

What are the trends and dynamics of child malnutrition in South Africa?

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Introduction

Over 70% of the world's poor live in middle income countries (Kanbur & Sumner, 2012). In many of these countries, food insecurity and malnutrition affect a significant proportion of the population. South Africa is not an exception. A middle-income country, it has high levels of poverty and inequality, and a significant proportion of the population is affected by various forms of malnutrition. Over 40% of children under 5 years suffer from Vitamin A deficiency, over a quarter of children under 5 years are reportedly stunted, while 13% of children in the same age group are overweight or obese (Hall et al., 2017). Among children, stunting is the most prominent form of malnutrition, while a high prevalence of over-nutrition (overweight and obesity) affects adults, particularly women. Results from a 2012 health and nutrition survey found that 24.8% and 39.2% of females aged 15 years and older were overweight and obese respectively, compared to 20.1% and 10.6% of males of the same age group who were classified as overweight or obese (Shisana et al., 2013).

Stunting, the main form of malnutrition globally and in South Africa, is present when a child's height is faltered, compared to other healthy children of similar age and gender. Stunting is caused by lack of adequate food and prolonged infections brought about by exposure to poor living conditions (United Nations Childrens Fund, 1990). Numerous studies conducted in South Africa have shown that stunting is the most common form of malnutrition and that prevalence has not changed much over the last two decades (Said-Mohamed et al., 2015). However, the estimates have not been consistent, with prevalence reported ranging from 20% to 27%. Nevertheless, these studies have shown that stunting prevalence is highest among young children (under 5 years old), among male children, and in poor and food insecure households (Mamabolo, Steyn & Alberts, 2006; May & Timæus, 2014; Dukhi, Sartorius & Taylor, 2017).

In this paper, the main aim is to examine trends and dynamics in child malnutrition levels in South Africa, focusing on two data sources: the National Income Dynamics Study (NIDS) and the South Africa Demographic and Health Survey (SADHS). These two nationally representative surveys contain fairly recent data collected from large samples of the country's population. Because the SADHS (2016) was conducted in between NIDS waves 4 and 5, we expect the estimates from these surveys to be fairly comparable. There are two main research questions underlying this study:

- 1) What are the trends and dynamics in malnutrition levels in South Africa?
- 2) Are malnutrition estimates within the NIDS panel comparable?
- 3) Are malnutrition estimates from NIDS and the SADHS comparable?

This paper shall begin with a discussion on sampling methodologies used in the two types of surveys, followed by a discussion on the extent of missing anthropometric data and computation of inverse probability weights. Thereafter, there will be a presentation on trends in stunting.

Data sources and methodology

The South Africa Demographic and Health Survey (SADHS) is a cross-sectional survey designed to produce nationally representative estimates on demographic and health indicators. In many countries, the DHS is conducted after every five years, allowing for regular monitoring of trends in population health and nutrition. However, in the case of South Africa the most recent SADHS was conducted in 2016, after a 13-year break. The National Income Dynamics Study (NIDS), on the other hand, is a panel survey that has been following individuals and their households since 2008/09. The survey has been carried out five times (also called waves). Wave 1 (2008) interviewed 28226 individuals. In terms of sampling, the 2016 SADHS followed a two-stage sampling design, with the first stage being the sampling of PSUs based on probability proportional to size using Statistics South Africa's (Stats SA) 2011 master sample frame (MSF). Thereafter, Dwelling Units (DUs) were selected based on systematic sampling. NIDS also followed a two-stage sampling design in the selection of dwelling units included in wave 1 (2008). The first stage involved selection of Primary Sampling Units (PSUs) from Stats SA's 2003 Master Sample. Both NIDS and the SADHS surveys were designed to produce nationally representative estimates. They also allow for calculation of provincial estimates.

Table 1 presents a comparison of NIDS (waves 1, 4 and 5) and SADHS household sample sizes (realised). Cross-sectional weights have been applied to the reported percentages. The number of NIDS households has increased significantly over the years, from 7296 in 2008 to 13719 in 2017. This is mainly due to two reasons. First, some individuals moved from their base households to form new ones. Second, in wave 5, the sample was topped up with new households in order to maintain the representativeness of the survey. This was necessary due to attrition of White, Indian and high-income households. Compared to 2008, the number of urban households included in NIDS has increased and in 2017, 62% of households were located in urban areas. This is not surprising, given the increase in population living in urban areas of South Africa (see for example, Hall, 2017). A comparison of the SADHS and NIDS waves 4 and 5, do not show striking differences in number and proportion of households across geographical areas (urban, rural traditional, and rural farms) within and across provinces. This is evident when we consider wave 4 and the SADHS. There are some differences when comparisons are made between wave 5 and the SADHS, mainly when we examine urban/rural distribution, and in the case of some provinces (decrease in provincial share in North-West and increases in Gauteng). Overall, the share of urban households increased from 68% to 70% between NIDS waves 4 and 5; this could be due to the topping up of the sample in wave 5, which mainly affected White, Indian and high-income households, mainly found in the urban areas of South Africa.

Table 1: Household sample size comparison (NIDS and SADHS), % weighted

	NIDS 2008		NIDS 2014/15		DHS (2016)		NIDS (2017)	
	n	%	n	%	n	%	n	%
Number of households	7296		11889		11083		13719	
Geo type total:								
Urban	3,862	66.0%	6,474	67.8%	6,556	68.1%	7,754	70.4%
Rural traditional	2,708	27.6%	3,916	27.8%	3,810	28.4%	4,032	25.2%
Rural farm	726	6.4%	713	4.5%	717	3.6%	763	4.4%
Across provinces:								
Western Cape - all	1,004	11.0%	1,390	11.1%	969	10.9%	1,594	11.5%
Western Cape - urban	849	95.4%	1,216	94.4%	931	96.3%	1,419	95.3%
Western Cape - rural traditional	0		0		0		0	0.0%
Western Cape - rural farms	155	4.6%	168	5.6%	38	3.7%	170	4.7%
Eastern Cape	933	11.9%	1,337	11.9%	1,409	11.7%	1,464	10.9%
Eastern Cape - urban	418	48.1%	601	46.0%	713	49.5%	732	49.1%
Eastern Cape - rural traditional	483	48.6%	692	50.7%	633	47.7%	685	48.2%
Eastern Cape - rural farms	32	3.3%	37	3.2%	63	2.8%	41	2.6%
Northern Cape	569	2.3%	810	2.4%	913	1.9%	846	2.5%
Northern Cape - urban	414	69.7%	608	75.7%	658	72.0%	653	80.1%
Northern Cape - rural traditional	87	14.8%	126	14.9%	178	21.4%	118	12.5%
Northern Cape - rural farms	68	15.5%	70	9.3%	77	6.6%	69	7.4%
Free State	455	5.6%	657	5.3%	1,127	5.2%	712	5.5%
Free State - urban	392	85.2%	581	87.1%	983	85.7%	633	87.0%
Free State - rural traditional	37	9.1%	48	6.5%	98	10.0%	48	6.8%
Free State - rural farms	26	5.8%	26	6.4%	46	4.3%	29	6.2%
KwaZulu-Natal	1,766	15.8%	2,843	17.9%	1,553	17.8%	3,100	17.3%
KwaZulu-Natal - urban	381	39.8%	957	50.2%	806	56.0%	1,142	53.3%
KwaZulu-Natal - rural traditional	1,144	47.6%	1,645	41.8%	613	40.1%	1,705	40.0%
KwaZulu-Natal - rural farms	241	12.6%	229	8.0%	134	3.9%	241	6.7%
North West	483	7.2%	708	7.3%	1,230	7.5%	764	5.4%
North West - urban	181	41.1%	288	46.1%	545	44.9%	330	39.4%
North West - rural traditional	267	52.5%	387	50.7%	576	49.4%	394	56.5%
North West - rural farms	35	6.4%	27	3.2%	109	5.6%	35	4.0%
Gauteng	933	28.4%	1,755	28.0%	1,252	27.5%	2,248	29.8%
Gauteng - urban	835	95.4%	1,651	96.5%	1,137	97.7%	2,127	96.0%
Gauteng - rural traditional	22	1.4%	36	1.9%	71	1.2%	40	1.5%
Gauteng - rural farms	76	3.2%	57	1.6%	44	1.1%	70	2.5%
Mpumalanga	552	7.8%	788	7.4%	1,257	7.7%	911	8.4%
Mpumalanga - urban	281	55.5%	420	55.8%	541	49.1%	521	62.0%
Mpumalanga - rural traditional	188	36.3%	282	38.0%	606	43.6%	302	32.2%
Mpumalanga - rural farms	83	8.1%	83	6.2%	110	7.3%	85	5.8%
Limpopo	601	10.0%	873	8.7%	1,373	9.8%	965	8.6%
Limpopo - urban	111	26.5%	152	21.4%	242	20.0%	197	24.0%
Limpopo - rural traditional	480	65.0%	700	74.9%	1,035	75.1%	740	71.2%
Limpopo - rural farms	10	8.5%	16	3.7%	96	4.9%	23	4.8%

In table 2 we focus on the distribution of children (0 -17 years) across age groups and provinces, in NIDS and the SADHS. There are similarities with results presented in table 1. For example, the number of children included in the panel (NIDS) has increased significantly over time, with over

6,000 more children in 2017 than in 2008. The distributions across provinces, age groups and income quintiles do not differ significantly across NIDS years. There is little variation when comparisons are made between NIDS (waves 4 & 5) and the SADHS, except across socio-economic levels. However, this can be attributed to the different ways that the two surveys derive socio-economic status; i.e. the use of a wealth index in SADHS as opposed to income in NIDS.

Table 2: Children’s characteristics (NIDS), % weighted

	NIDS					SADHS
	2008 (Wave 1)	2010/11 (Wave 2)	2012 (Wave 3)	2014/15 (Wave 4)	2017 (Wave 5)	2016
N (children 0 - 18 years):	11502	13614	14752	16547	17613	
Across age groups:						
0 - 2 years	17.5%	17.4%	16.3%	17.3%	17.6%	16.5%
3 - 4 years	11.2%	11.8%	13.4%	12.8%	12.5%	12.4%
5 - 6 years	10.3%	11.1%	12.1%	11.8%	11.1%	11.3%
7 - 8 years	11.4%	10.5%	10.6%	11.1%	12.6%	12.0%
9 - 10 years	10.9%	10.8%	9.9%	10.4%	11.4%	11.7%
11 - 12 years	11.0%	11.1%	10.9%	10.4%	10.6%	10.9%
13 - 14 years	11.5%	10.8%	10.2%	10.8%	9.9%	10.0%
15 - 17 years	16.3%	16.6%	16.7%	15.4%	14.4%	15.3%
Across provinces:						
Western Cape	9.2%	9.9%	9.9%	9.2%	9.7%	9.1%
Eastern Cape	15.2%	14.6%	14.6%	14.3%	12.7%	14.5%
Northern Cape	2.2%	2.0%	2.1%	2.1%	2.4%	2.2%
Free State	5.5%	5.2%	5.2%	5.0%	5.1%	5.5%
KwaZulu-Natal	22.5%	21.3%	21.0%	20.9%	21.1%	19.3%
North West	6.3%	7.1%	7.1%	6.9%	5.3%	7.0%
Gauteng	18.8%	19.7%	19.5%	20.7%	23.5%	21.1%
Mpumalanga	8.5%	8.3%	8.4%	8.5%	9.0%	8.9%
Limpopo	11.9%	12.0%	12.1%	12.5%	11.4%	12.4%
Across income quintiles / wealth quintiles:						
Poorest 20%	31.8%	29.6%	31.1%	31.4%	31.8%	23.3%
2	25.9%	24.5%	24.6%	22.7%	24.2%	21.6%
3	18.0%	17.4%	17.5%	19.1%	19.1%	21.1%
4	11.1%	14.0%	12.6%	14.9%	15.1%	18.9%
Richest 20%	13.2%	14.6%	14.2%	11.9%	9.8%	15.1%

*Percentages weighted

Table 3 contains a comparative analysis of children’s characteristics in NIDS and the SADHS. This is restricted to children under five years because one of the main aims of this paper is to examine disparities in nutritional outcomes across the two types of surveys, and SADHS does not contain anthropometric data for children aged 5 – 14 years. In the SADHS, only half of the households sampled were targeted for biomarker data collection (including anthropometric measurements). Thus, the table provides statistics on all children under five years as well as those included in the biomarker sub-sample. The results show very little variation in children’s

characteristics across the two SADHS samples. There are also no significant variations across NIDS and the SADHS, except in provincial distribution in KwaZulu-Natal and North West provinces, where the percentages of under five-year olds represented in the SADHS samples are higher than in NIDS. Similar to the results presented in table 2 (household distribution), the SADHS results are comparable to NIDS wave 4.

Table 3: Under-five year old characteristics (NIDS vs SADHS), % weighted

	NIDS 2008	NIDS 2014/15	DHS (2016)	DHS 2016 (anthropometric sub-sample)	NIDS (2017)
		n	n	n	n
Number of children: 0 - 59 months	3236	4508	4137	2024	4682
% across age groups:					
0 - 2 years	61.0%	57.5%	57.2%	57.0%	58.5%
3 -4 years	39.0%	42.5%	42.8%	43.0%	41.5%
% across gender:					
Male	50.3%	50.5%	51.3%	51.6%	50.6%
Female	49.7%	49.5%	48.7%	48.4%	49.4%
% across province:					
Western Cape	9.8%	9.3%	8.7%	7.4%	8.7%
Eastern Cape	14.6%	15.2%	12.8%	12.9%	13.0%
Northern Cape	2.2%	2.1%	1.9%	1.8%	2.5%
Free State	4.6%	4.9%	4.9%	4.6%	5.2%
KwaZulu-Natal	22.7%	20.2%	18.4%	18.7%	21.0%
North West	6.3%	6.3%	7.4%	7.7%	5.2%
Gauteng	21.3%	21.7%	24.5%	24.9%	24.2%
Mpumalanga	8.0%	7.8%	9.5%	10.1%	9.1%
Limpopo	10.5%	12.5%	12.0%	11.9%	11.0%
% across income/wealth quintiles:					
Poorest 20%	33.3%	33.0%	22.5%	22.4%	33.0%
2	26.2%	22.2%	22.9%	23.0%	23.5%
3	17.0%	19.4%	21.5%	22.9%	19.1%
4	10.3%	14.9%	18.8%	17.3%	14.8%
Richest 20%	13.2%	10.5%	14.3%	14.4%	9.7%

Attrition in Anthropometric data in NIDS and the SADHS

The analysis presented in tables 2 and 3 indicate that there are no significant variations in the child populations represented in the SADHS and NIDS, particularly when we consider the 2014/15 and 2016 datasets. In this section, focus is on analysing the availability and comparability of anthropometric data in the two surveys. As previously discussed, both surveys collect data on child anthropometrics, but there are some differences in data availability. For example, while all children included in NIDS are eligible for anthropometric data collection, only those aged under five years or 15-17 years are eligible for this exercise in the SADHS. In

addition, the extent of and variability in attrition levels in the anthropometric data differ within and across the two surveys. This is discussed in detail in the next section.

All children included in the NIDS surveys are eligible for anthropometric measurements, but a significant number and proportion of anthropometric data is missing across the 5 waves. In wave 1 for example, 23% of children did not have data on heights and weights (see table 1). In wave 2, over a third (36%) of children did not have data on anthropometric measurements. Across all waves, missing data was highest for children living in the poorest 40% of households. In wave 1, close to two thirds (65%) of these children (whose data is missing) are found in households belonging to the first 3 income quintiles. When considering all five waves of NIDS, analyses show that missing anthropometric data is highest in wave 2, where 37% of the children did not have data on both anthropometric measurements (table 4). Fifty three percent of these children 53% were part of the panel cohort (i.e. they were part of wave 1), 31% were new respondents while 16% were movers (i.e. left the panel). The percentage of children with missing anthropometric data declines in waves 3, 4 and 5 (18%, 12% and 15% respectively). However, as was the case in wave 2, missing anthropometric data in wave 3 largely affects children who were from previous waves: 54% were from wave 2 (stayers), 25% were new respondents, while the rest (21%) had moved and their data was not captured. A similar observation is made for waves 4 and 5, where approximately 50% of those whose anthropometric data was missing were respondents who had been included in the preceding waves.

Analysis of missing anthropometric data within provinces shows that the highest percentage of missing data was in the Western Cape and Free State provinces, and the lowest in North-West and KwaZulu-Natal. In wave 2, the Western Cape, Northern Cape, Free State, North-West and Mpumalanga provinces had the highest percentages of missing data. Between waves 1 and 2, there was a significant increase in missing data in the North west, Eastern Cape and Limpopo, provinces that have a significant share of the population (including children) living in poverty. There was also a significant increase in the Northern Cape provinces, although the child population in that province is the lowest in the country. As presented earlier in table 2, across all the waves, the highest proportion of children are found in the KwaZulu-Natal, Gauteng and Eastern Cape provinces. Analysis of missing data within income quintiles show that the percentage is highest in the richer quintiles (see table 4). However, figure 1 shows that the distribution of missing data is concentrated among the poorest households. Because of the high proportion of missing data in wave 2, figure 2 looks at the distribution of missing data across income, across provinces. Similar to results shown in figure 1, missing data is concentrated in the poorest households.

Table 4: Missing anthropometric data in NIDS, % weighted

	NIDS				
	2008	2010/11	2012	2014/15	2017
Number of children (0 - 17 years):	11 502	13 613	14 750	16 547	17 612
Number of children with height data	9 035	8 006	12 090	14 548	14 987
Number of children with missing height data	2 467	5 607	2 660	1 999	2 625
% of children missing height	23.5%	36.7%	12.8%	7.7%	10.3%
Number of children with weights	8 911	7 882	12 138	14 571	15 031
Number of children with missing weights data	2 591	5 731	2 612	1 976	2 581
% of children missing weight	24.5%	37.2%	12.4%	7.5%	9.9%
Number of children with anthropometric data (weight & height)	9 109	8 041	12 143	14 574	15 038
Number of children with missing anthropometric data	2 393	5 572	2 607	1 973	2 574
% of children with heights or weights missing	22.8%	36.4%	12.4%	7.5%	9.9%
% of children with missing anthropometric data, within income quintiles					
Poorest 20%	18.9%	34.7%	13.7%	8.2%	8.6%
2	20.9%	35.1%	11.1%	7.1%	7.3%
3	24.7%	31.8%	9.2%	5.8%	6.4%
4	25.7%	40.5%	12.0%	7.7%	11.5%
Richest 20%	30.5%	43.5%	16.2%	8.8%	24.3%
% of children with missing anthropometric data, within province					
Western Cape	46.8%	48.4%	17.4%	7.7%	11.5%
Eastern Cape	20.3%	33.2%	14.0%	7.0%	7.1%
Northern Cape	29.2%	47.1%	15.0%	8.6%	10.3%
Free State	33.2%	39.6%	9.1%	5.1%	10.5%
KwaZulu-Natal	16.6%	25.6%	12.8%	7.2%	8.2%
North West	13.5%	40.2%	17.7%	5.5%	9.2%
Gauteng	23.0%	38.3%	9.5%	8.2%	13.5%
Mpumalanga	21.8%	45.0%	11.8%	7.9%	8.2%
Limpopo	18.1%	34.9%	8.4%	9.0%	8.3%

in table 6, we explore missing data among children under 5 years, given the high level of missing data amongst the age group. The estimates presented in **Table 5** includes a comparison of NIDS (waves 1 – 5) and the SADHS (2016). Compared to NIDS waves 4 and 5, the SADHS has significantly higher percentages of missing data (26% vs 16% and 20% in NIDS waves 4 and 5).

Table 6: Children under 5 years with missing anthropometric data, % weighted

	NIDS					SADHS
	2008	2010	2012	2014/15	2017	2016
Number of children (0-59 months)	3236	3722	3979	4508	4682	2024
Number of children with height data	2184	1582	3065	3781	3775	1507
Number of children with missing height data	1052	2140	914	727	907	517
% of children missing height	35.5%	55.8%	20.7%	15.4%	18.5%	28.5%
Number of children with weights	2165	1575	3113	3804	3822	1506
Number of children with missing weights data	1071	2147	866	704	860	518
% of children missing weight	35.7%	55.7%	19.2%	14.7%	17.3%	28.4%
Number of children with all anthropometric data (weight & height)	2108	1551	3062	3778	3771	1491
Number of children with missing anthropometric data	1128	2171	917	730	911	533
% of children with heights or weights missing	33.7%	55.0%	19.2%	14.7%	17.1%	27.9%
By age group						
0-2 years	42.2%	64.6%	26.2%	21.8%	23.6%	27.5%
3-4 years	20.3%	41.1%	10.6%	0.5%	7.9%	28.4%
Male	31.8%	55.9%	18.7%	15.8%	17.5%	28.7%
Female	35.5%	54.1%	19.6%	13.6%	16.7%	27.0%
Western Cape	55.4%	67.9%	24.4%	10.7%	14.9%	56.8%
Eastern Cape	34.7%	48.2%	20.5%	13.7%	11.8%	17.8%
Northern Cape	47.9%	64.9%	17.2%	14.3%	23.0%	29.5%
Free State	45.9%	50.4%	14.2%	11.5%	17.1%	20.9%
KwaZulu-Natal	26.2%	44.1%	22.6%	15.6%	11.9%	20.8%
North West	23.0%	55.5%	20.2%	14.8%	23.8%	15.0%
Gauteng	32.9%	58.6%	14.8%	14.2%	22.9%	38.8%
Mpumalanga	29.1%	78.5%	20.4%	16.0%	17.3%	22.1%
Limpopo	31.1%	46.5%	16.0%	18.6%	17.4%	24.5%

Inverse probability weighting

The high rates of missing data means that a substantial number of children are excluded from computation of malnutrition rates, increasing the risk of bias in the estimates. We use inverse probability weighting to reduce this bias by opometric sample to be representative of the entire child population (Woolridge, 2010). We begin by modelling the relationship between missing anthropometric data and other variables of interest (**table 7**). To do this, we use logistic regressions to model the probability of a child having anthropometric data. The variable of interest is a dummy representing missing child anthropometric data (0 = missing, and 1=non-missing). The predictor variables include household income, child's age in months, child's

gender (female vs male), child's population group (African, Coloured, Indian vs White), provincial residence, geographical area (rural traditional and rural farm vs urban), household size, matric qualification (at least one household member with a matric). As shown in the table, the probability of having anthropometric data in wave 1 increases with increase in age up to a certain point, and then decreases. The probability increases if a child is resident in any of the 8 provinces (relative to the Western Cape), living in rural traditional areas (vs urban areas). The probability decreases with increased in household size (although this relationship is not linear). A logistical regression with wave 2 data, which had significantly more missing anthropometric data (see table 4 & 6), shows that the probability of having anthropometric data increases with increase in age and being resident in KwaZulu-Natal, Eastern Cape, Gauteng and Limpopo provinces, and increases if a child is resident in the Northern Cape province or if they live in a household where the caregiver's height data is missing. Wave 5 analysis shows that probability of having anthropometric data increases with increase, and for African and Coloured children, while it decreases for those living in the Free State province and for those whose caregivers have missing height data.

Table 7: Logit regression: probability of a child having anthropometric data, NIDS

VARIABLES	wave 1	wave 2	wave 3	wave 4	wave 5
Household income (log)	-0.00951 (0.0475)	-0.00660 (0.0412)	0.0924 (0.0606)	-0.0165 (0.0956)	-0.0309 (0.0635)
Age (months)	0.0657*** (0.00557)	0.0711*** (0.00531)	0.104*** (0.00675)	0.124*** (0.0106)	0.114*** (0.00714)
Age squared	-0.000530*** (6.11e-05)	-0.000615*** (5.98e-05)	-0.000937*** (7.69e-05)	-0.00108*** (0.000126)	-0.00100*** (8.19e-05)
Age cubed	1.27e-06*** (1.88e-07)	1.71e-06*** (1.91e-07)	2.42e-06*** (2.37e-07)	2.69e-06*** (3.99e-07)	2.53e-06*** (2.60e-07)
Female	0.0352 (0.0741)	0.0743 (0.0676)	0.0317 (0.0934)	0.191 (0.126)	-0.00453 (0.0995)
African	0.207 (0.261)	0.348 (0.254)	1.171*** (0.307)	0.727 (0.465)	2.077*** (0.213)
Coloured	0.481* (0.278)	0.138 (0.285)	0.615* (0.329)	0.747 (0.486)	1.429*** (0.250)
Indian	-0.309 (0.433)	-0.538 (0.416)	0.0166 (0.490)	1.426 (0.957)	0.0485 (0.316)
Eastern Cape	0.940*** (0.177)	0.394** (0.186)	-0.260 (0.217)	0.0732 (0.315)	0.0415 (0.221)
Northern Cape	0.684*** (0.147)	-0.0691 (0.161)	-0.0231 (0.209)	-0.134 (0.277)	-0.0660 (0.205)
Free State	0.576*** (0.200)	0.181 (0.208)	0.309 (0.252)	0.502 (0.354)	-0.453* (0.231)
KwaZulu-Natal	1.247*** (0.192)	0.983*** (0.186)	0.0178 (0.230)	0.0493 (0.333)	0.0639 (0.247)

North West	1.591***	0.231	-0.404	0.425	-0.294
	(0.210)	(0.223)	(0.285)	(0.338)	(0.244)
Gauteng	1.371***	0.444**	0.460**	0.0870	-0.308
	(0.193)	(0.187)	(0.219)	(0.315)	(0.197)
Mpumalanga	0.995***	0.00369	-0.0563	-0.0348	0.0749
	(0.198)	(0.188)	(0.240)	(0.335)	(0.229)
Limpopo	0.879***	0.391*	0.286	-0.161	-0.180
	(0.197)	(0.202)	(0.241)	(0.361)	(0.260)
Rural traditional	0.742***	-0.0253	0.310***	-0.0560	0.00176
	(0.0914)	(0.0851)	(0.114)	(0.161)	(0.143)
Rural formal	0.165	0.127	0.156	-0.197	0.497**
	(0.147)	(0.128)	(0.203)	(0.285)	(0.245)
Household size	-0.124	0.302***	0.113	0.0780	0.182*
	(0.0951)	(0.0591)	(0.0888)	(0.0969)	(0.106)
Household size squared	0.0197**	-0.0235***	-0.0164*	-0.00701	-0.0134
	(0.00983)	(0.00502)	(0.00853)	(0.00907)	(0.00918)
Household size cubed	-0.000724**	0.000441***	0.000438*	0.000173	0.000285
	(0.000296)	(0.000122)	(0.000229)	(0.000234)	(0.000220)
Matric in household	-0.0803	-0.196***	0.0511	-0.204*	-0.296***
	(0.0787)	(0.0692)	(0.0972)	(0.120)	(0.0999)
Constant	-1.969***	-3.325***	-2.680***	-1.199	-2.414***
	(0.580)	(0.508)	(0.710)	(1.101)	(0.638)
R squared	11.32%	10.59%	11.57%	18.04%	19.35%
Observations	11,492	12,156	13,648	15,588	16,260
Robust standard errors in parentheses					
*** p<0.01, ** p<0.05, * p<0.1					

**The logit model predicts the probability of a child (aged 0 – 17 years) having anthropometric data. The data has been weighted*

A similar model is estimated for SADHS and is presented in table 8. The results show that probability of a child having anthropometric data increases if the child is resident in the all provinces except Limpopo, relative to being resident in the Western Cape. Similarly, the probability increases for children living in rural areas (relative to urban areas). It decreases for those living in households where there was at least one person with matric qualification, or for those living in the wealthiest 20% of households.

Table 8: Logit regression: probability of a child having anthropometric data, SADHS

VARIABLES	2016
Wealth index	-2.63e-06
	(2.00e-06)
Age (months)	-0.00133
	(0.00407)
Female	0.0346
	(0.139)
Eastern Cape	0.805***

	(0.278)
Northern Cape	0.657**
	(0.285)
Free State	1.445***
	(0.273)
KwaZulu-Natal	0.943***
	(0.264)
North West	1.366***
	(0.311)
Gauteng	0.648**
	(0.254)
Mpumalanga	0.892***
	(0.293)
Limpopo	0.342
	(0.299)
Rural traditional	0.697***
	(0.226)
Rural formal	1.108**
	(0.461)
Household size	-0.432**
	(0.212)
Household size squared	0.0616***
	(0.0235)
Household size cubed	-0.00181**
	(0.000712)
Matric in household	-0.332**
	(0.157)
Electricity (1=yes)	0.236
	(0.355)
Formal house (1=yes)	0.0817
	(0.252)
Television (1=yes)	-0.0320
	(0.235)
Refrigerator (1=yes)	0.0177
	(0.230)
Car (1=yes)	-0.279
	(0.189)
Improved toilet (1=yes)	0.312*
	(0.174)
Improved water (1=yes)	-0.237
	(0.209)
Number of rooms	-0.0506
	(0.0723)
Constant	0.729
	(0.761)
R squared	11.79%
Observations	2,024
Robust standard errors in parentheses	

*** p<0.01, ** p<0.05, * p<0.1	
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**The logit model predicts the probability of a child (aged 0 – 59 months) having anthropometric data. The data has been weighted.*

After estimating the logit models above (tables 7 and 8), we estimate predicted probability of a child having anthropometric data and use these results to calculate inverse probability weights for the sample. First, we calculate the inverse of predicted probability (i.e. 1/predicted probability). We then use these results to generate new weights by multiplying the inverse probability with published weights contained in the dataset. The new weights are then applied to analysis of malnutrition levels. This process was carried out for both NIDS and the SADHS, and table 10 presents summary statistics for published and computed IP weights, across the five waves of NIDS and the SADHS. Across all the five waves of NIDS, the means, medians, and spread of the IP weights are larger and more spread out than those of the published weights, particularly in waves 1, 2 and 3 (NIDS) and the SADHS. In tables 9 and 10, we compare child distribution estimates using both published and IP weights. The estimates also include the population and distribution across age groups, gender, population group and geographical location, household education levels and income quintiles for NIDS wave 1 and the SADHS. A comparison is made between child distribution using published weights, children with anthropometric data (published weights), and for children with anthropometric data (using the computed IP weights). When comparing the percentages across categories between all children and those with anthropometric data, using the published weights, the differences in estimates are observed in some age groups, population groups and provinces. However, the differences are most notable in the 0-2-year age group, across all five waves of NIDS. These differences disappear when the computed IP weights are applied to estimates from children with anthropometric data, and their distribution now resembles that of all children using the published weights. Additional tables that show these comparisons using NIDS wave 2 – 4 can be found in the Appendix section (tables 1-4).

Table 9: Child population distribution published vs IP weights (NIDS wave 1)

		All children (published weights)	Children with anthropometrics (published weights)	Children with anthropometrics (new weights)
N (0-17 years old)		11502	9109	9109
Distribution across categories (%):				
Age groups	0 - 2 years	17.5%	13.1%	18.2%
	3 - 4 years	11.2%	11.5%	11.2%
	5 - 6 years	10.3%	10.7%	9.7%
	7 - 8 years	11.4%	12.3%	11.1%
	9 - 10 years	10.9%	11.7%	10.6%
	11 - 12 years	11.0%	11.9%	11.2%
	13 - 14 years	11.5%	11.6%	11.3%
	15 - 17 years	16.3%	17.1%	16.5%
Gender	Male	50.4%	50.3%	50.9%
	Female	49.6%	49.7%	49.1%
Population group	African	84.1%	86.5%	82.8%
	Coloured	8.5%	7.3%	8.7%
	Indian	1.9%	1.7%	2.1%
	White	5.5%	4.5%	6.4%
Geographical location	Western Cape	9.2%	6.3%	9.8%
	Eastern Cape	15.2%	15.7%	15.0%
	Northern Cape	2.2%	2.0%	2.1%
	Free State	5.5%	4.8%	5.5%
	KwaZulu-Natal	22.5%	24.3%	22.4%
	North West	6.3%	7.0%	6.2%
	Gauteng	18.8%	18.8%	18.7%
	Mpumalanga	8.5%	8.6%	8.5%
	Limpopo	11.9%	12.6%	11.7%
Education in the household	No matric	52.6%	54.1%	52.0%
	Matric	47.4%	45.9%	48.0%
Household income quintiles	Poorest 20%	31.8%	33.4%	31.4%
	2	25.9%	26.5%	25.6%
	3	18.0%	17.6%	17.4%
	4	11.1%	10.6%	11.5%
	Richest 20%	13.2%	11.9%	14.1%

Table 10: Child population distribution published vs IP weights (SADHS)

SADHS (2016)				
		All children (published weights)	Children with anthropometrics (published weights)	Children with anthropometrics (new weights)
N (0-59 months)		2024	1522	1522
Distribution across categories (%):				
Age groups	0 - 2 years	57.0%	57.3%	57.7%
	3 - 4 years	43.0%	42.7%	42.3%
Gender	Male	51.6%	51.0%	52.4%
	Female	48.4%	49.0%	47.6%
Geographical location	Western Cape	7.4%	4.4%	7.9%
	Eastern Cape	12.9%	14.7%	12.6%
	Northern Cape	1.8%	1.8%	1.8%
	Free State	4.6%	5.1%	4.7%
	KwaZulu-Natal	18.7%	20.5%	18.0%
	North West	7.7%	9.0%	7.4%
	Gauteng	24.9%	21.1%	25.4%
	Mpumalanga	10.1%	10.9%	10.3%
	Limpopo	11.9%	12.4%	11.9%
Education in the household	No matric	45.3%	50.0%	43.4%
	Matric	54.7%	50.0%	56.6%
Household wealth quintiles	Poorest 20%	22.4%	25.8%	21.1%
	2	23.0%	24.5%	21.8%
	3	22.9%	24.3%	23.9%
	4	17.3%	15.9%	18.6%
	Richest 20%	14.4%	9.5%	14.6%

What are the trends in stunting levels in South Africa? Figure 1 shows the weighted distribution (IP weights) of height for age (HAZ) for all children in NIDS waves 1 to 5. This graph is restricted to HAZ distribution between -4 and 2. Compared to waves 4 and 5, there are more children in waves 1-3 with HAZs below the -2 threshold for stunting. A larger upward shift in waves 4 and 5 is observed when we focus on HAZ between -2 and 0. In **table 11**, we explore distribution in more detail, grouping the HAZ ranges into six categories (<-4, between -4 and <-2, between >=-2 and <-1, between >=-1 & <=0, and >1, in order to determine where the biggest shifts occurred. Among all children (0-17 year olds), the main shifts across the HAZ ranges appear to have occurred in group 2 (-4 and <-2 group) and group 4 (>=-1 & <=0). However, when we consider the distribution across age groups, then we see that shifts in the HAZ distribution between waves 1 and 2 occurred mainly occurred among the youngest children (0-2 years and 3-4 years). This trend is also observed across other age groups, although the shifts between waves 1 and 2 was largest in the 0-2-year olds and 9-10-year olds, and among male children and those living in KwaZulu-Natal and Limpopo provinces (see table 5 in the appendix). Across all children and all categories, there

was a significant increase in the percentage of children whose HAZ fell within this range (≥ -4 and < -2) between waves 3 and 4.

Figure 1: Weighted HAZ distribution using IP weights (0-17 year olds), NIDS

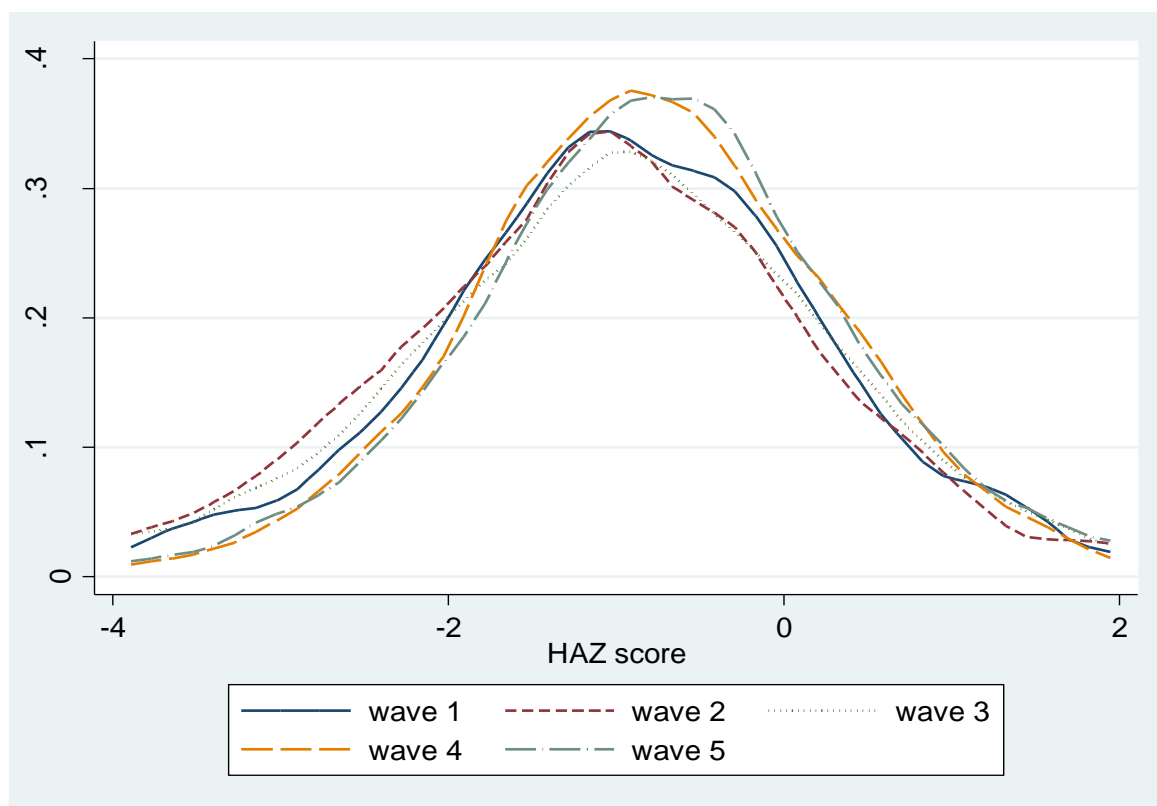


Table 11: % of change across HAZ ranges

		N (height data)	Group 1 HAZ <-4	Group 2 HAZ >=-4 & HAZ <-2	Group 3 HAZ >=-2 & HAZ <-1	Group 4 HAZ >=-1 & HAZ <=0	Group 5 HAZ >0 & HAZ <=1	Group 6 HAZ >1
Overall rates	Wave 1	8580	2.1%	15.8%	29.5%	30.9%	14.5%	7.2%
Overall rates	Wave 2	6566	2.4%	20.1%	29.6%	28.3%	13.6%	6.0%
Overall rates	Wave 3	9985	3.1%	17.9%	26.9%	29.6%	15.1%	7.4%
Overall rates	Wave 4	12654	0.7%	11.8%	29.3%	34.7%	17.7%	5.8%
Overall rates	Wave 5	14754	0.7%	11.9%	27.2%	35.5%	17.6%	7.1%
0-2 years	Wave 1	1438	3.8%	21.6%	25.5%	21.5%	11.8%	15.8%
	Wave 2	958	4.4%	37.6%	20.9%	18.2%	7.1%	11.8%
	Wave 3	1420	6.8%	25.1%	17.9%	19.9%	12.8%	17.5%
	Wave 4	2070	2.7%	21.0%	25.6%	24.9%	14.6%	11.2%
	Wave 5	2503	2.2%	21.2%	23.6%	24.1%	13.8%	15.0%
3-4 years	Wave 1	953	1.9%	20.9%	33.4%	26.5%	11.1%	6.1%
	Wave 2	791	2.1%	23.5%	29.5%	28.9%	10.8%	5.1%
	Wave 3	1261	4.6%	18.4%	29.5%	28.6%	11.3%	7.6%
	Wave 4	1593	0.7%	15.3%	33.0%	31.8%	15.1%	4.1%
	Wave 5	1811	0.6%	15.1%	32.4%	33.2%	15.4%	3.3%
5-6 years	Wave 1	839	1.9%	12.3%	28.2%	35.7%	14.9%	7.0%
	Wave 2	750	0.9%	14.2%	32.0%	33.1%	13.6%	6.2%
	Wave 3	1195	1.8%	12.7%	25.2%	31.6%	22.7%	6.0%

	Wave 4	1444	0.7%	7.7%	27.1%	39.8%	19.6%	5.1%
	Wave 5	1570	0.1%	8.2%	26.8%	39.6%	19.2%	6.1%
7-8 years	Wave 1	977	1.9%	10.5%	25.9%	34.7%	21.0%	6.0%
	Wave 2	714	1.1%	13.6%	31.0%	32.1%	15.8%	6.5%
	Wave 3	1126	3.0%	12.0%	26.2%	30.1%	18.3%	10.4%
	Wave 4	1426	0.2%	7.5%	22.7%	41.3%	21.3%	7.0%
	Wave 5	1874	0.4%	5.0%	26.0%	38.6%	20.7%	9.3%
9-10 years	Wave 1	928	2.3%	9.5%	30.9%	32.6%	19.6%	5.1%
	Wave 2	762	2.1%	15.7%	27.1%	29.8%	17.0%	8.3%
	Wave 3	1016	2.2%	16.9%	27.3%	31.1%	18.5%	4.0%
	Wave 4	1351	0.4%	7.9%	27.1%	37.8%	20.8%	5.9%
	Wave 5	1710	0.1%	8.4%	25.4%	38.0%	21.0%	7.2%
11-12 years	Wave 1	987	1.4%	16.7%	32.0%	28.4%	13.9%	7.5%
	Wave 2	749	2.7%	16.2%	29.5%	28.8%	18.8%	4.0%
	Wave 3	1205	0.7%	21.4%	27.6%	32.4%	11.7%	6.2%
	Wave 4	1369	0.1%	9.6%	30.0%	35.5%	19.7%	5.0%
	Wave 5	1628	0.2%	11.2%	26.0%	36.3%	20.0%	6.4%
13-14 years	Wave 1	985	2.4%	16.9%	28.4%	34.0%	13.7%	4.6%
	Wave 2	727	3.4%	19.4%	34.6%	25.7%	13.4%	3.6%
	Wave 3	1072	4.8%	21.0%	28.1%	31.1%	12.8%	2.2%
	Wave 4	1443	0.2%	13.9%	34.3%	30.9%	17.3%	3.4%
	Wave 5	1525	1.0%	13.6%	25.3%	37.6%	17.3%	5.2%
15-17 years	Wave 1	1472	0.9%	15.0%	32.1%	36.5%	12.4%	3.2%
	Wave 2	1114	1.9%	17.0%	33.4%	31.2%	14.2%	2.4%
	Wave 3	1689	1.2%	15.0%	32.4%	33.1%	14.2%	4.1%
	Wave 4	1959	0.2%	8.0%	33.8%	38.9%	15.6%	3.5%
	Wave 5	2133	0.3%	9.5%	31.9%	40.9%	15.4%	2.0%

Children are considered stunted if their respective height-for-age (HAZ) Z scores are less than -2 standard deviations from those of a healthy child of similar age and sex. Table 12 presents a comparison of the overall stunting levels (weighted using IP weights). There is marginal difference when we apply NIDS published weights in the computation of stunting estimates (see a comparison in table 5 in the appendices). The estimates presented in table 12 show a decline in overall stunting rates between 2008 and 2017, from 18% to 13%. Across all the five waves, stunting rates are highest for the youngest age groups, and decline significantly after age 5, although they increase again in adolescence. This trend is observable in all the 5 waves. Analysis also shows that in wave 1, stunting rates are worse among male children (compared to females), among Black African children, and in the Eastern Cape, Northern Cape, Free State, KwaZulu-Natal and Limpopo provinces. In 2017 (wave 5), stunting rates were worst in the Eastern Cape, Northern Cape, Free State and the North-West provinces. When we assess children's stunting across household education levels (matric vs no matric), we see significantly lower stunting rates in all waves for children who live in household where none of the residents have matric. Table 16 also contains a comparison of stunting rates across income quintiles. Except for waves 4 and 5, the differences in stunting rates in the first three quintiles are minimal. When we consider changes in between waves, we see a sharp increase in overall stunting rates (suggesting worsening child nutritional outcomes) in waves 2 and 3, after which there is a significant decline in wave 4. There are minimal changes in stunting estimates between wave 4 and 5.

Table 12: Cross-sectional analysis of stunting across various categories, IP weights

		wave 1 (2008)			wave 2 (2010)			wave 3 (2012)			wave 4 (2014/15)			wave 5 (2017)		
All children	0 - 17 years	18.0%	16.5%	19.6%	22.7%	20.8%	24.7%	21.3%	19.6%	23.1%	12.7%	11.7%	13.8%	12.7%	11.6%	13.8%
Age groups	0 - 2 years	25.3%	21.3%	29.6%	41.2%	34.4%	48.5%	31.9%	27.4%	36.7%	23.7%	20.8%	26.9%	23.3%	19.9%	27.0%
	3 -4 years	22.9%	19.3%	27.0%	25.9%	21.1%	31.4%	23.3%	20.0%	27.0%	16.5%	14.2%	19.1%	15.7%	13.1%	18.8%
	5 - 6 years	14.2%	11.1%	18.0%	15.1%	11.9%	18.8%	14.9%	12.1%	18.2%	8.1%	6.6%	10.0%	8.3%	6.6%	10.3%
	7 - 8 years	12.5%	10.1%	15.3%	15.1%	11.6%	19.5%	15.0%	12.5%	18.0%	7.5%	5.9%	9.5%	5.3%	4.2%	6.8%
	9 - 10 years	11.8%	9.1%	15.3%	18.2%	15.2%	21.7%	19.2%	15.5%	23.5%	8.3%	6.6%	10.4%	8.4%	6.8%	10.5%
	11 - 12 years	18.1%	14.9%	21.7%	19.2%	15.4%	23.6%	22.6%	18.9%	26.8%	9.9%	7.9%	12.3%	11.3%	9.3%	13.7%
	13 - 14 years	19.4%	15.8%	23.5%	22.6%	18.8%	27.0%	25.6%	22.0%	29.6%	15.0%	12.1%	18.4%	14.6%	12.1%	17.5%
15 - 17 years	15.9%	13.4%	18.8%	18.4%	15.6%	21.4%	16.7%	14.0%	19.8%	8.1%	6.6%	10.0%	9.8%	8.3%	11.7%	
Gender	Male	18.8%	16.8%	21.0%	24.6%	22.2%	27.2%	23.1%	20.7%	25.7%	14.3%	12.9%	15.8%	14.4%	13.0%	15.9%
	Female	17.2%	15.3%	19.3%	20.7%	18.2%	23.5%	19.5%	17.5%	21.6%	11.2%	10.1%	12.4%	10.9%	9.7%	12.3%
Population group	African	19.2%	17.6%	20.8%	24.2%	22.3%	26.3%	22.8%	20.9%	24.7%	13.6%	12.5%	14.7%	85.1%	26.3%	98.9%
	Coloured	18.0%	13.9%	23.0%	20.8%	14.1%	29.5%	19.7%	14.9%	25.5%	11.0%	7.6%	15.7%	12.9%	11.7%	14.2%
	Indian	9.0%	2.0%	32.1%	14.6%	9.5%	21.7%	8.5%	3.4%	19.4%	7.0%	2.6%	17.9%	15.4%	12.5%	18.9%
	White	5.8%	2.3%	14.1%	4.2%	1.4%	11.7%	5.0%	2.1%	11.4%	3.1%	1.1%	8.0%	9.1%	4.7%	16.8%
Geographical location	Western Cape	11.9%	7.8%	17.8%	19.5%	12.1%	29.9%	14.7%	10.1%	21.0%	8.4%	5.8%	12.0%	4.5%	2.3%	8.7%
	Eastern Cape	26.7%	22.9%	30.9%	28.3%	23.4%	33.8%	22.0%	16.4%	28.8%	14.9%	12.8%	17.2%	11.4%	8.5%	15.1%
	Northern Cape	23.7%	19.8%	28.2%	18.3%	13.3%	24.7%	21.9%	17.8%	26.6%	19.6%	16.2%	23.5%	13.4%	11.1%	16.0%
	Free State	19.1%	13.7%	26.0%	21.2%	15.5%	28.2%	19.5%	15.7%	23.9%	17.7%	14.6%	21.3%	19.5%	16.1%	23.5%
	KwaZulu-Natal	18.1%	15.8%	20.7%	24.3%	21.2%	27.6%	21.7%	18.8%	25.0%	14.2%	12.6%	15.9%	17.3%	13.5%	21.9%
	North West	13.8%	9.8%	19.1%	18.9%	12.3%	27.9%	21.3%	15.4%	28.9%	16.9%	13.0%	21.6%	12.9%	11.6%	14.3%
	Gauteng	16.1%	11.7%	21.6%	19.0%	14.8%	23.9%	20.4%	16.7%	24.6%	9.1%	6.9%	11.9%	17.0%	11.8%	23.9%
	Mpumalanga	12.9%	9.0%	18.2%	18.2%	13.6%	24.0%	24.4%	17.7%	32.6%	9.2%	7.2%	11.6%	10.4%	7.7%	13.8%
Limpopo	20.1%	16.1%	25.0%	28.1%	23.3%	33.4%	25.0%	20.5%	30.2%	14.0%	10.9%	17.9%	10.1%	7.5%	13.4%	
Education (household)	No matric	21.1%	19.3%	23.1%	28.0%	25.6%	30.6%	24.2%	21.9%	26.7%	14.5%	13.1%	16.1%	13.7%	10.5%	17.8%
	Matric	14.7%	12.6%	17.0%	17.6%	15.0%	20.6%	18.6%	16.6%	20.6%	11.0%	9.7%	12.5%	14.9%	13.4%	16.6%
Household income quintiles	Poorest 20%	21.4%	18.7%	24.4%	27.2%	24.1%	30.6%	24.6%	21.6%	27.8%	15.6%	14.0%	17.4%	10.8%	9.6%	12.2%
	2	19.0%	16.4%	21.8%	26.2%	23.0%	29.7%	24.3%	21.7%	27.0%	15.1%	13.4%	17.0%	16.3%	14.5%	18.2%
	3	18.2%	14.8%	22.2%	21.1%	17.8%	24.7%	19.8%	16.9%	23.1%	12.7%	10.4%	15.4%	12.5%	10.8%	14.3%
	4	14.6%	10.9%	19.2%	22.5%	16.5%	29.9%	20.5%	16.4%	25.4%	9.1%	6.9%	11.9%	12.3%	10.2%	14.7%
	Richest 20%	11.5%	7.5%	17.1%	9.9%	6.2%	15.6%	11.5%	7.8%	16.7%	5.3%	3.5%	7.9%	9.7%	7.3%	12.7%

In table 13, we focus on stunting rates across a range of age cohorts (2008-2017). Among the <2 year old cohorts, stunting rates increased from 23% in 2008 to 31% in 2010, but declined to 20% in 2012 when the children would be aged 4-5 years. The increase in stunting rates among 2-3-year olds is not surprising, given that at this stage children are weaned off breast milk to household diets, and it is also during this period that they are more likely to pick up infections. Stunting rates decline after age 4, but increase again in adolescence (11-14 years).

Table 13: Stunting rates (weighted) across age cohorts, NIDS waves 1-5

		2008	2010	2012	2014	2017
Cohort 1		<2 years	2-3 years	4-5 years	6-7 years	9-10 years
	<2 years	23.1%	30.8%	20.4%	8.1%	8.4%
Cohort 2		2-3 years	4-5 years	6-7 years	8-9 years	11-12 years
	2-3 years	28.3%	22.7%	13.4%	8.8%	11.3%
Cohort 3		4-5 years	6-7 years	8-9 years	10-11 years	13-14 years
	4-5 years	15.8%	13.9%	17.1%	8.9%	14.6%
Cohort 4		6-7 years	8-9 years	10-11 years	13-14 years	15-16 years
	6-7 years	14.2%	15.0%	18.8%	14.1%	9.9%
Cohort 5		10-11 years	13-14 years	15-16 years	16-17 years	
	10-11 years	12.2%	22.8%	20.7%	8.2%	
Cohort 6		13-14 years	15-16 years	17-18 years		
	13-14 years	19.3%	19.8%	7.6%		
Cohort 7		15-16 years	17-18 years			
	15-16 years	14.7%	16.2%			
Cohort 8		17-18 years				
	17-18 years	14.5%				

Malnutrition rates across the balanced panel

In figure 2, we show the weighted HAZ distribution across the balanced panel, among children in the NIDS panel for whom anthropometric data was collected during all the 5 waves.

Figure 2: Weighted HAZ scores across all children, balanced panel (NIDS)

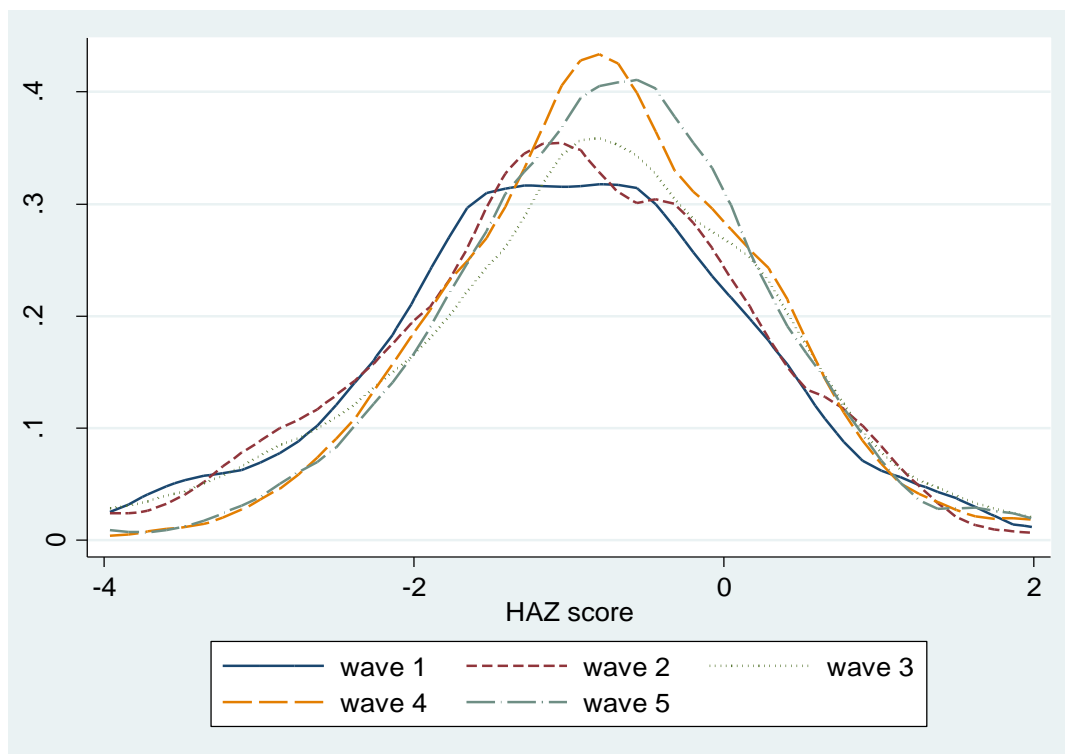


Table 14 contains detailed analysis of HAZ and stunting rates across the balanced panel using IP weights. Stunting rates declined from 21% (wave 1) to 20% (wave 2) to 16% (wave 3) to 9% and 10% in waves 4 and 5 respectively. Similar trend is observed when we consider stunting rates across population groups. Analysis across age groups reveals declining stunting rates in wave 1 with increase in age (see table 15), and this is consistent with previous cross-sectional analysis that shows stunting rates are highest in the youngest age groups. The population in older age groups is also smaller in waves 1 and 2 because at that stage, we expect a significant proportion of the total child population will be concentrated in the younger age groups. This is also evident in figure 3, which shows that the population distribution in waves 1 and 2 are fairly similar, with a slight change in wave 3 (which also corresponds with a slight decline in overall stunting rates). In waves 3 and 4, the population distribution changes significantly with over half the children in the panel aged between 7-11 years (wave 4), and 13-17 years (wave 5). As the population of older children increases in wave 3, 4 and 5, there is an increase in stunting rates. As was previously discussed in the cross-sectional analysis, studies have demonstrated higher prevalence in poor anthropometric status among adolescents and young teenagers. Across geographical location, we observe declines in stunting rates in urban, rural traditional and rural formal areas. Across provinces, we find a reduction in stunting levels in all except Eastern Cape, KwaZulu-Natal and Mpumalanga provinces where stunting levels increased between waves 4 and 5.

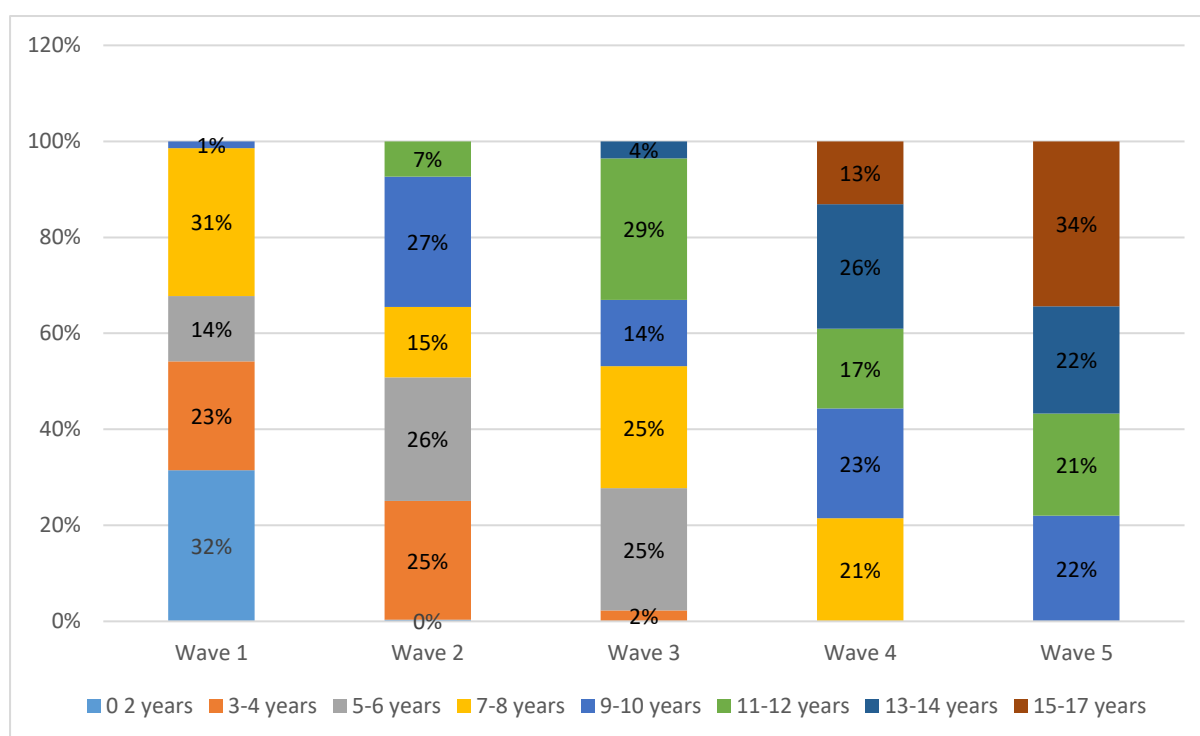
Table 14: Summary stats (HAZ) & Stunting rates by category, balanced panel

		Wave 1	Wave 2	Wave 3	Wave 4	Wave 5
	N	1733	1733	1733	1733	1733
HAZ	Mean HAZ	-0.92	-0.99	-0.79	-0.71	-0.72
	Median HAZ	-0.96	-1.03	-0.75	-0.75	-0.73
STUNTING	% stunted	20.5%	19.9%	15.9%	9.3%	10.3%
	By Gender:					
	Male	20.3%	18.6%	14.7%	9.2%	10.5%
	Female	20.7%	21.2%	14.7%	9.4%	10.0%
	By Race:					
	African	20.4%	21.6%	17.6%	9.6%	11.2%
	Coloured	25.6%	19.7%	13.2%	9.9%	3.7%
	Indian	5.0%	1.7%		13.7%	5.2%
	White	17.3%				
	By Geographical location					
	Urban	20.4%	18.9%	11.3%	7.6%	10.3%
	Rural traditional	20.3%	21.5%	21.7%	10.8%	10.0%
	Rural formal	23.5%	14.4%	10.6%	15.9%	12.1%
	By Province:					
	Western Cape	28.8%	14.2%	8.1%	7.9%	6.8%
	Eastern Cape	25.8%	21.7%	22.4%	9.1%	10.0%
	Northern Cape	19.1%	18.4%	14.8%	13.1%	11.0%
	Free State	26.7%	16.0%	5.1%	4.0%	10.6%
	KwaZulu-Natal	14.5%	17.3%	14.5%	9.8%	10.0%
	North West	17.4%	25.1%	20.4%	13.5%	13.5%
	Gauteng	21.0%	23.5%	14.8%	7.9%	11.0%
	Mpumalanga	8.9%	17.0%	20.8%	5.5%	9.8%
	Limpopo	24.3%	23.1%	19.6%	13.9%	11.2%
	By Household quintiles					
	1	19.8%	22.2%	16.9%	10.2%	9.6%
	2	21.9%	24.3%	21.2%	13.0%	8.8%
	3	25.3%	23.1%	19.1%	8.4%	14.4%
4	15.4%	15.8%	11.7%	11.7%	10.9%	
5	17.9%	13.5%	8.5%	1.9%	5.9%	

Table 15: Stunting rates across the balanced panel, waves 1-5

N	Age	2008	2010	2012	2014/15	2017
373	0-2 years	30%	31%	16%	9%	8%
	Upper CI (95%)	23.0%	22.7%	10.6%	5.6%	4.9%
	Lower CI (95%)	37.4%	41.0%	24.2%	15.3%	13.3%
467	3-4 years	22%	12%	9%	7%	14%
	Upper CI (95%)	15.8%	7.3%	5.7%	4.3%	9.1%
	Lower CI (95%)	29.7%	18.4%	14.1%	9.9%	19.7%
432	5-6 years	15%	18%	18%	12%	13%
	Upper CI (95%)	11.1%	12.8%	13.2%	8.4%	9.0%
	Lower CI (95%)	21.1%	24.4%	24.1%	17.9%	17.2%
449	7-8 years	13%	16%	20%	10%	8%
	Upper CI (95%)	9.1%	11.7%	14.9%	6.5%	5.2%
	Lower CI (95%)	18.6%	22.2%	27.1%	15.7%	12.7%

Figure 3: Child population distribution across the panel, by age groups



The above analysis suggests catch-up growth among children in the NIDS panel. We explore this possibility by focusing on stunting recovery among children aged under 5 years in 2008, and their status in 2017 when they would be aged between 14-19 years (figure 4). We find that among children in this age group, 26% of them were stunted in 2008. Within this group, stunting rates had declined to 10% in 2017. Table 16 contains more information, across

more categories. Recovery was highest among children who were aged 0-2 years in 2008 (of those who were stunted, 20% had recovered). Recovery rates while also high among children from Coloured ethnic group, and those from the Western Cape, Eastern Cape and Free State provinces.

Figure 4: Stunting rates across panel, for children in aged under 5 years in 2008

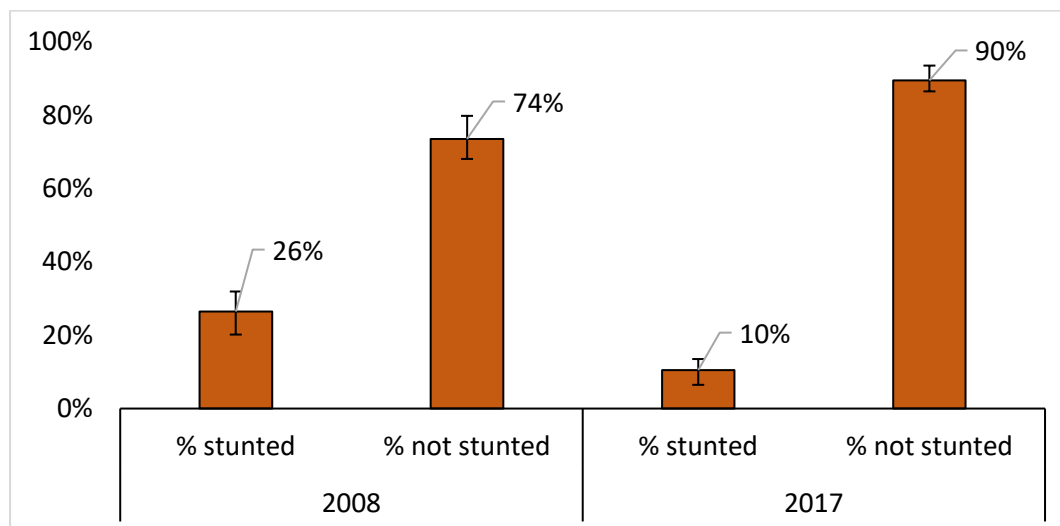


Table 16: Stunting status in 2017 compared to 2008

		Not stunted in 2008 or 2017			Stunted in 2008, recovered in 2017		
		%	Upper CI (95%)	Lower CI (95%)	%	Upper CI (95%)	Lower CI (95%)
Age groups	0-2 years	72%	64%	78%	20%	15%	27%
	3-4 years	75%	68%	81%	11%	7%	17%
	5-6 years	80%	73%	85%	8%	4%	13%
	7-8 years	82%	76%	86%	10%	7%	15%
Gender	Male	77%	71%	82%	13%	9%	17%
	Female	76%	71%	81%	14%	10%	18%
Population group	African	77%	72%	81%	12%	10%	15%
	Coloured	75%	59%	86%	21%	12%	36%
	Indian	95%	68%	99%			
	White	81%	39%	96%	19%	4%	61%
Geographical type	Urban	75%	68%	81%	14%	10%	20%
	Rural traditional	78%	74%	82%	12%	9%	15%
	Rural formal	77%	60%	88%	11%	4%	25%
Province	Western Cape	69%	55%	80%	24%	14%	38%
	Eastern Cape	70%	60%	78%	20%	14%	29%
	Northern Cape	81%	68%	89%	8%	5%	15%
	Free State	66%	44%	83%	23%	10%	44%
	KwaZulu-Natal	81%	76%	85%	9%	6%	13%
	North West	78%	65%	87%	8%	3%	21%

	Gauteng	79%	64%	89%	10%	5%	19%
	Mpumalanga	87%	80%	92%	3%	1%	7%
	Limpopo	74%	67%	80%	15%	10%	21%

Comparing estimates from NIDS and the SADHS

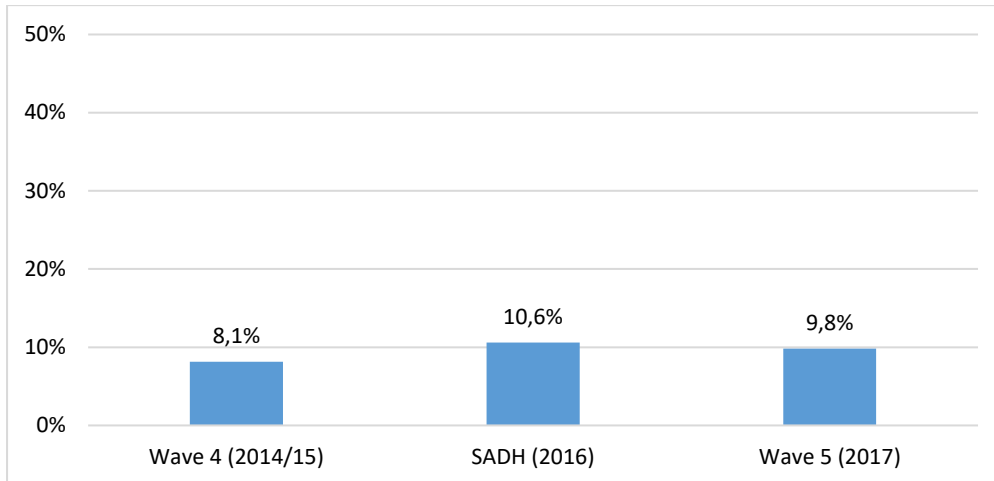
In **table 17**, a comparative analyses using data from NIDS and the SADHS examines variations in stunting, overweight, and underweight percentages among children under 5 years. Both old (published) and new (IP) weights have been applied to the data but, regardless of the weights used, we find an increase in stunting and overweight rates between NIDS waves 1 and 2, followed by a decline in wave 3. Thereafter, there is a much larger (6.7%-points) decline stunting rates in wave 4. Stunting rates in SADHS are significantly higher (27%) than the estimates from NIDS waves 4 and 5, and this does not change with application of the new weights. However, when we compare stunting prevalence among new entrants (temporary sample) into the panel at wave 4 and 5, we find that the estimates are fairly close to those reported in the SADHS, with 23% and 26% of new entrant stunted in wave 4 and 5. A possible explanation for this is that children who are part of the continuing sample record improved anthropometric statuses in subsequent waves, as was seen in earlier cross-sectional and panel analysis.

Table 17: Stunting rates among children under 5 years, NIDS & SADHS

	Children 0-59 months	Stunting		Overweight		Underweight	
		Published weights	IP weights	Published weights	IP weights	Published weights	IP weights
Wave 1	% mean	25.5%	24.4%	13.3%	14.4%	9.3%	8.7%
	Lower CI	22.7%	21.4%	10.6%	10.9%	7.2%	6.8%
	Upper CI	28.5%	27.6%	15.9%	17.8%	11.3%	10.7%
Wave 2	% mean	33.0%	34.6%	18.0%	19.5%	7.8%	8.5%
	Lower CI	29.3%	30.2%	14.5%	15.0%	5.9%	6.3%
	Upper CI	36.9%	39.3%	21.5%	24.1%	9.7%	10.7%
Wave 3	% mean	27.7%	27.9%	17.1%	17.4%	8.9%	8.7%
	Lower CI	24.7%	24.7%	14.9%	15.1%	7.1%	6.9%
	Upper CI	30.9%	31.4%	19.3%	19.6%	10.7%	10.5%
Wave 4	% mean	20.8%	20.6%	13.0%	13.6%	5.0%	5.1%
	Lower CI	18.7%	18.6%	10.5%	11.0%	3.8%	3.8%
	Upper CI	23.0%	22.8%	15.5%	16.2%	6.2%	6.4%
SADHS (2016)	% mean	27.4%	26.5%	13.3%	13.0%	5.8%	5.7%
	Lower CI	24.2%	23.0%	11.2%	10.7%	4.1%	4.1%
	Upper CI	30.9%	30.3%	15.5%	15.3%	7.5%	7.4%
Wave 5	% mean	20.9%	20.2%	11.7%	12.3%	5.7%	5.5%
	Lower CI	18.3%	17.6%	9.9%	10.4%	4.1%	3.9%
	Upper CI	23.7%	23.0%	13.6%	14.3%	7.3%	7.0%

The SADHS also contains anthropometric data on children aged 15-17 years. As show in figure 5 we find no significant differences between SADHS and NIDS, within this age group. On the other hand, overweight and underweight rates are fairly comparable across the three surveys (NIDS waves 4 and 5, and the SADHS).

Figure 5: Stunting rates among 15-17 year olds, NIDS and SADHS



What are the predictors of malnutrition in South Africa?

A logistic regression model to estimate the probability of a child under 5 years being stunted, using various demographic and socio-economic-level variables as predictors. In all waves, higher household income or wealth status (SADHS) is associated with reduced probability of a child being stunted. In waves 3-5 and the SADHS, the probability of stunting decreases with increase in a child's age, while it decreases for female children (wave 3-5). In all waves except 1 and 4, children from the African population group have a higher probability of stunting, compared to White children. On the other hand, except for wave 5, children from the coloured population group have a higher probability of stunting, compared to White children. In wave 1, children from the Eastern Cape, Northern Cape, Free State, Gauteng and Limpopo have increased probability of being stunted, compared to children from the Western Cape Province. In wave 2, the data does not show that being resident in any of the provinces, compared to the Western Cape, increases or decreases the probability of stunting. In wave 3, Limpopo provinces, there is an increased probability of being stunted relative to those in the Western Cape. In waves 4 a being resident in the Eastern Cape, Northern Cape, Free State, North West and Limpopo provinces vs the Western Cape provinces increases the probability of a child being stunted. In wave 5, only the Free State is found to be associated with stunting. In the case of the SADHS, living in the Eastern Cape, Northern Cape, Free State and Limpopo are found to increase the probability of a child being stunted. In waves 2-5 and the SADHS, the probability of stunting decreases for children living in households where at least one person has a matric qualification.

Table 18: Cross-sectional logistic regression model, stunting under five-year olds

VARIABLES	NIDS					SADHS
	2008	2010	2012	2014/15	2017	2016
Household income (log) NIDS & wealth index (SADHS)	-0.106 (0.104)	-0.212* (0.122)	-0.241** (0.0975)	-0.322*** (0.0958)	-0.271*** (0.0918)	-6.61e-07*** (2.16e-07)
Age (months)	0.116 (0.0839)	0.124 (0.125)	0.171** (0.0680)	0.264*** (0.0716)	0.406*** (0.0619)	0.0404*** (0.0146)
Age squared	-0.00315 (0.00281)	-0.00576 (0.00400)	-0.00628*** (0.00230)	-0.00769*** (0.00237)	-0.0133*** (0.00217)	-0.00119** (0.000489)
Age cubed	2.28e-05 (2.82e-05)	6.29e-05 (3.86e-05)	6.18e-05*** (2.32e-05)	6.18e-05*** (2.35e-05)	0.000124*** (2.23e-05)	9.48e-06** (4.77e-06)
Female	-0.0586 (0.157)	-0.0568 (0.210)	-0.332** (0.140)	-0.327** (0.129)	-0.483*** (0.133)	-0.0289 (0.0305)
African	0.497 (0.794)	15.64*** (0.604)	2.085*** (0.805)	14.01*** (0.384)	0.268 (0.562)	
Coloured	1.397* (0.747)	15.18*** (0.777)	2.409*** (0.821)	14.02*** (0.401)	0.495 (0.663)	
Indian	-3.024** (1.328)	15.01*** (1.281)	1.863 (1.299)	14.30*** (1.048)	0.211 (0.722)	
Eastern Cape	1.140** (0.495)	-0.190 (0.664)	0.0626 (0.340)	0.570* (0.338)	0.0492 (0.367)	0.189*** (0.0510)
Northern Cape	1.108*** (0.406)	-1.039* (0.618)	0.235 (0.351)	0.913*** (0.306)	0.522 (0.346)	0.215*** (0.0562)
Free State	1.379** (0.543)	-0.180 (0.725)	0.600 (0.385)	0.815** (0.351)	0.723* (0.387)	0.0829** (0.0414)
KwaZulu-Natal	0.549 (0.491)	-0.302 (0.645)	0.205 (0.329)	0.547* (0.329)	0.223 (0.363)	0.0137 (0.0441)
North West	0.736 (0.550)	-0.397 (0.698)	0.240 (0.364)	0.813** (0.353)	0.481 (0.398)	0.0493 (0.0409)
Gauteng	1.174** (0.482)	0.0673 (0.713)	0.215 (0.348)	0.0207 (0.341)	0.215 (0.388)	0.0807 (0.0499)
Mpumalanga	0.684 (0.597)	-0.394 (0.757)	0.368 (0.366)	0.108 (0.386)	0.0929 (0.404)	0.0666 (0.0534)
Limpopo	1.234** (0.514)	0.156 (0.693)	0.732** (0.355)	0.646* (0.345)	0.412 (0.382)	0.165** (0.0657)
Rural traditional	0.148 (0.190)	-0.134 (0.250)	-0.123 (0.182)	-0.0290 (0.173)	0.0650 (0.167)	0.0321 (0.0354)
Rural formal	-0.0922 (0.311)	-0.387 (0.351)	-0.469 (0.296)	0.194 (0.303)	-0.0348 (0.281)	-0.00962 (0.0719)
Household size	-0.399 (0.299)	-0.210 (0.230)	-0.309* (0.162)	-0.180 (0.209)	0.285** (0.139)	0.0156 (0.0451)
Household size squared	0.0561 (0.0349)	0.0227 (0.0218)	0.0388** (0.0158)	0.0388 (0.0244)	-0.0171 (0.0132)	7.56e-05 (0.00481)
Household size cubed	-0.00202 (0.00124)	-0.000614 (0.000582)	-0.00107** (0.000452)	-0.00151* (0.000836)	0.000281 (0.000365)	-1.45e-05 (0.000147)
Matric in household	-0.170 (0.167)	-0.507** (0.205)	-0.371** (0.146)	-0.287* (0.146)	-0.395*** (0.138)	-0.0833** (0.0360)
Constant	-1.971 (1.474)	-13.77*** (1.684)	-1.362 (1.385)	-15.06*** (1.261)	-3.317*** (1.280)	-0.211 (0.179)
Observations	2,026	1,238	2,397	3,230	3,657	1,387
R squared	0.0612	0.0798	0.0705	0.1034	0.0799	0.092

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

DISCUSSION

Our analysis shows high rates of stunting among children under 5 years, particularly high among 0-2-year olds, across all waves of NIDS and the SADHS. Stunting rates are higher among male children compared to females, and among children of poorer socio-economic status. These estimates are similar to other studies that have found high levels of stunting (Zembe-Mkabile et al., 2016; Matsungu et al., 2017). We found that stunting rates decline year 5, in line with others from previous studies in South Africa and other parts of the world (Graham, Hochfeld & Stuart, 2018). However, stunting rates rise again in adolescence, another when there is increased demand for adequate nutrients to support healthy growth and development. High stunting rates among adolescents has also been observed in other local and international studies (Tathiah et al., 2013; Oldewage-Theron, Egal & Moroka, 2015; Malongane & Mbhenyane, 2017).

We used inverse probability weighting to deal with the high levels of missing anthropometric data. We found that applying the IP weights among the anthropometric sub-sample resulted in individual and household characteristics that were similar to those of the general child populations included in the surveys. However, in all the surveys, use of the IP weights did not result in any substantial changes in the anthropometric estimates. It is possible that unobserved measurement issues in wave 2 of NIDS could have resulted in the high stunting estimates witnessed in that wave. We also observed a significant decline in stunting estimates between wave 3 and 4, particularly in the youngest age groups. This also coincided with a significant decline in the percentage of missing anthropometric data, which was more prevalent in more urbanised provinces and households of higher socio-economic status. Because waves 4 and 5 captured anthropometric data from such households which generally have lower stunting rates, this lowered the estimates substantially. It is also worth noting that generally, the new entrants into the NIDS panel in wave 4 and 5 had lower stunting rates, compared to waves 2 and 3.

With regards to SADHS and NIDS (2014/15 & 2017) comparison, our study found that the three surveys reported fairly similar estimates for stunting among children aged 15-17, and in wasting and over nutrition rates among under 5-year olds. However, we found significant differences in stunting rates among under 5 year olds, even after applying IP weights to the NIDS and the SADHS estimates This could be due to either of several factors including measurement issues in the SADHS especially among very young children, or improved living conditions and poverty status among households in the NIDS panel.

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Appendix

Table 1: Child population distribution published vs IP weights (NIDS wave 2)

		All children (published weights)	Children with anthropometrics (published weights)	Children with anthropometrics (new weights)
N (0-17 years old)		13614	8041	8041
Distribution across categories (%):				
Age groups	0 - 2 years	17.4%	9.7%	17.0%
	3 - 4 years	11.8%	10.9%	11.7%
	5 - 6 years	11.1%	11.8%	11.2%
	7 - 8 years	10.5%	11.1%	10.2%
	9 - 10 years	10.8%	11.9%	11.0%
	11 - 12 years	11.1%	11.4%	10.8%
	13 - 14 years	10.8%	12.0%	11.0%
	15 - 17 years	16.6%	21.2%	17.1%
Gender	Male	50.1%	49.4%	50.1%
	Female	49.8%	50.5%	49.9%
Population group	African	84.2%	86.5%	84.4%
	Coloured	8.4%	7.3%	8.7%
	Indian	1.8%	1.5%	1.7%
	White	5.5%	4.7%	5.2%
Geographical location	Western Cape	9.9%	9.9%	10.2%
	Eastern Cape	14.6%	14.6%	14.5%
	Northern Cape	2.0%	2.0%	2.1%
	Free State	5.2%	5.2%	5.5%

	KwaZulu-Natal	21.3%	21.3%	21.1%
	North West	7.0%	7.0%	7.2%
	Gauteng	19.7%	19.7%	19.4%
	Mpumalanga	8.3%	8.3%	7.7%
	Limpopo	12.0%	12.0%	12.4%
Education in the household	No matric	48.4%	50.8%	48.4%
	Matric	51.6%	49.2%	51.6%
Household income quintiles	Poorest 20%	29.6%	30.4%	29.0%
	2	24.4%	24.9%	24.2%
	3	17.4%	18.6%	18.5%
	4	14.0%	13.1%	14.0%
	Richest 20%	14.6%	12.9%	14.3%

Table 2: Child population distribution published vs IP weights (NIDS wave 3)

		All children (published weights)	Children with anthropometrics (published weights)	Children with anthropometrics (new weights)
N (0-17 years old)		14752	12143	12143
Distribution across categories (%):				
Age groups	0 - 2 years	16.3%	13.7%	16.4%
	3 - 4 years	13.4%	13.6%	13.0%
	5 - 6 years	12.1%	13.0%	12.1%
	7 - 8 years	10.6%	11.4%	10.6%
	9 - 10 years	9.8%	10.2%	9.7%
	11 - 12 years	10.9%	11.4%	11.2%
	13 - 14 years	10.2%	10.1%	10.3%
	15 - 17 years	16.7%	16.6%	16.7%
Gender	Male	50.5%	50.4%	50.5%
	Female	49.5%	49.6%	49.5%
Population group	African	84.8%	86.1%	84.7%
	Coloured	8.0%	7.6%	8.1%
	Indian	1.8%	1.6%	1.8%
	White	5.3%	4.7%	5.4%
Geographical location	Western Cape	9.9%	9.3%	9.9%
	Eastern Cape	14.6%	14.3%	14.7%
	Northern Cape	2.1%	2.0%	2.1%
	Free State	5.2%	5.4%	5.2%
	KwaZulu-Natal	21.0%	20.9%	21.0%

	North West	7.1%	6.7%	7.0%
	Gauteng	19.5%	20.2%	19.5%
	Mpumalanga	8.4%	8.5%	8.4%
	Limpopo	12.1%	12.7%	12.1%
Education in the household	No matric	48.7%	49.1%	48.8%
	Matric	51.3%	50.9%	51.2%
Household income quintiles	Poorest 20%	31.1%	30.7%	30.5%
	2	24.6%	25.0%	24.9%
	3	17.5%	18.1%	18.0%
	4	12.6%	12.7%	12.8%
	Richest 20%	14.1%	13.5%	13.8%

Table 3: Child population distribution published vs IP weights (NIDS wave 4)

		All children (published weights)	Children with anthropometrics (published weights)	Children with anthropometrics (new weights)
N (0-17 years old)		16547	14574	14574
Distribution across categories (%):				
Age groups	0 -2 years	17.3%	14.6%	17.2%
	3 - 4 years	12.8%	13.2%	12.7%
	5 - 6 years	11.8%	12.4%	11.8%
	7 - 8 years	11.1%	11.5%	11.0%
	9 - 10 years	10.3%	10.8%	10.3%
	11 - 12 years	10.4%	10.9%	10.6%
	13 - 14 years	10.8%	11.1%	11.0%
	15 - 17 years	15.4%	15.6%	15.5%
Gender	Male	50.2%	49.9%	50.3%
	Female	49.7%	50.1%	49.7%
Population group	African	85.5%	85.5%	85.4%
	Coloured	7.8%	7.9%	7.8%
	Indian	1.7%	1.8%	1.8%
	White	4.9%	4.8%	5.0%
Geographical location	Western Cape	9.2%	9.2%	9.2%
	Eastern Cape	14.3%	14.4%	14.3%
	Northern Cape	2.1%	2.0%	2.1%
	Free State	5.0%	5.1%	5.0%
	KwaZulu-Natal	20.9%	21.0%	20.9%

	North West	6.9%	7.1%	6.9%
	Gauteng	20.7%	20.5%	20.7%
	Mpumalanga	8.5%	8.4%	8.5%
	Limpopo	12.5%	12.3%	12.5%
Education in the household	No matric	48.2%	48.7%	48.3%
	Matric	51.8%	51.3%	51.7%
Household income quintiles	Poorest 20%	31.4%	31.2%	31.1%
	2	22.7%	22.7%	22.7%
	3	19.1%	19.5%	19.4%
	4	14.9%	14.8%	14.9%
	Richest 20%	11.9%	11.8%	11.9%

Table 4: Child population distribution published vs IP weights (NIDS wave 5)

		All children (published weights)	Children with anthropometrics (published weights)	Children with anthropometrics (new weights)
N (0-17 years old)				
Distribution across categories (%):				
Age groups	0 - 2 years	17.5%	14.9%	18.6%
	3 - 4 years	12.5%	12.7%	12.2%
	5 - 6 years	11.1%	11.6%	10.8%
	7 - 8 years	12.6%	13.3%	12.3%
	9 - 10 years	11.4%	11.9%	11.2%
	11 - 12 years	10.6%	11.1%	10.7%
	13 - 14 years	9.9%	10.2%	10.0%
	15 - 17 years	14.4%	14.3%	14.1%
Gender	Male	50.0%	50.0%	49.9%
	Female	49.7%	49.7%	50.1%
Population group	African	85.4%	87.6%	84.6%
	Coloured	8.3%	8.1%	8.3%
	Indian	1.7%	1.3%	1.8%
	White	4.4%	3.1%	5.2%
Geographical location	Western Cape	9.6%	9.5%	9.6%
	Eastern Cape	12.7%	13.1%	12.7%
	Northern Cape	2.4%	2.4%	2.4%
	Free State	5.1%	5.0%	5.1%

	KwaZulu-Natal	21.1%	21.5%	21.1%
	North West	5.3%	5.4%	5.3%
	Gauteng	23.5%	22.6%	23.7%
	Mpumalanga	8.9%	9.1%	8.9%
	Limpopo	11.4%	11.6%	11.3%
Education in the household	No matric	44.7%	46.0%	44.4%
	Matric	55.3%	54.0%	55.6%
Household income quintiles	Poorest 20%	31.7%	32.2%	31.0%
	2	24.2%	24.9%	24.0%
	3	19.1%	19.8%	19.5%
	4	15.1%	14.8%	15.1%
	Richest 20%	9.8%	8.3%	10.3%

Table 5: Summary statistics for various HAZ ranges, across gender, province and income quintiles.

		N	HAZ= <-2 (stunting)	HAZ <-4	HAZ>=-4 & HAZ <-2	HAZ>=-2 & HAZ <-1	HAZ>=-1 & HAZ <=0	HAZ>0 & HAZ <=1	HAZ>1
Male	Wave 1	4346	18.7%	2.1%	16.6%	30.4%	30.6%	12.8%	7.4%
	Wave 2	3281	24.3%	2.2%	22.1%	28.5%	27.9%	12.9%	6.4%
	Wave 3	5076	22.8%	3.3%	19.6%	27.0%	29.3%	13.9%	7.0%
	Wave 4	6373	14.1%	0.9%	13.2%	29.7%	33.8%	17.0%	5.4%
	Wave 5	7352	14.3%	0.6%	13.7%	27.1%	35.4%	16.7%	6.4%
Female	Wave 1	4234	17.1%	2.1%	15.0%	28.5%	31.3%	16.2%	7.0%
	Wave 2	3285	20.7%	2.6%	18.1%	30.8%	28.7%	14.3%	5.6%
	Wave 3	4909	19.1%	3.0%	16.1%	26.7%	29.9%	16.4%	7.9%
	Wave 4	6281	11.0%	0.6%	10.4%	28.9%	35.6%	18.3%	6.3%
	Wave 5	7402	10.9%	0.7%	10.2%	27.2%	35.6%	18.4%	7.9%
African	Wave 1	7120	19.1%	2.3%	16.8%	30.6%	30.6%	13.8%	5.9%
	Wave 2	5487	23.9%	2.5%	21.4%	29.2%	28.8%	12.4%	5.6%
	Wave 3	8391	22.5%	3.4%	19.1%	27.8%	29.8%	13.5%	6.4%
	Wave 4	10744	13.5%	0.8%	12.7%	29.7%	35.6%	15.9%	5.3%
	Wave 5	12533	12.9%	0.7%	12.1%	28.3%	36.5%	16.7%	5.7%
Coloured	Wave 1	748	17.6%	2.4%	15.3%	32.0%	29.5%	14.7%	6.1%
	Wave 2	592	21.6%	1.7%	19.9%	33.8%	25.3%	10.9%	8.4%
	Wave 3	840	19.2%	2.4%	16.8%	27.1%	30.9%	15.8%	7.0%
	Wave 4	996	10.5%	0.5%	10.0%	34.3%	30.9%	18.5%	5.9%
	Wave 5	1216	15.4%	0.7%	14.7%	26.8%	29.8%	18.4%	9.6%
Indian	Wave 1	185	9.2%		9.2%	24.9%	47.6%	16.7%	1.7%
	Wave 2	121	14.6%		14.6%	25.4%	42.6%	12.6%	4.8%
	Wave 3	204	8.1%		8.1%	25.8%	35.3%	20.8%	10.0%
	Wave 4	231	6.8%		6.8%	33.2%	24.8%	29.9%	5.3%
	Wave 5	258	9.0%		9.0%	22.0%	31.4%	28.8%	8.8%
White	Wave 1	528	5.8%	0.2%	5.6%	11.7%	31.1%	22.6%	28.7%
	Wave 2	366	4.6%	1.8%	2.8%	30.7%	20.9%	36.3%	7.5%
	Wave 3	550	4.8%	0.7%	4.1%	12.5%	23.2%	37.0%	22.5%
	Wave 4	682	2.9%	0.6%	2.3%	13.4%	28.8%	40.4%	14.4%
	Wave 5	742	4.6%		4.6%	10.5%	29.9%	27.2%	27.9%
Western Cape	Wave 1	811	11.8%	0.3%	11.4%	24.5%	34.1%	15.8%	13.8%
	Wave 2	681	19.1%	1.3%	17.8%	29.4%	27.3%	14.2%	10.0%
	Wave 3	1009	14.1%	1.9%	12.2%	25.6%	33.5%	14.8%	11.9%
	Wave 4	1202	8.3%	0.7%	7.6%	28.1%	33.5%	23.1%	7.0%
	Wave 5	1400	11.4%	1.1%	10.3%	26.4%	34.3%	18.9%	9.0%
Eastern Cape	Wave 1	1175	26.6%	5.4%	21.2%	28.3%	26.0%	10.2%	9.0%
	Wave 2	931	28.6%	3.9%	24.7%	30.0%	27.5%	10.1%	3.8%
	Wave 3	1455	21.7%	4.4%	17.4%	28.3%	28.6%	14.6%	6.7%
	Wave 4	1788	14.9%	1.2%	13.7%	31.8%	34.0%	15.1%	4.3%
	Wave 5	1870	13.4%	0.9%	12.5%	29.3%	35.3%	17.1%	5.0%
Northern Cape	Wave 1	189	23.5%	0.8%	22.7%	33.1%	29.8%	8.6%	5.0%
	Wave 2	145	18.1%	1.4%	16.7%	29.0%	30.1%	16.1%	6.6%
	Wave 3	217	21.7%	1.7%	20.0%	31.2%	27.9%	13.3%	5.9%
	Wave 4	263	19.0%	0.9%	18.1%	29.8%	33.8%	12.8%	4.6%
	Wave 5	349	19.7%	0.8%	18.9%	31.6%	32.8%	11.7%	4.1%

		N	HAZ= <-2 (stunting)	HAZ <-4	HAZ>=-4 & HAZ <-2	HAZ>=-2 & HAZ <-1	HAZ>=-1 & HAZ <=0	HAZ>0 & HAZ <=1	HAZ>1
Free State	Wave 1	484	19.0%	0.9%	18.1%	30.3%	31.4%	13.9%	5.4%
	Wave 2	369	21.2%	1.7%	19.5%	30.8%	27.6%	14.8%	5.7%
	Wave 3	543	18.7%	2.2%	16.5%	27.4%	35.1%	13.6%	5.2%
	Wave 4	634	17.5%	0.6%	17.0%	27.0%	30.5%	17.0%	8.0%
	Wave 5	728	17.1%	1.1%	16.1%	28.3%	34.1%	17.6%	2.8%
KwaZulu-Natal	Wave 1	1968	18.1%	1.3%	16.8%	32.0%	31.0%	13.3%	5.6%
	Wave 2	1380	24.4%	2.9%	21.4%	27.7%	29.8%	10.7%	7.4%
	Wave 3	2087	21.2%	3.5%	17.7%	27.3%	31.0%	14.3%	6.2%
	Wave 4	2648	14.0%	0.6%	13.4%	29.6%	35.7%	16.0%	4.6%
	Wave 5	3112	12.9%	0.6%	12.2%	27.3%	35.5%	18.2%	6.2%
North West	Wave 1	555	13.7%	0.2%	13.5%	25.5%	32.0%	23.4%	5.4%
	Wave 2	461	19.4%	2.7%	16.6%	27.4%	29.4%	19.8%	4.0%
	Wave 3	682	21.6%	5.0%	16.6%	27.7%	28.0%	15.8%	6.9%
	Wave 4	870	16.2%	0.9%	15.3%	26.8%	35.1%	14.8%	7.1%
	Wave 5	785	17.0%	0.2%	16.7%	27.9%	34.3%	14.8%	6.0%
Gauteng	Wave 1	1618	16.0%	3.0%	12.9%	29.6%	30.2%	15.7%	8.5%
	Wave 2	1275	18.7%	1.7%	17.1%	33.8%	26.9%	16.5%	4.1%
	Wave 3	1965	20.3%	2.0%	18.3%	25.0%	26.4%	18.3%	9.9%
	Wave 4	2628	8.8%	0.4%	8.4%	29.6%	32.4%	21.5%	7.7%
	Wave 5	3523	10.4%	0.4%	10.0%	25.3%	36.0%	17.8%	10.5%
Mpumalanga	Wave 1	750	12.8%	1.1%	11.7%	26.4%	36.6%	18.5%	5.6%
	Wave 2	502	18.0%	1.1%	16.9%	29.6%	31.8%	15.4%	5.2%
	Wave 3	827	23.8%	4.3%	19.5%	25.3%	30.2%	14.7%	6.0%
	Wave 4	1055	8.7%	0.6%	8.1%	27.3%	40.0%	18.7%	5.3%
	Wave 5	1318	10.1%	0.9%	9.2%	26.2%	37.3%	20.0%	6.6%
Limpopo	Wave 1	1032	20.0%	2.3%	17.7%	32.9%	30.5%	12.4%	4.3%
	Wave 2	822	27.0%	2.7%	24.3%	26.9%	27.0%	11.9%	7.2%
	Wave 3	1200	25.2%	2.6%	22.6%	27.8%	28.9%	13.0%	5.1%
	Wave 4	1565	14.3%	1.2%	13.1%	29.9%	36.5%	14.8%	4.5%
	Wave 5	1669	13.7%	0.7%	13.0%	28.1%	36.1%	15.9%	6.2%
Quintile 1	Wave 1	2171	20.7%	3.0%	17.7%	33.5%	28.4%	12.1%	5.3%
	Wave 2	1477	25.5%	2.9%	22.5%	27.0%	30.0%	11.3%	6.3%
	Wave 3	2346	23.4%	3.9%	19.4%	29.9%	28.6%	13.4%	4.8%
	Wave 4	2886	16.1%	1.4%	14.7%	31.7%	33.9%	14.3%	4.1%
	Wave 5	3201	16.4%	0.7%	15.8%	31.0%	34.6%	13.5%	4.4%
Quintile 2	Wave 1	1795	21.5%	1.6%	19.9%	30.2%	29.1%	13.1%	6.0%
	Wave 2	1247	27.5%	2.9%	24.6%	29.8%	25.5%	11.4%	5.9%
	Wave 3	2030	25.1%	3.9%	21.1%	28.5%	30.7%	11.5%	4.2%
	Wave 4	2630	14.4%	0.6%	13.9%	31.2%	36.3%	13.8%	4.3%
	Wave 5	3124	14.4%	0.8%	13.6%	28.9%	35.5%	15.6%	5.6%
Quintile 3	Wave 1	1643	17.7%	1.7%	16.0%	31.8%	30.4%	15.2%	4.9%
	Wave 2	1291	24.8%	2.6%	22.2%	31.3%	29.1%	10.2%	4.6%
	Wave 3	1774	23.1%	2.8%	20.3%	27.9%	29.4%	13.2%	6.4%
	Wave 4	2320	14.2%	0.6%	13.6%	29.0%	35.6%	15.3%	6.0%
	Wave 5	2980	13.2%	0.9%	12.3%	29.7%	35.3%	16.8%	5.1%
Quintile 4	Wave 1	1289	17.2%	1.7%	15.5%	29.0%	31.9%	15.2%	6.8%
	Wave 2	1194	19.9%	2.5%	17.4%	34.8%	27.6%	14.2%	3.5%
	Wave 3	1750	20.7%	3.2%	17.5%	26.5%	30.4%	13.3%	9.1%

		N	HAZ= <-2 (stunting)	HAZ <-4	HAZ>=-4 & HAZ <-2	HAZ>=-2 & HAZ <-1	HAZ>=-1 & HAZ <=0	HAZ>0 & HAZ <=1	HAZ>1
	Wave 4	2239	11.7%	0.6%	11.1%	29.5%	33.8%	19.1%	6.0%
	Wave 5	2855	10.0%	0.5%	9.4%	27.5%	36.8%	17.9%	7.9%
Quintile 5	Wave 1	1681	11.3%	2.1%	9.1%	21.5%	36.1%	17.8%	13.4%
	Wave 2	1357	12.3%	0.5%	13.8%	26.2%	28.9%	20.9%	9.2%
	Wave 3	2085	14.7%	1.7%	11.1%	21.1%	29.3%	23.7%	13.0%
	Wave 4	2578	5.9%	0.4%	5.4%	24.8%	33.9%	26.4%	9.0%
	Wave 5	2595	8.0%	0.4%	7.6%	17.1%	35.4%	25.4%	14.0%

Table 14: Cross-sectional analysis of stunting across various categories

		wave 1						wave 2					
		Old weights			New weights			Old weights			New weights		
		%	Lower CI (95%)	Upper CI (95%)	%	Lower CI (95%)	Upper CI (95%)	%	Lower CI (95%)	Upper CI (95%)	%	Lower CI (95%)	Upper CI (95%)
All children	0 - 17 years	17.9%	16.5%	19.4%	18.0%	16.5%	19.6%	21.4%	19.7%	23.2%	22.7%	20.8%	24.7%
Age groups	0 - 2 years	27.7%	24.1%	31.6%	25.3%	21.3%	29.6%	40.9%	35.3%	46.6%	41.2%	34.4%	48.5%
	3 - 4 years	23.1%	19.4%	27.1%	22.9%	19.3%	27.0%	26.7%	21.9%	32.1%	25.9%	21.1%	31.4%
	5 - 6 years	14.2%	11.1%	17.9%	14.2%	11.1%	18.0%	15.2%	12.2%	18.9%	15.1%	11.9%	18.8%
	7 - 8 years	12.5%	10.1%	15.4%	12.5%	10.1%	15.3%	15.4%	11.8%	19.7%	15.1%	11.6%	19.5%
	9 - 10 years	11.8%	9.1%	15.3%	11.8%	9.1%	15.3%	18.9%	15.8%	22.5%	18.2%	15.2%	21.7%
	11 - 12 years	18.3%	15.2%	22.0%	18.1%	14.9%	21.7%	20.0%	16.2%	24.6%	19.2%	15.4%	23.6%
	13 - 14 years	20.3%	16.7%	24.4%	19.4%	15.8%	23.5%	23.1%	19.5%	27.2%	22.6%	18.8%	27.0%
	15 - 17 years	16.2%	13.7%	19.1%	15.9%	13.4%	18.8%	18.6%	15.8%	21.7%	18.4%	15.6%	21.4%
Gender	Male	19.0%	17.1%	21.1%	18.8%	16.8%	21.0%	23.9%	21.7%	26.3%	24.6%	22.2%	27.2%
	Female	16.8%	15.0%	18.9%	17.2%	15.3%	19.3%	18.9%	17.0%	21.0%	20.7%	18.2%	23.5%
Population group	African	18.7%	17.2%	20.3%	19.2%	17.6%	20.8%	22.5%	20.8%	24.4%	24.2%	22.3%	26.3%
	Coloured	18.2%	13.9%	23.3%	18.0%	13.9%	23.0%	20.3%	14.6%	27.6%	20.8%	14.1%	29.5%
	Indian	11.3%	2.9%	35.3%	9.0%	2.0%	32.1%	15.6%	11.1%	21.5%	14.6%	9.5%	21.7%
	White	6.3%	2.7%	14.0%	5.8%	2.3%	14.1%	4.8%	1.6%	13.3%	4.2%	1.4%	11.7%
Geographical location	Western Cape	13.2%	9.4%	18.2%	11.9%	7.8%	17.8%	16.1%	11.3%	22.4%	19.5%	12.1%	29.9%
	Eastern Cape	26.3%	22.4%	30.6%	26.7%	22.9%	30.9%	27.3%	21.9%	33.3%	28.3%	23.4%	33.8%
	Northern Cape	22.8%	19.3%	26.8%	23.7%	19.8%	28.2%	18.9%	14.7%	23.9%	18.3%	13.3%	24.7%
	Free State	17.9%	13.1%	24.0%	19.1%	13.7%	26.0%	19.4%	14.0%	26.3%	21.2%	15.5%	28.2%
	KwaZulu-Natal	18.4%	16.1%	20.8%	18.1%	15.8%	20.7%	23.9%	21.4%	26.7%	24.3%	21.2%	27.6%
	North West	13.4%	9.5%	18.5%	13.8%	9.8%	19.1%	17.3%	11.3%	25.7%	18.9%	12.3%	27.9%
	Gauteng	15.3%	11.2%	20.7%	16.1%	11.7%	21.6%	17.4%	13.8%	21.8%	19.0%	14.8%	23.9%
	Mpumalanga	12.4%	8.9%	16.9%	12.9%	9.0%	18.2%	16.5%	12.5%	21.4%	18.2%	13.6%	24.0%
	Limpopo	19.6%	15.8%	24.1%	20.1%	16.1%	25.0%	24.8%	20.6%	29.5%	28.1%	23.3%	33.4%
Education household	No matric	20.7%	18.9%	22.6%	21.1%	19.3%	23.1%	26.2%	23.8%	28.7%	28.0%	25.6%	30.6%
	Matric	14.7%	12.8%	16.9%	14.7%	12.6%	17.0%	16.5%	14.4%	18.8%	17.6%	15.0%	20.6%
income quintiles	Poorest 20%	20.7%	18.3%	23.4%	21.4%	18.7%	24.4%	25.4%	22.5%	28.6%	27.2%	24.1%	30.6%
	2	18.3%	15.9%	21.1%	19.0%	16.4%	21.8%	24.6%	21.6%	27.9%	26.2%	23.0%	29.7%
	3	18.0%	14.6%	22.0%	18.2%	14.8%	22.2%	19.8%	16.9%	23.0%	21.1%	17.8%	24.7%
	4	14.3%	10.6%	19.1%	14.6%	10.9%	19.2%	19.4%	15.7%	23.8%	22.5%	16.5%	29.9%
	Richest 20%	12.4%	8.4%	17.9%	11.5%	7.5%	17.1%	10.2%	6.6%	15.6%	9.9%	6.2%	15.6%

Table 14 continued: Cross-sectional analysis of stunting across various categories

		wave 3						wave 4						95%)
		Old weights			New weights			Old weights			New weights			
		%	Lower CI (95%)	Upper CI (95%)	%	Lower CI (95%)	Upper CI (95%)	%	Lower CI (95%)	Upper CI (95%)	%	Lower CI (95%)	Upper CI (95%)	
All children	0 – 17 years	21.0%	19.4%	22.8%	21.3%	19.6%	23.1%	12.5%	11.5%	13.6%	12.7%	11.7%	13.8%	
Age groups	0 – 2 years	32.5%	28.1%	37.2%	31.9%	27.4%	36.7%	24.7%	21.8%	27.9%	23.7%	20.8%	26.9%	
	3 – 4 years	23.3%	20.0%	27.0%	23.3%	20.0%	27.0%	16.5%	14.2%	19.1%	16.5%	14.2%	19.1%	
	5 – 6 years	15.0%	12.2%	18.3%	14.9%	12.1%	18.2%	8.1%	6.6%	10.1%	8.1%	6.6%	10.0%	
	7 – 8 years	15.0%	12.5%	17.9%	15.0%	12.5%	18.0%	7.6%	6.0%	9.5%	7.5%	5.9%	9.5%	
	9 – 10 years	19.2%	15.5%	23.5%	19.2%	15.5%	23.5%	8.3%	6.6%	10.4%	8.3%	6.6%	10.4%	
	11 – 12 years	22.8%	19.1%	27.0%	22.6%	18.9%	26.8%	9.9%	8.0%	12.3%	9.9%	7.9%	12.3%	
	13 – 14 years	25.9%	22.3%	29.9%	25.6%	22.0%	29.6%	15.0%	12.1%	18.4%	15.0%	12.1%	18.4%	
Gender	15 – 17 years	16.7%	14.0%	19.8%	16.7%	14.0%	19.8%	8.2%	6.6%	10.0%	8.1%	6.6%	10.0%	
	Male	22.8%	20.5%	25.4%	23.1%	20.7%	25.7%	14.0%	12.7%	15.5%	14.3%	12.9%	15.8%	
Population group	Female	19.2%	17.3%	21.4%	19.5%	17.5%	21.6%	11.0%	9.9%	12.2%	11.2%	10.1%	12.4%	
	African	22.4%	20.6%	24.3%	22.8%	20.9%	24.7%	13.3%	12.3%	14.4%	13.6%	12.5%	14.7%	
	Coloured	18.6%	14.3%	23.8%	19.7%	14.9%	25.5%	11.0%	7.6%	15.6%	11.0%	7.6%	15.7%	
	Indian	7.7%	3.3%	16.8%	8.5%	3.4%	19.4%	6.4%	2.5%	15.6%	7.0%	2.6%	17.9%	
Geographical location	White	5.3%	2.2%	12.1%	5.0%	2.1%	11.4%	3.2%	1.2%	8.1%	3.1%	1.1%	8.0%	
	Western Cape	14.4%	10.3%	19.7%	14.7%	10.1%	21.0%	8.3%	5.8%	11.8%	8.4%	5.8%	12.0%	
	Eastern Cape	21.7%	16.1%	28.5%	22.0%	16.4%	28.8%	14.5%	12.3%	16.9%	14.9%	12.8%	17.2%	
	Northern Cape	21.2%	17.4%	25.6%	21.9%	17.8%	26.6%	19.5%	16.2%	23.3%	19.6%	16.2%	23.5%	
	Free State	19.2%	15.4%	23.7%	19.5%	15.7%	23.9%	17.6%	14.6%	21.1%	17.7%	14.6%	21.3%	
	KwaZulu-Natal	21.5%	18.7%	24.6%	21.7%	18.8%	25.0%	13.8%	12.3%	15.4%	14.2%	12.6%	15.9%	
	North West	20.9%	15.1%	28.2%	21.3%	15.4%	28.9%	16.8%	12.9%	21.5%	16.9%	13.0%	21.6%	
	Gauteng	20.3%	16.7%	24.5%	20.4%	16.7%	24.6%	9.1%	6.8%	12.0%	9.1%	6.9%	11.9%	
	Mpumalanga	24.2%	17.6%	32.3%	24.4%	17.7%	32.6%	9.0%	7.0%	11.5%	9.2%	7.2%	11.6%	
Education household	Limpopo	24.4%	19.9%	29.5%	25.0%	20.5%	30.2%	13.7%	10.6%	17.5%	14.0%	10.9%	17.9%	
	No matric	23.7%	21.5%	26.1%	24.2%	21.9%	26.7%	14.2%	12.9%	15.7%	14.5%	13.1%	16.1%	
income quintiles	Matric	18.5%	16.6%	20.5%	18.6%	16.6%	20.6%	10.9%	9.6%	12.4%	11.0%	9.7%	12.5%	
	Poorest 20%	23.9%	21.0%	27.0%	24.6%	21.6%	27.8%	15.2%	13.7%	17.0%	15.6%	14.0%	17.4%	
	2	23.8%	21.2%	26.6%	24.3%	21.7%	27.0%	14.8%	13.1%	16.7%	15.1%	13.4%	17.0%	
	3	19.6%	16.6%	22.9%	19.8%	16.9%	23.1%	12.5%	10.3%	15.1%	12.7%	10.4%	15.4%	
	4	20.6%	16.6%	25.1%	20.5%	16.4%	25.4%	9.1%	6.9%	11.8%	9.1%	6.9%	11.9%	
	Richest 20%	11.9%	8.0%	17.2%	11.5%	7.8%	16.7%	5.3%	3.5%	7.9%	5.3%	3.5%	7.9%	

Table 14 continued: Cross-sectional analysis of stunting across various categories

		wave 5					
		Old weights			New weights		
		%	Lower CI (95%)	Upper CI (95%)	%	Lower CI (95%)	Upper CI (95%)
All children	0 - 17 years	12.6%	11.5%	13.7%	12.7%	11.6%	13.8%
Age groups	0 - 2 years	25.4%	21.9%	29.1%	23.3%	19.9%	27.0%
	3 - 4 years	15.9%	13.3%	19.0%	15.7%	13.1%	18.8%
	5 - 6 years	8.3%	6.7%	10.3%	8.3%	6.6%	10.3%
	7 - 8 years	5.3%	4.2%	6.8%	5.3%	4.2%	6.8%
	9 - 10 years	8.5%	6.8%	10.5%	8.4%	6.8%	10.5%
	11 - 12 years	11.5%	9.5%	13.8%	11.3%	9.3%	13.7%
	13 - 14 years	14.9%	12.4%	17.8%	14.6%	12.1%	17.5%
	15 - 17 years	10.0%	8.4%	11.9%	9.8%	8.3%	11.7%
Gender	Male	14.2%	12.9%	15.6%	14.4%	13.0%	15.9%
	Female	10.9%	9.8%	12.2%	10.9%	9.7%	12.3%
Population group	African	12.7%	11.5%	13.9%	85.1%	26.3%	98.9%
	Coloured	15.1%	12.4%	18.4%	12.9%	11.7%	14.2%
	Indian	9.3%	5.3%	15.9%	15.4%	12.5%	18.9%
	White	4.7%	2.4%	8.9%	9.1%	4.7%	16.8%
Geographical location	Western Cape	11.3%	8.5%	15.0%	4.5%	2.3%	8.7%
	Eastern Cape	13.5%	11.2%	16.1%	11.4%	8.5%	15.1%
	Northern Cape	19.0%	15.7%	22.8%	13.4%	11.1%	16.0%
	Free State	16.4%	12.8%	20.8%	19.5%	16.1%	23.5%
	KwaZulu-Natal	12.8%	11.5%	14.1%	17.3%	13.5%	21.9%
	North West	16.9%	11.8%	23.7%	12.9%	11.6%	14.3%
	Gauteng	10.5%	7.8%	13.9%	17.0%	11.8%	23.9%
	Mpumalanga	9.9%	7.3%	13.1%	10.4%	7.7%	13.8%
	Limpopo	13.4%	10.2%	17.3%	10.1%	7.5%	13.4%
Education household	No matric	14.6%	13.1%	16.2%	13.7%	10.5%	17.8%
	Matric	10.8%	9.6%	12.2%	14.9%	13.4%	16.6%
Income quintiles	Poorest 20%	15.7%	14.0%	17.5%	10.8%	9.6%	12.2%
	2	12.2%	10.6%	14.1%	16.3%	14.5%	18.2%
	3	12.1%	10.1%	14.4%	12.5%	10.8%	14.3%
	4	9.8%	7.4%	12.9%	12.3%	10.2%	14.7%
	Richest 20%	7.5%	5.1%	10.7%	9.7%	7.3%	12.7%

Table 15: Cross-sectional logistic regression model, all children (NIDS)

VARIABLES:	wave 1	wave 2	wave 3	wave 4	wave 5
Household income (log)	-0.0523 (0.0531)	-0.0809 (0.0596)	-0.127** (0.0532)	-0.233*** (0.0617)	-0.170*** (0.0542)
Age (months)	-0.0272*** (0.00740)	-0.0623*** (0.0115)	-0.0587*** (0.00657)	-0.0324*** (0.00623)	-0.0451*** (0.00610)
Age squared	0.000191** (7.77e-05)	0.000518*** (0.000112)	0.000570*** (6.98e-05)	0.000220*** (6.99e-05)	0.000337*** (6.80e-05)
Age cubed	-4.05e-07* (2.31e-07)	-1.31e-06*** (3.21e-07)	-1.62e-06*** (2.11e-07)	-4.81e-07** (2.16e-07)	-7.56e-07*** (2.10e-07)
Female	-0.132 (0.0819)	-0.233** (0.0978)	-0.258*** (0.0765)	-0.307*** (0.0789)	-0.348*** (0.0803)
African	0.921** (0.438)	1.085* (0.623)	1.233*** (0.386)	0.977* (0.569)	0.487 (0.380)
Coloured	1.207*** (0.443)	1.278* (0.653)	1.425*** (0.403)	0.920 (0.563)	0.875** (0.417)
Indian	0.342 (0.614)	0.979 (0.749)	0.464 (0.735)	0.799 (0.794)	0.454 (0.513)
Eastern Cape	0.885*** (0.290)	0.439 (0.344)	0.293 (0.191)	0.257 (0.224)	0.0655 (0.207)
Northern Cape	0.743*** (0.240)	-0.177 (0.291)	0.335* (0.197)	0.769*** (0.196)	0.527*** (0.194)
Free State	0.634** (0.315)	0.128 (0.382)	0.260 (0.225)	0.628*** (0.236)	0.632*** (0.223)
KwaZulu-Natal	0.404 (0.289)	0.366 (0.341)	0.332* (0.189)	0.254 (0.217)	0.0411 (0.208)
North West	0.143 (0.310)	0.143 (0.375)	0.416* (0.217)	0.591** (0.236)	0.434* (0.226)
Gauteng	0.440 (0.304)	0.116 (0.363)	0.516** (0.204)	-0.0888 (0.236)	0.109 (0.228)
Mpumalanga	0.0669 (0.337)	0.0442 (0.369)	0.546*** (0.207)	-0.201 (0.254)	-0.144 (0.244)
Limpopo	0.566* (0.295)	0.299 (0.362)	0.488** (0.213)	0.270 (0.229)	0.122 (0.221)
Rural traditional	0.130 (0.106)	0.0414 (0.126)	0.139 (0.0939)	0.0127 (0.103)	0.112 (0.0984)
Rural formal	0.371* (0.204)	-0.155 (0.193)	-0.114 (0.175)	0.116 (0.192)	-0.0781 (0.178)
Household size	-0.150 (0.110)	-0.0393 (0.113)	-0.0826 (0.0730)	0.127 (0.0843)	0.246*** (0.0759)
Household size squared	0.0203* (0.0114)	0.00648 (0.0107)	0.0112* (0.00662)	-0.00242 (0.00816)	-0.0119* (0.00679)
Household size cubed	0.000699** (0.000347)	-0.000224 (0.000291)	-0.000284* (0.000165)	-5.99e-05 (0.000231)	0.000199 (0.000159)
Matric in household	-0.245*** (0.0927)	-0.445*** (0.107)	-0.284*** (0.0827)	-0.201** (0.0886)	-0.303*** (0.0849)
Constant	-1.129* (0.675)	0.413 (0.946)	0.00803 (0.684)	-0.321 (0.861)	-0.362 (0.668)
R squared	3.9%	6.6%	4.7%	6.1%	5.8%
Observations	8,580	6,566	9,985	12,654	14,754
Robust standard errors in parentheses					

*** p<0.01, ** p<0.05, * p<0.1
