4% were severely underweight. Children living in rural areas were more likely to be underweight, while 13% and 10% of children in rural formal and tribal areas were underweight compared to 8% and 9% in the urban formal and urban informal areas respectively. Rates were lowest amongst children in relatively wealthy households (5%), compared to 11% amongst children in the poorest quintile.

The proportion of underweight children under five years decreased from 15% in 1993 to 9% in 2008, and may have declined further to 5.2%, according to the SAHANES-1 report.[40]

References

1 Constitution of the Republic of South Africa, 1996.
2 Secretary General of the African Union (1990) *African Charter on the Rights and Welfare of the Child. OAU resolution 21.8/49*. Addis Ababa: OAU.
3 Office of the High Commissioner of Human Rights (1989) *Convention on the Rights of the Child. UN General Assembly resolution 44/25*. Geneva: United Nations.
4 Statistics South Africa (2009) *Mortality and causes of death in South Africa, 2007. Findings from death notification.* Statistical release P0309.3. Pretoria: Stats SA.
5 United Nations (2000) *United Nations Millennium Declaration. Resolution adopted by the General Assembly [without reference to a Main Committee (A/55/L.2)]. A/RES/55/2*, 18 September 2000. UN: New York.
6 Nannan N, Dorrington RE, Laubscher R, Zinyakatira N, Prinsloo M, Darikwa TB, Matzopoulos R & Bradshaw D (2012) *Under-5 mortality statistics in South Africa: Shedding some light on the trends and causes 1997 – 2007*. Cape Town: Medical Research Council.
7 Bradshaw D, Dorrington RE & Laubscher R (2012) *Rapid Mortality Surveillance Report 2011*. Cape Town: Medical Research Council.
8 Goga A, Dinh TH, Jackson D, Lombard C, Crowley S, Sherman G et al. (2012) *Impact of the National Prevention of Mother-to-Child Transmission of HIV (PMTCT) Program on Perinatal Mother-to-Child Transmission of HIV (MTCT) Measured at 6 Weeks Postpartum, South Africa (SA): Results of the First Year of Implementation of the 2010 PMTCT Guidelines Recommended by the World Health Organization (WHO)*. Presented at the XIX International AIDS Conference, 22 – 27 July 2012, Washington, DC.
9 South Africa Every Death Counts Writing Group (2008) Every death counts: Use of mortality audit data for decision making to save the lives of mothers, babies and children in South Africa. *The Lancet*, 371(6920): 1294-1304.
10 Bradshaw D, Nannan N, Laubscher R, Groenawald P, Joubert J, Nojilana B, Norman R, Pieterse D & Schneider M (2005) *South African National Burden of Disease Study 2000. Estimates of Provincial Mortality*. Cape Town: Burden of Disease Research Unit, Medical Research Council.
11 Department of Health (2012) *Saving Mothers 2008 – 2010: Fifth Report on Confidential Enquiries into Maternal Deaths in South Africa*. Pretoria: DoH.
12 Stephen CR, Bamford LJ & Patrick ME (eds) (2011) *Saving Children 2009. Five Years of Data. A Sixth Survey of Child Healthcare in South Africa*. Pretoria: Tshepesa Press, Medical Research Council & Centers for Disease Control and Prevention.
13 Barron P, Pillay Y, Doherty T, Sherman G, Jackson D, Bhardwaj S, Robinson P & Goga A (2013) Eliminating mother-to-child HIV transmission in South Africa. *Bulletin of the World Health Organization*, 91: 70-74. doi: 10.2471/BLT.12.106807.
14 See no.8 above.
15 Auvert B, Buvé A, Ferry B, Caraël M, Morison L, Lagarde E, Robinson NJ, Kahindo M, Chege J, Rutenberg N, Musonda R, Laourou M & Akam E (2001) Ecological and individual level analysis of risk factors for HIV infection in four urban populations in sub-Saharan Africa with different levels of HIV infection. *AIDS*, 15(Suppl 4): S15-30;
Williams BG, Lloyd-Smith JO, Gouws E, Hankins C, Getz WM, Hargrove J, de Zoysa I, Dye C & Auvert B (2006) The potential impact of male circumcision on HIV in Sub-Saharan Africa. *PLoS Medicine*, 3(7): e262.
16 Connolly C, Simbayi LC, Shanmugam R & Nqeketo A (2008) Male circumcision and its relationship to HIV infection. *South African Medical Journal*, 98(10): 789-794.
17 Johnson L, Dorrington R, Bradshaw D, du Plessis H & Makubalo L (2009) The effect of educational attainment and other factors on HIV risk in South African women: Results from antenatal surveillance, 2000 – 2005. *AIDS* ,23(12): 1583-1588.
Bärnighausen T, Hosegood V, Timaeus I & Newell M (2007) The socioeconomic determinants of HIV incidence: Evidence from a longitudinal, population-based study in rural South Africa. *AIDS*, 21(Suppl 7): S29-S38;
Wilkinson D (1999) HIV infection among pregnant women in the South African private medical sector. *AIDS*, 13(13): 1783.
18 Jones G, Steketee RW, Black RE, Bhutta ZA, Morris SS & Bellagio Child Survival Study Group (2003) How many deaths can we prevent this year? *The Lancet*, 362(9977): 65-71.
19 United Nations Economic and Social Council (2000) *International Covenant on Economic, Social and Cultural Rights, Article 12: The Right to the Highest Attainable Standard of Health: General Comment No. 14*. Geneva: Committee on Economic, Social and Cultural Rights.
20 McLaren Z, Ardington C & Leibbrandt M (2013) *Distance as a Barrier to Health Care Access in South Africa*. A Southern Africa Labour and Development Research Unit working paper no. 97. Cape Town: SALDRU, UCT.
21 Statistics South Africa (2012) *General Household Survey 2011*. Pretoria: Stats SA. [Analysis by K Hall, Children's Institute, UCT]
22 Grantham-McGregor S, Cheung YB, Cueto S, Glewwe P, Richter L & Strupp B (2007) Developmental potential in the first five years for children in developing countries. *The Lancet*, 369(9555): 60-70.
23 Caulfield LE, Richard SA, Rivera JA, Musgrove P & Blacket RE (2006) Stunting, wasting, and micronutrient deficiency disorders. In: Jamison DT, Breman JG, Measham AR, Alleyne G, Claeson M, Evans DB, Jha P, Mills A & Musgrove P (eds) *Disease Control Priorities in Developing Countries*. 2nd ed. Washington, DC: World Bank;
Alderman H, Hoddinott J & Kinsey B (2002) Long-term Consequences of Early Childhood Malnutrition. Presented at the "Understanding poverty and growth in sub-Saharan Africa" conference, Centre for Study of African Economies, University of Oxford, 18 – 19 March 2002;
De Onis M & Blössner M (1997) *WHO Global Database on Child Growth and Malnutrition*. Geneva: World Health Organisation.
24 UNICEF (2012) *The State of the World's Children 2012*. New York: UNICEF.
25 See no. 12 above.
26 Ruel M & Hoddinott J (2008) *Investing in Early Childhood Nutrition*. International Food Policy Research Institute policy brief no. 8, November 2008. Washington DC: IFPRI.
27 See no. 23 above (Caulfield et al 2006).
28 UNICEF (1990) *Strategy for Improved Nutrition of Children and Women in Developing Countries*. New York: UNICEF.
29 Nell ED (2010) Diarrhoea and malnutrition. *South African Journal of Clinical Nutrition*, 23(1): s15-s18.
30 See no. 28 above.
31 Ardington C & Gasealahwe B (2012) *Health: Analysis of the NIDS Wave 1 and 2 Datasets*. SALDRU working paper no. 80 / NIDS discussion paper 2012/3. Cape Town: University of Cape Town.
32 Shisana O, Labadarios D, Rehle T, Simbayi L, Zuma K, Dhansay A, Reddy P, Parker W, Hoosain E, Naidoo P, Hongoro C, Mchiza Z, Steyn NP, Dwane N, Makoae M, Maluleke T, Ramlagan S, Zungu N, Evans MG, Jacobs L, Faber M, & SANHANES-1 Team (2013) *South African Health and Nutrition Examination Survey (SANHANES-1)*. Cape Town: HSRC Press.
33 World Health Organisation (2006) *WHO Child Growth Standards: Length/height-for age, Weight-for-age, Weight-for-length, Weight-for-height and Body Mass Index-for-age. Methods and Development.* Geneva: WHO.
34 WHO Working Group (1986) Use and interpretation of anthropometric indicators on nutritional status. *Bulletin of the World Health Organization*, 64(6): 929-941.
35 See no. 23 above (De Ornis et al 1997).
36 See no. 32 above
37 See no. 23 above.
38 Faber M & Wenhold F (2007) *Nutrition in Contemporary South Africa*. Pretoria: South African Water Commission.
39 See no. 38 above.
40 See no. 32 above.