UNITED NATIONS UNIVERSITY
UNU-WIDER

WIDER Working Paper 2016/147

Characteristics and determinants of child malnutrition in Mozambique, 2003–11

José Cardoso,[1] Lindsey Allwright,[2] Vincenzo Salvucci[3]

December 2016

United Nations University World Institute for Development Economics Research

wider.unu.edu

Abstract: Child malnutrition continues to be a serious impediment to development both at the individual and national levels in many developing countries. In Mozambique, despite a high and sustained GDP growth, child malnutrition has been decreasing at a rather slow pace over the past 15 years. In this study, using the Mozambican Demographic and Health Surveys 2003 and 2011 we find that household wealth, mother's education, area of residence, and access to safe water and improved sanitation facilities have a strong relation with different measures of chronic child malnutrition. Also, the relative importance of these variables remained mostly unchanged over time. We conclude that continued and more focused and effective interventions aimed at directly reducing child malnutrition should be undertaken by all public and private actors involved.

Keywords: child malnutrition, stunting, Demographic and Health Survey data, Mozambique
JEL classification: I15, J13, O15

---

[1] Directorate of Economic and Financial Studies (DEEF), Ministry of Economics and Finance (MEF), Maputo, Mozambique; [2] Independent Consultant; [3] UNU-WIDER, Helsinki, Finland; corresponding author Vincenzo@wider.unu.edu.

This study has been prepared within the project on 'Inclusive Growth in Mozambique—Scaling-up Research and Capacity' implemented in collaboration between UNU-WIDER, University of Copenhagen, University Eduardo Mondlane, and the Mozambican Ministry of Economics and Finance. The project is financed through specific programme contributions by the governments of Denmark, Finland, Norway, and Switzerland.

Information and requests: publications@wider.unu.edu

ISSN 1798-7237 ISBN 978-92-9256-191-8

Typescript prepared by Lesley Ellen.

The United Nations University World Institute for Development Economics Research provides economic analysis and policy advice with the aim of promoting sustainable and equitable development. The Institute began operations in 1985 in Helsinki, Finland, as the first research and training centre of the United Nations University. Today it is a unique blend of think tank, research institute, and UN agency—providing a range of services from policy advice to governments as well as freely available original research.

The Institute is funded through income from an endowment fund with additional contributions to its work programme from Denmark, Finland, Sweden, and the United Kingdom.

Katajanokanlaituri 6 B, 00160 Helsinki, Finland

1 Introduction

Child malnutrition continues to be a serious impediment to development both at the individual and national levels. It is the cause, both directly and indirectly, of about 50 per cent of child deaths in the world (Rice et al. 2000; Levinson and Bassett 2007). Because of this, child malnutrition has been identified as an important factor in six of the millennium development goals (MDGs): eradicate extreme poverty and hunger, achieve universal primary education, promote gender equality and empower women, reduce child mortality, improve maternal health, and combat HIV/AIDS, malaria and other diseases (World Bank 2006). However, progress in achieving several of the MDGs, particularly to do with health, has been lagging. UNDP (2013) finds Africa to be off track on four of the MDGs including eradicating extreme poverty and hunger, reducing child mortality, and improving maternal health. Child malnutrition is therefore such a concerning problem because of its detrimental effects on child mortality and future human capital development.

Experiencing malnutrition in early ages has consequences on future development causing, for example, impairment to cognitive skills. Child malnutrition has been linked with lower school outcomes and completion rates and reduced adult productivity (World Bank 2006; Victoria et al. 2008). This in turn has a detrimental effect on human capital, income levels, and overall national development (UNICEF 2006; Levinson and Bassett 2007; Victoria et al. 2008).

Furthermore, malnutrition is found to have an intergenerational effect: malnourished female children are more likely to give birth in the future to children with low birth weight, while malnourished pregnant mothers often give birth to children with a higher probability of malnutrition (Morales et al. 2004; Victoria et al. 2008).

In Mozambique, child malnutrition has been decreasing over the past 15 years (MPD-DNEAP 2010); however, it is still a significant problem with the latest Demographic and Health Survey (DHS) 2011 survey showing that about 43 per cent of under-five children suffer from chronic malnutrition. This is a very high percentage, even compared with other Sub-Saharan countries.

In this study, using the DHS 2003 and 2011 we find that household wealth, mother's education, area of residence, and access to safe water and sanitation have a strong relation with different measures of chronic child malnutrition. The remainder of the paper is developed as follows: Section 1 describes child malnutrition and most used measures of this dimension. In Section 2, we describe malnutrition in Mozambique. Next, we present the data and the methodology used in Section 3, and the analysis of the results in Section 4. We conclude in Section 5.

2 Measuring child malnutrition

Child malnutrition is usually described in three ways: stunting (low height-for-age), underweight (low weight-for-age), and wasting (low weight-for-height). Stunting is also known as chronic malnutrition and can be described as the inability to reach one's biological potential for growth. Wasting usually indicates significant recent or current weight loss often resulting from severe disease or emergency conditions. Underweight can derive from stunting or wasting. All three conditions can be described in terms of mild, moderate, or severe.

Malnutrition is commonly measured using the World Health Organization standards (WHO 2006). These use a reference population of healthy children to compare a child's anthropometric measurements with the median for children of the same sex and age from the reference population. The difference between the value for an individual and the median value of the reference population, divided by the standard deviation of the reference population, are referred to as Z-scores. Using height-for-age, weight-for-age, and weight-for-height Z-scores, respectively, it is possible to assess a child's condition compared to the reference population. When Z-scores are between -3 and -2 standard deviations, the child can be described as *moderately malnourished*, while if they are below -3 standard deviations it can be described as *severely malnourished*.

Stunting is usually considered a more precise indicator of long-term malnutrition, as underweight or wasting may be driven by short-term factors like illnesses or fluctuations in food intake throughout the year (Beaton et al. 1990; WHO 2000; UNICEF 2011). Because of that, in the rest of the paper we prefer to use height-for-age indicators as our dependent variables. In particular, we present results relative to height-for-age Z-scores, moderate stunting, and severe stunting.

3 Child malnutrition in Mozambique

Despite the efforts made to monitor and reduce child malnutrition in Mozambique, chronic malnutrition is still suffered by about 43 per cent of under-five children, one of the highest percentages in the world (UNICEF 2011; MISAU et al. 2013).

Using the DHS from 1997, 2003, 2009, and 2011, it is possible to observe that stunting decreased from about 50 per cent to 43 per cent, underweight decreased from 25 per cent to slightly less than 15 per cent, and wasting from about 9 per cent to 6 per cent. This indicates that child malnutrition has been declining in the past 15 years, but rather slowly over time (MPD-DNEAP 2010; Salvucci 2016).

Results from the DHS 2011 survey show children in rural areas suffer malnutrition considerably more than children in urban areas (46 per cent and 35 per cent, respectively). Nevertheless, between 2003 and 2011, stunting decreased more in rural areas than urban areas (Figure 1, panel a). Also, children living in northern (Cabo Delgado, Nampula, and Niassa) and central (Zambezia, Tete, Manica, and Sofala) provinces have higher rates of chronic malnutrition compared to southern provinces (Inhambane, Gaza, Maputo province, and Maputo City). Figure 1, panel b, also shows that in many provinces malnutrition decreased between 2003 and 2011, except for Nampula. The biggest drops are observed for Cabo Delgado, Sofala, and Gaza.

The prevalence of chronic malnutrition is slightly higher in male children than female children (MISAU et al. 2013). Moreover, Table 1 shows that the highest percentage of stunting is found in children in the three poorest wealth quintiles. Notably, the percentage of stunted children decreased for all quintiles (Figure 1, panel d).

The DHS shows a strong link between mother's education level and nutritional status of the child: the higher the level of education the lower the percentage of malnourished children. The difference between the no education and primary education categories is tiny in terms of nutritional status of the child, whereas the secondary education category shows much lower levels of stunting. However, between 2003 and 2011 the stunting rates decreased for no education and primary education levels, while increasing for mothers with secondary education, from about 22 per cent to 27 per cent (Figure 1, panel c). Finally, a lower percentage of children appear to be malnourished if the households in which they live have better access to safe water and to improved sanitation facilities.

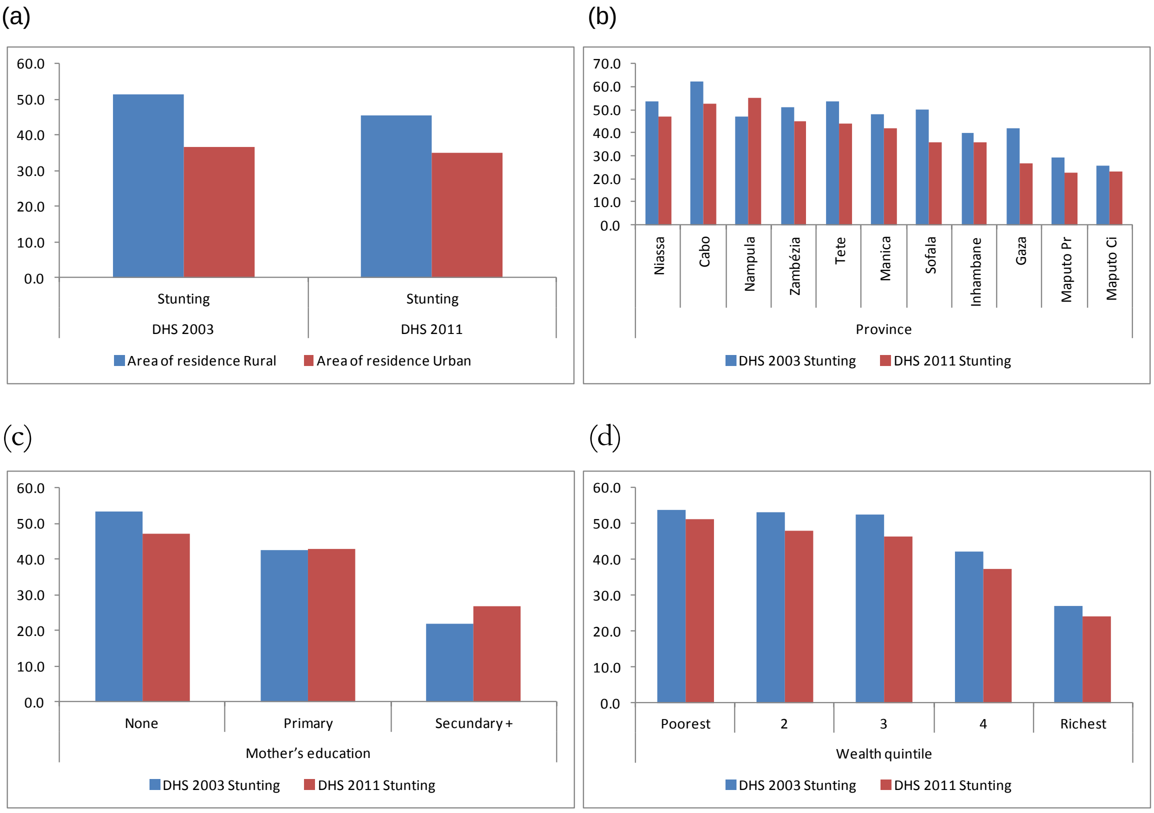
Table 1: Prevalence of stunting, wasting, and underweight for under-five children in Mozambique, 2003–11

		DHS 2003				DHS 2011		
		Stunting	Wasting	Underweight		Stunting	Wasting	Underweight
	National	47.2	6.0	21.5	National	42.6	5.9	14.9
Area of residence	Rural	51.5	6.7	24.8	Rural	45.5	6.7	16.9
	Urban	36.5	4.2	13.3	Urban	35.0	3.8	9.8
Province	Niassa	53.4	2.4	23.2	Niassa	46.8	3.7	18.2
	Cabo	62.5	5.5	31.0	Cabo	52.8	5.6	20.6
	Nampula	46.9	10.4	25.8	Nampula	55.3	6.5	15.5
	Zambezia	51.1	7.4	26.7	Zambezia	45.2	9.4	21.3
	Tete	53.6	2.8	21.5	Tete	44.2	5.6	17.0
	Manica	48.0	4.6	20.9	Manica	41.9	6.7	10.8
	Sofala	50.0	9.4	23.9	Sofala	35.7	7.4	11.3
	Inhambane	40.0	2.0	10.2	Inhambane	36.0	2.2	6.9
	Gaza	42.1	8.3	19.7	Gaza	26.8	1.0	6.3
	Maputo Province	29.5	1.2	7.2	Maputo Province	22.7	2.1	7.4
	Maputo City	25.8	1.6	6.8	Maputo City	23.2	2.2	5.4
Gender	Male	49.6	6.4	23.0	Male	44.7	6.4	16.6
	Female	44.8	5.7	20.1	Female	40.5	5.4	13.3
Mother's education	None	53.2	5.8	24.2	None	47.0	7.2	18.7
	Primary	42.5	4.7	17.0	Primary	43.0	5.8	14.2
	Secondary +	21.9	6.6	10.7	Secondary +	26.9	3.5	6.2
Wealth quintile	Poorest	53.9	8.7	29.2	Poorest	51.1	9.6	23.0
	2	53.1	6.4	25.0	2	48.0	6.1	17.2
	3	52.6	4.9	22.4	3	46.4	5.3	15.2
	4	42.2	5.1	17.5	4	37.4	4.0	9.7
	Richest	27.1	3.8	7.9	Richest	24.1	3.2	6.4
Source of drinking water	Inside the house	20.5	2.2	6.2	Piped into dwelling	18.6	2.1	3.4
	Inside neighbour's house	28.5	4.6	8.4	Piped to yard/plot	20.4	2.1	4.1
	Public water	38.8	5.3	14.8	Public tap/standpipe	41.2	5.9	10.8
	In own land	38.6	6.1	14.2	Neighbour's house	33.6	3.1	9.2
	In neighbour's land	47.5	2.0	14.3	Protected well	39.0	5.4	12.1
	Unprotected public well	51.9	6.7	24.8	Unprotected well	49.5	6.9	18.9
	Protected	48.7	4.2	19.7	Borehole with pump	43.2	5.2	15.4

	public well							
	River/lake	53.8	8.8	29.9	River/dam/lake/ponds/ stream/canal/irrigation	46.2	6.1	15.1
	Rainwater	30.6	2.1	5.1	Rainwater	23.5	0.5	4.8
	Other	52.3	6.3	31.0	Tanker truck	43.6	0.0	5.7
					Bottled water	28.2	0.0	0.0
					Other	28.5	2.6	2.0
	Flush toilet	18.0	2.4	5.6	Flush, don't know where	12.4	1.4	1.9
	Latrine	42.9	4.6	17.3	Toilet without flush, don't know where	15.1	1.2	2.9
Type of toilet facility	No flush toilet	24.5	3.2	6.2	Ventilated improved pit latrine (vip)	28.4	3.6	7.8
	No facility	52.4	7.4	26.1	Pit latrine with slab	40.0	4.4	11.4
	Other	58.4	9.0	32.4	Pit latrine without slab/ open pit	44.5	4.1	12.7
					No facility/bush/field	46.9	7.8	18.2

Source: Authors' calculations.

Figure 1: Stunting prevalence by area of residence, province, mother's education, and wealth quintile (%)



Source: Authors' calculations.

4 Data and methodology

The datasets used in this study are the DHS 2003 and 2011. Both surveys are nationally representative and provide data for a wide range of population, health, and nutrition indicators. Moreover, they are largely comparable in terms of survey design and information provided. However, in order to make the 2003 results comparable with those of 2011, a recalculation of main malnutrition indicators was needed. In particular, height-for-age, weight-for-age, and weight-for-height Z-scores for 2003 were recomputed using the 2006 WHO standard. For this reason, the descriptive statistics presented here differ from those included in the official final report from 2003 (MISAU et al. 2005). Supplementary information for the DHS 2003 and the DHS 2011 can be found in INE et al. (2005) and MISAU et al. (2013). With regard to child health related issues, the surveys contain information on age, length/height, and weight, for children aged 0 to 59 months.

The analysis of the determinants of child malnutrition is undertaken by means of a regression-based approach. Three measures of chronic child malnutrition are used as dependent variables: (the negative of) height-for-age Z-scores, a binary variable indicating whether the child is stunted or not (less than 2 standard deviations with respect to the reference population), and a binary variable indicating whether the child is severely stunted or not (less than 3 standard deviations with respect to the reference population).

The regressors chosen include standard demographic variables such as sex, age in months, and age squared; information about household size, household wealth, access to safe water and sanitation, sex and age of the household head; mother's education level; and geographic controls like area of residence (urban/rural), and province. Descriptive statistics for dependent and independent variables used in the analysis are presented in Table 2.

Table 2: Descriptive statistics for variables considered in the analysis

	DHS 2003					DHS 2011				
Variable	Obs	Mean	Std Dev	Min	Max	Obs	Mean	Std Dev	Min	Max
Height-for-age Z-scores (* -100)	9,278	188.29	159.91	-600	600	10,364	167.87	164.70	-584	599
Stunting (0=No; 1=Yes)	9,278	0.47	0.50	0	1	10,364	0.43	0.49	0	1
Severe Stunting (0=No; 1=Yes)	9,278	0.23	0.42	0	1	10,364	0.20	0.40	0	1
Child age (months) squared	10,669	28.74	17.26	0	59	11,015	28.47	17.19	0	59
Sex (Male=1)	10,669	0.49	0.50	0	1	11,015	0.50	0.50	0	1
HH size	63,496	6.51	3.43	1	34	62,750	5.76	2.73	1	25
Wealth index	63,496	-3,214.95	97,582.51	-75,576	485,566	62,750	-14,030.72	92,815.48	-109,455	304,121
Niassa (North)	63,496	0.05	0.21	0	1	62,750	0.06	0.24	0	1
Cabo Delgado (North)	63,496	0.09	0.29	0	1	62,750	0.08	0.27	0	1
Nampula(North)	63,496	0.20	0.40	0	1	62,750	0.15	0.36	0	1
Zambezia (Centre)	63,496	0.16	0.37	0	1	62,750	0.19	0.39	0	1
Tete (Centre)	63,496	0.09	0.28	0	1	62,750	0.12	0.33	0	1
Manica (Centre)	63,496	0.07	0.25	0	1	62,750	0.07	0.25	0	1
Sofala (Centre)	63,496	0.07	0.26	0	1	62,750	0.09	0.29	0	1
Inhambane (South)	63,496	0.08	0.28	0	1	62,750	0.06	0.24	0	1
Gaza (South)	63,496	0.05	0.22	0	1	62,750	0.06	0.23	0	1
Maputo Province (South)	63,496	0.07	0.26	0	1	62,750	0.07	0.25	0	1
Maputo City (South) – reference	63,496	0.07	0.25	0	1	62,750	0.05	0.22	0	1
Urban	63,496	1.66	0.47	1	2	62,750	0.32	0.46	0	1
HH head sex (male=1)	63,496	1.22	0.41	1	2	62,750	1.31	0.46	1	2
HH head age	63,492	43.75	13.96	14	98	62,750	43.02	15.01	12	98
Mother’s education (none)	9,075	0.49	0.50	0	1	10,088	0.38	0.48	0	1
Mother’s education (primary)	9,075	0.47	0.50	0	1	10,088	0.51	0.50	0	1
Mother’s education (secondary)	9,075	0.04	0.19	0	1	10,088	0.11	0.32	0	1
Access to safe water	63,496	0.46	0.50	0	1	62,750	0.53	0.50	0	1
Sanitation	63,496	0.97	0.17	0	1	62,750	0.06	0.24	0	1

Source: Authors’ calculations.

5 Results

The first analysis we undertake is a simple OLS regression adjusted for the survey design in which the negative of height-for-age Z-scores is used as dependent variable. The negative of height-for-age Z-scores, multiplied by 100, is taken in order to improve the interpretability of the coefficients in terms of malnutrition. Higher values of this variable indicate higher levels of malnutrition. The results are presented in Table 3.

We find that being male is significantly associated with higher levels of child malnutrition, with a coefficient of about 0.2 standard deviations in 2003 and 2011. Older children were also more likely to be malnourished up to the age of about three years both in 2003 and 2011. The coefficient for living in urban areas was significant only for 2011, and urban children were on average less malnourished (0.13 standard deviations). Northern provinces showed much higher levels of malnutrition than other provinces, especially in 2011.

Concerning wealth, being in the two richest quintiles is very strongly associated with less malnutrition in both 2003 and 2011. The highest quintile showed a coefficient of about 0.6 standard deviations in both years. This is probably due to the fact that the higher the income or wealth of the household the more resources can be spent on food and better quality food with a higher nutritional value, assuming all members of the household continue to receive the same share of resources.

Mother's education, both primary and secondary education, was greatly significant in 2003. Mother's secondary or higher education also appeared to be very significant in 2011. The effect of mother's education on child malnutrition over a wide range of countries and time frames has been extensively studied with most studies finding a strong correlation (Christiaensen and Alderman 2004; Semba et al. 2008; Burchi 2012). Indeed, mother's education is likely to increase the transfer of health knowledge to future mothers; literacy and numeracy skills may enhance the capability to diagnose and treat child health problems; and increased familiarity with modern society through schooling may make women more receptive to modern medicine (Glewwe 1999). Burchi (2010) also suggests that formal schooling in particular enhances a mother's ability to access and interpret media, which leads to improved nutrition knowledge. As expected, having access to safe water and improved sanitation facilities is also associated with a lower level of malnutrition, both in 2003 and 2011, with the coefficient for sanitation being greater in magnitude in both years. Webb and Block (2004), while finding that formal education is an important determinant for long-term outcomes (height-for-age), also find when mothers receive nutritional information through interventions to be a big contributor of short-term child outcomes.

As expected, having access to safe water and improved sanitation facilities is also associated with a lower level of malnutrition, both in 2003 and 2011. This is also well documented in the literature (Strauss and Thomas 1995; Cuesta 2007). Sanitation and safe water also affect children's susceptibility to illnesses such as diarrhoea (Fewtrell and Colford 2004). There is a strong link and vicious cycle between malnutrition and diseases in that malnutrition increases a child's vulnerability to disease while ill health worsens poor nutrition by reducing appetite and increasing nutrient requirements (Pelletier 1994; Rice et al. 2000; World Bank 2006; Levinson and Bassett 2007).

Similar results are obtained when the dependent variables are weight-for-age Z-scores or weight-for-height Z-scores. The results for these regressions are presented in Table A1 in the Appendix.

In Table 4 instead, we present the marginal effects resulting from a probit regression where the dependent variable is binary and takes value 1 if the child is stunted (his/her height-for-age Z-score is less than -2 standard deviations with respect to the reference population) and 0 otherwise. The same independent variables are used.

Again, the results showed a higher probability of being malnourished if the child is older and male, for 2003 and 2011. Children living in northern and central provinces present a significantly higher probability of being stunted compared to southern provinces. Being in the two richest wealth quintiles also has a significant effect on the probability of being stunted. Belonging to the wealthiest 20 per cent of the population is associated with a lower 18 per cent probability of being stunted in 2003, and with a lower 14 per cent probability in 2011. If the mother has secondary education, this is associated with a reduced probability that the child is chronically malnourished by about 11 per cent in 2003 and 5 per cent in 2011. Access to safe water and improved sanitation facilities is also significantly and negatively associated with a lower probability of being stunted. For both malnutrition and stunting, most of our key variables show the expected sign in both 2003 and 2011 (Table 4). In Table A2 in the Appendix we also present results for when the dependent variable is underweight or wasting. The results for the probit regression using underweight and wasting as dependent variables give even greater robustness to our results on malnutrition.

Finally, we also analyse the correlates of severe stunting (height-for-age Z-sores less than 3 standard deviations with respect to the reference population). In the last two columns of Table 4 the marginal effects from a probit regression with severe stunting as the dependent binary variable are displayed. In general, we get results that are qualitatively similar to the analyses already described. The coefficients for demographic and geographic variables are in line with what was found in previous regressions. Household wealth appears to be correlated also with severe stunting, with the coefficients for the richest two quintiles being consistently negative and significant over time. Mother's education is again strongly associated with a reduced probability of being severely stunted, even though the coefficient for primary education is only significant for 2003. Safe water and sanitation show a statistically significant negative sign in 2003 and 2011.

Table 3: Ordinary least squares regression analysis of determinants related to height-for-age Z-scores among under-five children in Mozambique, 2003–11.

OLS	Height-for-age Z-scores (* -100)		Height-for-age Z-scores (* -100)	
	2003		2011	
	coef	se	coef	Se
Child age (months)	9.706***	(0.490)	6.042***	(0.475)
Child age (months) squared	-0.136***	(0.008)	-0.082***	(0.008)
Sex (Male=1)	19.262***	(3.938)	18.942***	(4.020)
HH size	0.566	(0.565)	-0.516	(0.870)
Wealth quintile 2	-12.145*	(6.445)	-0.544	(6.862)
Wealth quintile 3	-9.704	(6.832)	-8.424	(7.059)
Wealth quintile 4	-32.237***	(7.479)	-20.859***	(7.651)
Wealth quintile 5	-58.831***	(9.224)	-63.877***	(10.324)
Niassa (North)	16.517	(10.887)	11.936	(10.118)
Cabo Delgado (North)	58.946***	(9.709)	32.869***	(9.791)
Nampula (North)	-4.814	(9.250)	38.722***	(10.733)
Zambezia (Centre)	8.086	(9.952)	-5.041	(10.293)
Tete (Centre)	16.115*	(8.753)	5.713	(9.899)
Manica (Centre)	7.613	(8.860)	7.356	(9.871)
Sofala (Centre)	11.397	(9.147)	-16.874*	(9.125)
Inhambane (South)	-13.824*	(8.311)	-2.093	(9.646)
Gaza (South)	-1.281	(8.358)	-21.526**	(8.908)
Maputo Province (South)	-7.304	(7.882)	-5.159	(8.087)
Maputo City (South) – reference	0.000	(0.000)	0.000	(0.000)
Urban	2.194	(5.691)	-12.110**	(5.871)
HH head sex (male=1)	5.879	(5.083)	-0.135	(4.606)
HH head age	-0.100	(0.159)	-0.339**	(0.166)
Mother’s education (primary)	-12.347***	(4.359)	-5.121	(4.709)
Mother’s education (secondary)	-26.679**	(11.258)	-17.162**	(7.251)
Access to safe water	-11.709**	(4.988)	-9.574**	(4.813)
Sanitation	-45.166***	(11.340)	-36.418***	(7.994)
Constant	20.675	(21.808)	134.554***	(19.399)
Observations	9,046		9,516	
R-squared	0.150		0.089	

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

Source: Authors’ calculations.

Table 4: Probit regression analysis of determinants related to moderate and severe stunting among under-five children in Mozambique, 2003–11.

PROBIT (marginal effects)	Stunting (0=No; 1=Yes)		Stunting (0=No; 1=Yes)		Severe Stunting (0=No; 1=Yes)		Severe Stunting (0=No; 1=Yes)	
	2003		2011		2003		2011	
	coef	se	coef	se	coef	se	coef	se
Child age (months)	0.004***	(0.000)	0.003***	(0.000)	0.002***	(0.000)	0.001***	(0.000)
Sex (Male=1)	0.042***	(0.012)	0.043***	(0.012)	0.051***	(0.011)	0.031***	(0.010)
HH size	0.004**	(0.002)	-0.002	(0.003)	0.000	(0.002)	-0.001	(0.002)
Wealth quintile 2	-0.030	(0.020)	-0.020	(0.019)	-0.039**	(0.017)	0.003	(0.016)
Wealth quintile 3	-0.016	(0.021)	-0.011	(0.021)	-0.026	(0.018)	-0.020	(0.017)
Wealth quintile 4	-0.082***	(0.024)	-0.055**	(0.023)	-0.071***	(0.021)	-0.057***	(0.019)
Wealth quintile 5	-0.181***	(0.031)	-0.141***	(0.030)	-0.138***	(0.024)	-0.115***	(0.022)
Niassa (North)	0.087**	(0.039)	0.063*	(0.034)	0.078**	(0.036)	0.058**	(0.028)
Cabo Delgado (North)	0.179***	(0.037)	0.117***	(0.034)	0.127***	(0.034)	0.074***	(0.028)
Nampula (North)	0.033	(0.034)	0.159***	(0.034)	0.015	(0.030)	0.118***	(0.029)
Zambezia (Centre)	0.048	(0.035)	0.043	(0.033)	0.053*	(0.031)	0.025	(0.027)
Tete (Centre)	0.088***	(0.034)	0.060*	(0.033)	0.010	(0.030)	0.022	(0.027)
Manica (Centre)	0.052	(0.033)	0.060*	(0.033)	0.008	(0.030)	0.044	(0.027)
Sofala (Centre)	0.068**	(0.034)	-0.016	(0.031)	0.032	(0.031)	-0.010	(0.026)
Inhambane (South)	-0.038	(0.033)	-0.004	(0.033)	-0.050*	(0.029)	0.008	(0.027)
Gaza (South)	-0.000	(0.033)	-0.073**	(0.032)	-0.045	(0.029)	-0.054**	(0.026)
Maputo Province (South)	-0.028	(0.034)	-0.066**	(0.030)	-0.084***	(0.029)	-0.061**	(0.024)
Maputo City (South) - reference	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
Urban	-0.002	(0.019)	-0.021	(0.017)	0.007	(0.017)	-0.034**	(0.015)
HH head sex (male=1)	0.019	(0.016)	-0.002	(0.013)	0.039***	(0.014)	0.004	(0.011)
HH head age	-0.000	(0.001)	-0.001	(0.000)	0.000	(0.000)	-0.000	(0.000)
Mother's education (primary)	-0.050***	(0.014)	-0.008	(0.014)	-0.019*	(0.011)	-0.021*	(0.011)
Mother's education (secondary)	-0.110***	(0.040)	-0.053**	(0.024)	-0.072**	(0.035)	-0.059***	(0.020)
Access to safe water	-0.032**	(0.016)	-0.027*	(0.015)	-0.030**	(0.014)	-0.017	(0.012)
Sanitation	-0.110**	(0.055)	-0.138***	(0.033)	-0.135**	(0.055)	-0.067**	(0.030)
Observations	9,046		9,516		9,046		9,516	

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

Source: Authors' calculations.

6 Conclusions

Mozambique has had high and sustained GDP growth over the past 15 years. There is, however, concern over whether this growth has benefited the majority of Mozambican people. Poverty reduction stagnated between 2002/03 and 2008/09, following a big drop between 1996/97 and 2002/03. Temporary and chronic child malnutrition are important dimensions of wellbeing, and in alignment with the poverty figures, the existing surveys show that chronic malnutrition (stunting) has decreased rather slowly over the past 15 years, from about 49 per cent in 1996/97 to 43 per cent in 2011. Underweight prevalence has also reduced, while wasting rates have remained broadly stable over time.

As it emerges from our analysis, (lack of) wealth is among the most important factors associated with child malnutrition. However, poverty reduction is not necessarily translated into lower levels of child malnutrition, and more focused interventions aimed at reducing child malnutrition are probably needed. Our results show that improved sanitation and access to safe water are strongly linked to the probability of being malnourished, implying that improvements should continue to be made here. Another area of intervention with likely positive effects on reducing child malnutrition is boosting the provision of education for girls: in all our analyses we highlighted the strong association between mother's education and child malnutrition. Our results also show a geographical disparity in Mozambique leading us to conclude that intervention should be particularly focused in specific provinces and rural areas.

Furthermore, the statistical significance and magnitude of the coefficients did not change much between 2003 and 2011. This suggests that the determinants of child malnutrition remained mostly unchanged over time. Given that child malnutrition has significant consequences for development both at the individual and national level, we conclude that continued and more focused and effective interventions aimed at *directly* reducing child malnutrition should be undertaken by all public and private actors involved.

References

Beaton, G., A. Kelly, J. Kevany, R. Martorell, and J. Mason (1990). 'Appropriate Uses of Anthropometric Indices in Children'. ACC/SCN State-of-the-Art Series in Nutrition Policy. Paper nº 7. Geneva: United Nations.

Burchi, F. (2010). 'Child Nutrition in Mozambique in 2003: The Role of Mother's Schooling and Nutrition Knowledge'. *Economics and Human Biology*, 8(3): 331–45.

Burchi, F. (2012). 'Whose Education Affects a Child's Nutritional Status? From Parents' to Household's Education'. Demographic Research. *Max Planck Institute for Demographic Research*, Rostock, Germany 27(23): 681–704.

Christiaensen, L., and H. Alderman (2004). 'Child Malnutrition in Ethiopia: Can Maternal Knowledge Augment the Role of Income?'. *Economic Development and Cultural Change*, 52(2): 287–312.

Cuesta, J. (2007). 'Child Malnutrition and the Provision of Water and Sanitation in the Philippines'. *Journal of the Asia Pacific Economy*, 12(2): 125–27.

Fewtrell, L., and J.M. Colford (2004). 'Water, Sanitation and Hygiene: Interventions and Diarrhoea—A Systematic Review and Meta-analysis'. HNP Discussion Paper. Washington, DC: World Bank.

Glewwe, P. (1999). 'Why Does Mother's Schooling Raise Child Health in Developing Countries? Evidence from Morocco'. *Journal of Human Resources*, 34(1): 124–59.

INE (Instituto Nacional de Estatística), MISAU (Ministerio da Saude), and MEASURE DHS+/ORC Macro (2005). *Moçambique Inquérito Demográfico e de Saúde 2003*. Maputo: Mozambique.

Levinson, F., and L. Bassett (2007). 'Malnutrition is Still a Major Contributor to Child Deaths'. Population Reference Bureau. Available at: http://www.prb.org/pdf07/nutrition2007.pdf (accessed on 9 December 2016).

MISAU (Ministerio da Saude), INE (Instituto Nacional de Estatística), and ICFI (ICF International) (2013). *Moçambique Inquérito Demográfico e de Saúde 2011*. Calverton, MD: USA.

Morales, R., A.M. Aguilar, and A. Calzadilla (2004). 'Geography and Culture Matter for Malnutrition in Bolivia'. *Economics and Human Biology*, 2(3): 373–90.

MPD-DNEAP (Ministry of Planning and Development-National Directorate of Studies and Policy Analysis) (2010). *Poverty and Wellbeing in Mozambique: Third National Poverty Assessment*. Ministry of Planning and Development, República de Moçambique. Available at: http://www.preventionweb.net/files/16411_thirdnationalpovertyassessment.pdf (accessed on 9 December 2016).

Pelletier, D., E. Frongillo Jr, D. Schroeder, and J. Habicht (1994). 'A Methodology for Estimating the Contribution of Malnutrition to Child Mortality in Developing Countries'. *The Journal of Nutrition*, 124 (10 Suppl), 2106S.

Rice, A., L. Sacco, A. Hyder, and R. Black (2000). 'Malnutrition as an Underlying Cause of Childhood Deaths Associated with Infectious Diseases in Developing Countries'. *Bulletin of the World Health Organization*, 78(10): 1207–21.

Salvucci, V. (2016). 'Did Socioeconomic Inequality in Malnutrition Decrease in Mozambique? Determinants and Trends, 1996–2008'. *Journal of International Development*, 28(6): 857–75.

Semba, R.D., S. de Pee, K. Sun, M. Sari, N. Akhter, and M.W. Bloem (2008). 'Effect of Parental Formal Education on Risk of Child Stunting in Indonesia and Bangladesh: A Cross-Sectional Study'. *The Lancet*, 371(9609): 322–28.

Strauss J., and D. Thomas (1995). 'Human Resources: Empirical Modeling of Household and Family Decisions'. In J. Behrman and T.N. Srinivasan (eds), *Handbook of Development Economics, Vol. 3*. Amsterdam: North-Holland.

UNDP (2013). 'MDG Report 2013: Assessing Progress in Africa toward the Millennium Development Goals'. Available at: http://www.undp.org/content/dam/uganda/docs/Africa%20MDG%20report%202013%20summary_EN.pdf (accessed on 9 December 2016).

UNICEF (2006). *Childhood Poverty in Mozambique: A Situation and Trend Analysis*. United Nations Mozambique. Maputo: UNICEF.

UNICEF (2011). *Child Poverty and Disparities in Mozambique 2010*. United Nations Mozambique. Maputo: UNICEF.

Victora, C., L. Adair, C. Fall, P. Hallal, R. Martorell, L. Richter, and H. Sachdev (2008). 'Maternal and Child Undernutrition: Consequences for Adult Health and Human Capital'. *The Lancet*, 371(9609): 340–57.

Webb, P., and S. Block (2004). 'Nutritional Information and Formal Schooling as Inputs to Child Nutrition'. *Economic Development and Cultural Change*, 52(4): 801–20

World Bank (2006). *Repositioning Nutrition as Central to Development: A Strategy for Large-Scale Action*. Washington, DC: World Bank.

WHO (World Health Organization) (2000). *Turning the Tide of Malnutrition: Responding to the Challenge of the 21st Century*. Geneva: World Health Organization.

WHO (World Health Organization) (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: World Health Organization.

Appendix

Table A1: Ordinary least squares regression analysis of determinants related to weight-for-age and weight-for-height Z-scores among under-five children in Mozambique, 2003–11.

OLS	Weight-for-age Z-scores		Weight-for-age Z-scores		Weight-for-height Z-scores		Weight-for-height Z-scores	
	2003		2011		2003		2011	
	coef	se	coef	se	coef	se	coef	se
Child age (months)	-3.975***	(0.412)	-0.784**	(0.343)	-0.196	(0.409)	0.728	(0.457)
Child age (months) squared	0.059***	(0.007)	0.007	(0.005)	0.018***	(0.007)	-0.006	(0.007)
Sex (Male=1)	-5.780*	(3.250)	-13.515***	(2.801)	5.397	(3.300)	-5.175	(3.463)
HH size	-0.056	(0.471)	0.206	(0.622)	0.580	(0.469)	0.009	(0.733)
Wealth quintile 2	10.342**	(5.197)	10.651**	(4.594)	4.583	(5.368)	14.545**	(5.731)
Wealth quintile 3	17.211***	(5.424)	21.824***	(5.034)	13.227**	(5.632)	23.592***	(6.085)
Wealth quintile 4	25.528***	(6.068)	26.944***	(5.487)	5.048	(5.928)	20.416***	(6.542)
Wealth quintile 5	43.711***	(7.396)	49.613***	(7.066)	7.827	(8.146)	16.833*	(8.740)
Niassa (North)	-27.813***	(8.986)	-26.666***	(7.623)	-19.723**	(8.973)	-29.761***	(8.573)
Cabo Delgado (North)	-66.807***	(8.457)	-41.473***	(7.377)	-39.383***	(9.087)	-30.684***	(8.538)
Nampula (North)	-39.092***	(7.862)	-36.648***	(7.334)	-58.175***	(8.741)	-15.758*	(9.314)
Zambezia (Centre)	-29.764***	(8.193)	-36.822***	(7.384)	-29.941***	(8.776)	-57.696***	(8.787)
Tete (Centre)	-36.860***	(7.505)	-29.311***	(7.450)	-35.526***	(8.076)	-34.762***	(8.426)
Manica (Centre)	-38.572***	(7.503)	-22.920***	(6.884)	-48.427***	(7.993)	-27.275***	(8.408)
Sofala (Centre)	-48.264***	(7.896)	-18.506***	(6.820)	-57.981***	(8.732)	-39.004***	(7.973)
Inhambane (South)	10.027	(7.264)	8.132	(7.032)	2.807	(7.754)	8.051	(8.073)
Gaza (South)	-39.439***	(7.448)	15.091**	(7.057)	-57.185***	(8.091)	0.554	(7.527)
Maputo Province (South)	1.144	(7.001)	-1.799	(6.397)	-2.294	(6.741)	-8.050	(7.071)
Maputo City (South) - reference	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
Urban	-5.339	(4.609)	-0.248	(3.901)	-8.040*	(4.570)	-10.223**	(5.122)
HH head sex (male=1)	-4.094	(4.380)	-3.336	(3.123)	-3.049	(4.235)	-4.995	(4.093)
HH head age	0.163	(0.139)	0.095	(0.118)	0.053	(0.138)	-0.099	(0.152)
Mother’s education (primary)	11.498***	(3.529)	5.916*	(3.273)	3.707	(3.539)	3.528	(3.974)
Mother’s education (secondary)	3.253	(9.936)	19.173***	(5.285)	-15.884	(10.803)	11.440*	(6.539)
Access to safe water	8.089**	(4.070)	-0.918	(3.405)	1.906	(3.954)	-9.700**	(4.198)
Sanitation	31.581***	(10.358)	27.615***	(6.116)	4.506	(12.439)	9.616	(7.164)
Constant	-38.776**	(15.238)	-65.276***	(13.000)	32.641**	(15.297)	48.625***	(16.508)
Observations	9,073		9,516		9,067		9,516	
R-squared	0.093		0.087		0.052		0.035	

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

Source: Authors’ calculations.

Table A2: Probit regression analysis of determinants related to underweight and wasting among under-five children in Mozambique, 2003–11.

PROBIT (marginal effects)	Underweight (0=No; 1=Yes)		Underweight (0=No; 1=Yes)		Wasting (0=No; 1=Yes)		Wasting (0=No; 1=Yes)	
	2003		2011		2003		2011	
	coef	se	coef	se	coef	se	coef	se
Child age (months)	-0.000	(0.000)	-0.000*	(0.000)	-0.001***	(0.000)	-0.002***	(0.000)
Sex (Male=1)	0.022**	(0.010)	0.032***	(0.008)	0.007	(0.006)	0.007	(0.006)
HH size	-0.002	(0.002)	-0.001	(0.002)	-0.003***	(0.001)	-0.003**	(0.001)
Wealth quintile 2	-0.025	(0.017)	-0.037***	(0.014)	-0.009	(0.009)	-0.026***	(0.009)
Wealth quintile 3	-0.040**	(0.017)	-0.046***	(0.015)	-0.018**	(0.009)	-0.029***	(0.009)
Wealth quintile 4	-0.035*	(0.020)	-0.065***	(0.017)	0.001	(0.010)	-0.026**	(0.011)
Wealth quintile 5	-0.109***	(0.023)	-0.074***	(0.021)	0.009	(0.017)	-0.012	(0.018)
Niassa (North)	0.044	(0.031)	0.045*	(0.024)	0.007	(0.009)	-0.001	(0.013)
Cabo Delgado (North)	0.136***	(0.031)	0.060**	(0.025)	0.034***	(0.012)	0.011	(0.014)
Nampula (North)	0.081***	(0.028)	0.020	(0.024)	0.072***	(0.012)	0.028*	(0.015)
Zambezia (Centre)	0.057**	(0.028)	0.055**	(0.024)	0.045***	(0.011)	0.041***	(0.015)
Tete (Centre)	0.053*	(0.027)	0.039	(0.024)	0.013	(0.008)	0.013	(0.013)
Manica (Centre)	0.063**	(0.028)	-0.010	(0.022)	0.032***	(0.011)	0.027*	(0.014)
Sofala (Centre)	0.079***	(0.028)	0.012	(0.022)	0.077***	(0.013)	0.049***	(0.014)
Inhambane (South)	-0.049*	(0.025)	-0.042*	(0.022)	0.000	(0.008)	-0.014	(0.012)
Gaza (South)	0.053*	(0.027)	-0.039*	(0.022)	0.067***	(0.013)	-0.025**	(0.012)
Maputo Province (South)	-0.034	(0.027)	-0.010	(0.022)	-0.004	(0.007)	-0.011	(0.012)
Maputo City (South) - reference	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
Urban	0.025	(0.017)	0.007	(0.013)	0.013	(0.009)	0.017*	(0.009)
HH head sex (male=1)	0.010	(0.014)	0.015	(0.010)	0.003	(0.008)	0.005	(0.006)
HH head age	-0.000	(0.000)	-0.000	(0.000)	0.000	(0.000)	0.000**	(0.000)
Mother’s education (primary)	-0.033***	(0.011)	-0.021**	(0.010)	-0.002	(0.006)	-0.009	(0.006)
Mother’s education (secondary)	0.020	(0.042)	-0.062***	(0.017)	0.039	(0.029)	-0.024**	(0.010)
Access to safe water	-0.037***	(0.013)	-0.003	(0.010)	-0.010	(0.007)	0.006	(0.007)
Sanitation	-0.071	(0.058)	-0.078***	(0.026)	-0.022	(0.028)	-0.038**	(0.017)
Observations	9,073		10,088		9,067		10,088	

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

Source: Authors’ calculations.