Discussion Papers
Department of Economics
University of Copenhagen

No. 07-30

Child Height and Maternal Health Care Knowledge in Mozambique

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ISSN: 1601-2461 (online)

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This version October, 2007

* A first draft of the work was prepared while working for the World Bank in Maputo, Mozambique. I am thankful to Louise Fox for her continuous support, to Ken Simler for his advice on the use and interpretation of the data and to Mikkel Barslund for fruitful discussions on the topic. I thank participants at the CSAE Conference 2007 in Oxford for their very useful comments and in particular Frédéric Gaspart for suggestions on methodology. Permission to use the Mozambique Demographic and Health Survey 2003 from MEASURE DHS (www.measuredhs.com) is greatly acknowledged.

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Abstract: Stunting prevalence rates in Mozambique are very high (41 percent), especially in rural areas (46 percent). Recent research shows that consumption growth alone will not be sufficient to solve the problem of malnutrition. To investigate the role of additional determinants I use a two-stage quantile regression approach with specific attention to the role of maternal preventive health care knowledge and schooling. Three different scores for health care knowledge are used and show similar results. For rural Mozambique, I find that maternal schooling has positive effects especially in the top quintile of the height-for-age distribution while health care knowledge has a positive effect on height-for-age of under two year old children especially at the lower end of the distribution where the severely stunted children are located. Improving health care knowledge of mothers could substitute for the low levels of education and community health care facilities in rural areas and positively affect the height of the most severely stunted children.

1. Introduction

The latest Demographic and Health Survey (DHS, 2003) in Mozambique showed that 41 percent of children younger than five year old are stunted (low height-for-age) and nearly half of them (18 percent) are severely stunted. Stunting is generally used as a sign of chronic malnourishment reflecting a history of problematic dietary and/or health situations. Strong regional differences exist with the lowest levels of stunting in Maputo City and Maputo Province (21 and 24 %) in the south and the highest in Cabo Delgado in the north where 56 percent of under 5 year old children are stunted[1]. There is also a striking difference between rural and urban areas (46 and 29 percent respectively).

Malnutrition affects children's current health situation but also future development potential both at individual and national level. A bad nutritional status increases the susceptibility to diseases and ultimately death[2]. Not only is the child's physical but also its psycho-intellectual development likely to be affected by a low nutritional status (Behrman, 1999). Early childhood development has long-term consequences in terms of educational achievements and health status, hence future adult productivity and earning potential as shown for example in Glewwe, Jacoby and King (2001) and Alderman et al (1999). By affecting adult health and educational status, early childhood nutrition has consequences for long term economic development too (Strauss and Thomas, 1998; Alderman and Behrman, 2004). Its long term human and economic development effects have not always been acknowledged but recently malnutrition is being recognised as a key to fighting poverty (Worldbank, 2006).

A chronic situation of hunger was long believed to be the major cause of stunting. However, recent research suggests that increased food availability (Smith and Haddad, 2001a) and income growth alone will not be sufficient to solve the malnutrition problem (Wolfe and Behrman, 1982; Haddad et al, 2003; Ranjan, 2004; Glewwe et al, 2004;

[1] In Zambezia, Niassa, Tete, Sofala and Nampula stunting is higher than 40 percent (47, 47, 46, 42 and 42 respectively). In Cabo Delgado 30 percent of the under 5 year old children are severely stunted.
[2] Poor nutritional status contributes to 53 percent of deaths associated with infectious diseases among children under 5 year old (WHO, 2005).

Alderman, Hoogeveen and Rossi, 2005). Ray (2004) even finds that the worst cases of child malnutrition are not necessarily related to poverty or inequality.

Specifically for Mozambique, data suggest that income growth alone will not solve the malnutrition problem. For example, Haddad et al (2003), assuming a steady 2.5 percent annual consumption growth, find a projected decline from 23 percent underweight children in 1997 to 16 percent in 2015. Anthropometric analysis by Simler and Ibraimo (2005), using four Mozambican surveys between 1996 and 2003, confirms the results obtained by Haddad et al: despite significant reductions in poverty and steady consumption growth[3], they find only little improvement in children's anthropometric status. After controlling for missing data and changes in child mortality they find stunting has only declined from 42 percent in 1996/97 to 38 percent in 2003.[4] So more and more evidence shows that child malnutrition continues to exist even in food-secure households or where supplementary feeding programmes are in place,[5] suggesting that not only availability and access to food but also food utilisation and other care factors play a significant role in children's nutritional status.[6]

Non-income factors which have been studied extensively are maternal nutrition and child care knowledge and schooling. The effect of maternal schooling has always been acknowledged (Behrman and Wolfe, 1984; Smith and Haddad, 2001b) although the channels through which it materialises can differ. Channels through which parental education affects child health include, besides its possible income augmenting effect, better utilisation of community resources, such as health infrastructure, or better capability of processing information. The positive effect of education on information

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[3] Annual mean (percentile) growth rates of 4.1 percent between 1997 and 2003 (Fox et al, 2005).

[4] Simler and Ibraimo correct for several confounding factors and differences in the samples (such as different age distributions in the samples, correlation of incomplete anthropometric data with household economic status, variable truncation of the samples because of child mortality), after which the improvement over time in malnutrition outcomes is slightly larger but remains small.

[5] In India, levels of child malnutrition fell only slowly during the 1990s, even with significant economic growth and substantial public spending on an Integrated Child Development programme of which the main component was supplementary feeding to malnourished children. Das Gupta et al (2005) assess programme placement and the programme's outcomes. They find little evidence of a programme impact on child nutritional status.

[6] Deficiencies of key vitamins and minerals are very prominent (it is estimated that 35% of people lack adequate iodine, 40% suffer from iron deficiency, more than 40% of children are vitamin A deficient; World Bank, 2006)

processing capacities is found in many country studies, for example in Brazil (Thomas et al, 1991), in Morocco (Glewwe, 1999), Jamaica (Handa, 1999), the U.S. (Variyam et al, 1999), Central Java (Webb and Block, 2004), or Mexico (Behrman and Hoddinott, 2005).

Even though educated mothers process information better, information can have beneficial effects also for the children of uneducated mothers. In this case information can act as a substitute for schooling. For example for Ethiopia, Christiaensen and Alderman (2004) find that, additional to the effects of household resources, parental education and food prices, maternal nutritional knowledge (captured by the ability to spot growth faltering) is an important determinant of child chronic malnutrition. Also in an urban setting (Accra) Ruel et al. (1999) find that good care practices can substitute for education as input in child nutritional status. In a micronutrient study of Indonesian children, Block (2007) also finds that maternal nutrition knowledge substitutes for schooling.

While the anthropometric effect of income growth in Mozambique has been studied (and seems marginal), an investigation into the role of other possible determinants of chronic malnutrition has not been undertaken. Based on the findings in the literature discussed, information campaigns on child care could potentially act as a substitute for schooling and public facilities, especially in rural areas where the malnutrition problem is more severe and where education levels and community resources are low. In this paper I study whether there can be a role for informational programmes on children's health care beyond the role of education and income growth to improve child stunting.

The contribution of this paper is twofold. First of all, I aim to assess whether there is a role for maternal knowledge of preventive health care practices in the improvement of child anthropometric status in the specific case of Mozambique. The second contribution lies in the methodology. Child nutritional status has mostly been analysed using least squares regression methods. However, estimates of the effects of various correlates on the conditional mean of children's anthropometrics do not necessarily reflect the effects in the entire conditional distribution of anthropometrics. By applying a quantile regression approach (Koenker and Bassett, 1978) the effects on the entire conditional distribution can be analysed and effects are allowed to differ across quantiles.

Recent research shows that this approach is justified. Koenker and Hallock (2001) show that the effect of maternal behaviour on birthweight differs indeed across quantiles of the birthweight distribution. Aturupane, Deolalikar and Gunewardena (2006) use quantile regressions to analyse child malnutrition in Sri Lanka and find that least squares estimates can be misleading. They find that most explanatory variables (income, education, health environment) have stronger effects at the higher quantiles of the anthropometric distribution. So especially when the aim is to test whether maternal child care knowledge is a possible tool to improve the anthropometric status of the most severe cases of malnourishment (children in the lowest quantiles of the distribution) a quantile regression approach is suitable. Previous studies on maternal nutrition or child care knowledge have ignored this possibility. To take the endogeneity of child care knowledge into account, I explore the effect of maternal health care knowledge via two-stage quantile regressions (Amemiya, 1982). This will reveal where exactly in the distribution it is effective as a means to reduce the high prevalence of stunting in rural Mozambique.

Using three different indices to capture maternal knowledge of simple preventive health care practices, the results suggest that effects are different across the child height-for-age distribution. I find that the effect of maternal schooling is especially prevalent in the highest quantiles (similar to the results found in the Sri Lanka study) but that the effect of maternal health care knowledge is especially large and significant in the lowest quartile of the distribution (this is where the severely stunted children are found). Hence while schooling is effective to improve height-for-age of children in the higher ends of the rural distribution, improving maternal health care knowledge may increase height-for-age of the smallest children in the rural areas.

In the following sections I present the methodology, the data, the construction of three health care indices and the estimation results. The last section concludes.

2. Methodology

Child nutritional status (*N*) is a home produced good and the nutrition production function can be written as

$$N = f(K, M, H, I, \mu) \tag{1}$$

where K is a vector of child exogenous characteristics, M and H are vectors of exogenous mother and household characteristics, I represents nutrition inputs such as medical care and μ reflects children heterogeneity in terms of unobserved health endowments. Adopting a linear form of the nutrition production function, the empirical version of (1) becomes

$$N = \alpha_1 + \beta_1 X + \gamma_1 C + \varepsilon_1 \quad (2)$$

where X is a vector combining the child, mother and household exogenous controls, C is health care knowledge, and ε_1 is a random error term, identically and independently distributed (iid), containing the child's unobserved health endowment effect μ.

Health care C will be represented by different indices of knowledge of preventive health care practices evaluating the mother's answers to a range of child health related questions. However, health care inputs are endogenous (Rosenzweig and Schultz, 1983). The possible source of endogeneity here is omitted variable bias. It is likely that unobserved mothers characteristics such as mother ability, which are captured in ε_1, also affect the explanatory variable C. Moreover, there may also be a measurement error problem since the indices used will only be an imperfect measurement of the true health care practices of the mother. This measurement error can result in a downward bias on the effect of health care (Wooldridge, 2006).

Since the error term ε_1 is most likely correlated with C, ordinary least squares (OLS) or least absolute deviations (LAD) regressions would yield inconsistent estimates of the parameter of interest γ_1. In order to obtain consistent estimates for γ_1, C needs to be instrumented

$$C = \alpha_2 + \beta_2 X + \gamma_2 Z + \varepsilon_2 \quad (3)$$

with ε_2 is an iid error term and Z is a vector of instrumental variables such that Z is uncorrelated with ε_1 and (partially) correlated with C.

In analogy to (2)-(3) the quantile regression system becomes:

$$N = \alpha_1(\tau) + \beta_1(\tau) X + \gamma_1(\tau) C + \varepsilon_1 \quad (4)$$

where $\alpha_1(\tau), \beta_1(\tau), \gamma_1(\tau)$ are estimates of the constant term and the effects of *X* and *C* on the τth quantile. Addressing endogeneity in quantile regressions is not straighforward. Amemiya (1982); Powell (1983); Abadie, Angrist and Imbens (2002); Chernozhukov and Hansen (2002); Blundell and Powell (2003); Lee (2004); Chernozhukov, Hansen and Jansson (2007); Horowitz and Lee (2007) present different methods to solve the endogeneity problem in quantile regressions. I apply the "fitted value" approach developed by Amemiya (1982) and Powell (1983) and used for example in Arias, Hallock and Sosa-Escudera (2001); Garcia, Hernandez and Lopez-Nicolas (2001); Levin (2001). To find a consistent estimate of $\gamma_1(\tau)$, the coefficient of interest, *C* in (4) is replaced by its fitted value $\hat{C}$ from (3) so that:

$$N = \alpha_1(\tau) + \beta_1(\tau)X + \gamma_1(\tau)[\alpha_2 + \beta_2 X + \gamma_2 Z] + \delta_1 \quad (5)$$

where $\delta_1 = \varepsilon_1 + \gamma_1(\tau)\varepsilon_2$. For consistency it is necessary that $Q_{\delta_1|Z}(\tau \mid z)$ is independent of *z*. $Q_{\delta_1|Z}(\tau \mid z)$ is the τth quantile of δ_1 conditional on $Z = z$. Amemiya (1982) and Powell (1983) show how to obtain the covariance matrix when using this method. Practically the coefficients and their standard errors can also be obtained by bootstrapping both stages, where the first stage is an OLS regression of the endogenous variable *C* on the set of exogenous variables *X* and *Z* and the second stage is a quantile regression of the anthropometric outcome *N* on the set of exogenous regressors *X* and the fitted value of the endogenous variable, $\hat{C}$. The programme is run in Stata with 500 replications for each health care index and each quantile analysed.

3. Data

The data used for the analysis is the Demographic and Health Survey for Mozambique collected in 2003 (DHS2003). The survey is nationally representative of women of reproductive age (age 15 to 49), and was especially designed to obtain information on fertility, family planning, child survival and child health. The survey was implemented by the Instituto Nacional de Estatistica (INE) with the technical assistance of ORC Macro. 12,315 households were interviewed; 12,418 women and 2,900 men. Anthropometric data were collected for all children present in the household who were younger than five.

To capture the child's relative height-for-age the Z-score is used, which is the number of standard deviations a child's height-for-age differs from the median height-for-age of children of the same age and sex in the reference population.[7] In Table 1 three different indicators of nutritional status are presented: height-for-age (stunting) is an indicator of long-term or chronic malnutrition, weight-for-height (wasting) is a short-term indicator reflecting acute malnutrition, and weight-for-age (underweight) is a combination of both. It is generally accepted that Z-scores below a value of -2 indicate stunting, wasting and underweight respectively while Z-scores below -3 indicate severe malnourishment. Data are presented nationally, by area of residence - rural or urban- and by wealth quintiles.[8]

Table 1: Averages of anthropometric measures for children under age five, DHS 2003

	Height-for-age			Weight-for-height		Weight-for-age	
	average z-score	% stunted z<-2	% severely z<-3	average z-score	% wasted z<-2	average z-score	% underweight z<-2
Rural	-1.84	46	19	-0.12	4	-1.24	27
Urban	-1.32	29	9	0.04	3	-0.80	14
Poorest	-1.92	49	21	-0.16	5	-1.33	30
2nd	-1.86	46	18	-0.17	3	-1.29	26
3rd	-1.85	46	18	-0.06	3	-1.19	26
4th	-1.51	35	12	-0.03	3	-0.96	19
Richest	-1.10	20	6	0.11	2	-0.61	9
Total	**-1.70**	**41**	**16**	**-0.08**	**4**	**-1.12**	**23**

Source: Calculations from DHS 2003 dataset.

The average Z-score for height-for-age is -1.7 and 41 percent of the under five year old children have Z-scores below -2. Chronic malnutrition shows the worst results of the three indicators and is much worse in rural than in urban areas. 16 percent of under five year old children are severely stunted, 85 percent of which are living in rural areas. There

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7 Z-score=(observed value minus median reference value)/standard deviation of reference population. Most commonly used reference standards were developed by the US National Center for Health Statistics (NCHS). These are recommended by WHO for international use (see Food and Nutrition Technical Assistance website: www.fantaproject.org).

8 Weights are used for calculations and regressions throughout the paper; Wealth quintiles are quintiles of individuals rather than households. They are based on an asset index (wealth factor score) which is the weighted sum of household asset scores which were standardised in relation to a normal distribution with zero mean and standard deviation one. The household assets include ownership of consumer goods such as a radio, a television, a bicycle or car, as well as dwelling characteristics such as source of drinking water, sanitation facilities, and material of the floor. For more detail on the construction of wealth factor scores based on Mozambique DHS 1997 data, see Gwatkin et al (2000).

is a strong difference in the Z-scores of children in the three lowest and those in the two richest quintiles, the difference being nearly 30 percent more stunted children in the lowest compared to the richest quintile. Aggravating the high level of stunting in Mozambique is the fact that height-for-age Z-scores have hardly improved over time (Simler and Ibraimo, 2005).

For the remainder of the article, I focus on the long term indicator of malnutrition, height-for-age, which shows the persistently worst levels. Further, the analysis will be restricted to the sample of under two year old children. The reasons for doing so are: (1) some of the practices captured in the health care scores apply only to the lastborn child. So the mother may have only recently learned them and applied them only to the youngest child(ren), (2) especially early childhood developments (i.e. infants and young children under the age of two) are important for adult health and productivity status, and this two year time period is considered "the window of opportunity" to affect the child's long-term health status.

In this article I assess whether there is a role for simple illness prevention knowledge (such as intake of vitamins, use of mosquito nets, vaccinations, liquid providing habits for children with diarrhoea etcetera) in the improvement of height-for-age Z-scores. Composing a simple health care knowledge variable is not straightforward, especially as to how exactly the variable should be composed and how to weigh the different elements in order to capture as closely as possible the true health care knowledge and practices of the mother.[9] There is a range of possible variables available in the DHS2003. As a robustness check I construct three different scores of maternal simple health care knowledge, which will be discussed in turn in section 4. Here I merely show summaries of a selection of variables available together with the average years of schooling of mothers with children under age two (Table 2). Most of the variables in Table 2 are mother specific although variables related to vaccinations and vitamins are child specific. Some of the variables reflect practices during pregnancy (of the mother's lastborn child)

[9] For a comprehensive overview of studies on the effects of different types of childcare practices, see Arimond and Ruel, 2002. For example, Ruel et al (1999) analyse the effect of a childcare index concentrated on child feeding and hygiene practices on the conditional mean of child height-for-age in urban Accra.

as the period during and even before pregnancy through the first two years of life has a long-term impact on the child's growth (Worldbank, 2006).

Table 2: Maternal schooling and health care knowledge and practices, for children under age two

Percentage	Total	Rural	Urban
Schooling (average years)	2	1	4
Health care knowledge and practice			
Mother heard about Oral Rehydration Salts (ORS)	88	85	96
Mother heard about family planning	63	58	75
Mother knows child with diarrhoea needs more liquid	51	44	69
Mother did prenatal check-up for lastborn[a]	86	82	97
Mother took iron during pregnancy of lastborn	59	51	81
Mother gave vitaminA containing fruit to lastborn last 24h	17	17	15
Child vaccinated against polio[b]	74	70	85
Child received vitaminA at least once during last 6m	44	39	59

[a] Including traditional birth attendants (TBA). The total percentage remains 86 when only formal prenatal care is considered. In rural and especially the poorest quintiles more women visit a TBA.
[b] Percentage of two year olds vaccinated against polio once (vaccination repetition rates are much lower).
Source: Calculations from DHS 2003 dataset.

Schooling is on average around two years for the mothers of the under two year olds in the Mozambican DHS but much lower in rural areas where women have on average only year of schooling. It is especially in rural areas that substitutes for schooling, such as health care knowledge, could potentially have beneficial effects on child anthropometrics. Some of the health care methods appear to be widely known, such as prenatal check-ups and Oral Rehydration Salts (ORS), while others have more limited practice, such as making sure children get enough vitamins and need more liquid when they have diarrhoea. From Table 2 it is clear that urban dwellers appear to be better informed. An additional point to make is that, although mothers may have heard about a practice they may not actually practice it (88 percent of the children have a mother who heard about ORS but only 12 percent of the children have mothers who ever used ORS). This may indicate problems of availability, uncertainty of how to apply the knowledge or household constraints of monetary or other nature.

4. Health care scores and estimation results

Three different scores capturing maternal health care knowledge are constructed in order to be able to check the robustness of the results obtained. The three scores differ according to which variables are included and how they are weighted. The first one is elaborate and includes mother and child specific information related to simple health care knowledge and practices which could be valued. I call this the *weighted score*. As opposed to this one, I also create a very simple one which is a mere count of a list of health care issues (knowledge or practice). This one is the *simple score*. Last, I run a principal components analysis on the different elements included in the simple score to check for possible redundancies in the data and to create a new score of lower dimensions with data determined weights. The resulting score is called the *PCA score*.

To construct the first score, I select several variables related to child health care available in the Mozambique DHS 2003 and score the answers given by the respondent according to their relevance for child health. Each practice receives a score of minus one, zero or one, according to how well or bad a practice it is (e.g. when the respondent mentions that when a child has diarrhoea she gives less liquids than usual this is given minus one, more liquid is plus one and the same amount of liquid gets zero). See annex Table A1 for the variables and the scoring method used to construct the weighted score.

The second index is a simpler one, adding up whether a mother knows or practices a certain health improving technique. The seven selected techniques include whether the mother has heard about ORS and family planning, whether she gives more liquid when a child has diarrhoea, whether she has gone for prenatal care for the lastborn child, whether the child has received any vaccinations, whether the child has been given vitamin A during the first 2 months of life or has received any during the last six months. For this score no weights are used, and it only assumes that the more of these are known or practiced, the better.

Alternative to creating a simple count of a selection of techniques, all could be added as regressors. However, since some of them are highly correlated multicollinearity may lead to insignificant estimates. Moreover, instrumenting many different health care practices would become cumbersome. A principal components analysis is run on the seven practices included in the simple score to find redundant ones and whether the data can reasonably be lowered in dimension. It turns out that maternal knowledge can be captured by one score, which is a data weighted score of the elements in the simple score. All scores are presented in Table 3.

Table 3: Constructed health care knowledge scores, children under age two

	Observations		Mean		Min	Max
	Total	Total	Rural	Urban	Total	Total
Weighted score	3827	2.2	1.7	3.5	-5	9
Simple score	3863	3.6	3.3	4.3	0	7
PCA score	3716	-0.17	-0.45	0.56	-4.64	1.40

Averages over all children under age two.

The weighted score lies between minus five and nine where mothers score on average 2.2, while the simple score lies between zero and seven with an average of 3.6 and the PCA score has values between -4.64 and 1.40 with a negative average of -0.17. Unsurprisingly, the average knowledge and practice of simple health care techniques is lower in rural than in urban areas.

Besides the health care knowledge and practice scores, a number of exogenous variables enter both stages of the estimation. I include a vector of child specific variables including age (in months), age squared and sex. Also included is a vector of the mother physical characteristics (height in centimetres and body mass index), her age, and the years of schooling she received. A variable with the number of children between zero and five living in the household is also included. To correct for the poverty status of the household, I include dummies representing quintiles of household wealth.

Ideally the regression should also be augmented with community resources (Strauss, 1990; Smith and Haddad, 2001b). Unfortunately, community level information such as the presence of a health centre is not available.[10] Instead, I include the percentage of

[10] Some countries in the MeasureDHS database do have a Service Provision Assessment or SPA (however, information on services is collected not for the clusters but in a sample of health providers; Mozambique does not have one).

households that use safe water as their source of drinking water.[11] Further, province dummies are included to correct for provincial fixed effects such as average distance to and quality of health centres. Additionally, the provincial dummies may also capture cultural differences which affect feeding and other care practices. For example, Gillespie et al (2004) find that traditional beliefs in the Lao People's Democratic Republic determine how young children are fed and what type of foods pregnant or lactating women can eat. For Bolivia, Morales et al (2005) find that Quechua children have significant lower nutritional status compared to Aymara and Spanish children (correcting for other characteristics). Ethnicity is not available in the Mozambique DHS data so the cultural differences can be captured by the province dummies.

As indicated in the methodology section a two stage analysis is applied to correct for endogeneity. Finding proper instruments is crucial for identification of the parameters of interest. I use two community level variables and one household level variable as instruments. At the community level, the percentage of households that own a radio (excluding the household the child belongs to) and the percentage of mothers who heard about family planning (excluding the child's own mother) are used to capture access to and level of information available in the village. These variables will not directly affect the child's height unless her mother uses this information to update her child care knowledge and practice. Further, I include the household's religion as some religions may prohibit or encourage certain practices but should not affect child height directly.

As the characteristics of rural and urban areas are so different with respect to distance to health and education facilities, availability of goods, access to information, and not in the least the severity of the malnutrition problem, the analysis is focused on rural Mozambique only.[12] Table 4 presents summary statistics of the variables discussed above, separately for rural and urban areas. Large rural-urban differences exist for maternal education, household wealth and the community level variables.

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[11] Thomas (1992) finds that local infrastructure, especially modern sewerage, piped water and electricity, significantly affect child height in Brazil.

[12] A pooling test shows that this is justified: the hypothesis of all rural interaction terms being equal to zero was rejected at 5 percent irrespective of which health care variable included.

Table 4: Summary statistics of variables (children under age two)

Variables	Total	Rural	Urban
Child characteristics (under 2 year olds)			
Z-score height-for-age	-1.4	-1.6	-1.1
Age (in months)	11	11	11
Sex (% male)	50	51	50
Mother characteristics			
Height mother (in cm)	155	155	156
Body Mass Index of mother (BMI)	22	21	23
Age (in years)	27	27	26
Mother's education (average years)	2	1.3	4
Household characteristics			
Number of children between 0 and 5	1.9	1.9	1.9
Wealth score (base for wealth quintiles)	-21056	-50869	59542
Community characteristics			
Households using safe drinking water (%)	37	22	73
Instrumental variables			
Households owning radio (%, excl. HH)	58	52	70
Mothers heard about family planning (%, excl. mother)	61	55	73
Religion is moslem (% HHs)	19	20	18
Religion is zion (% HHs)	8	8	11
Religion is protestant/evangelic (% HHs)	26	24	31

Table 5 shows the coefficients and standard errors of the three instrumented health care scores and maternal schooling for the 5^{th} to 95^{th} quantile of the conditional height-for-age distribution of under two year old children living in rural areas in Mozambique. The results are obtained by bootstrapping both the first OLS stage and the second LAD stage (500 replications). The coefficients are also presented graphically in Figure 1.

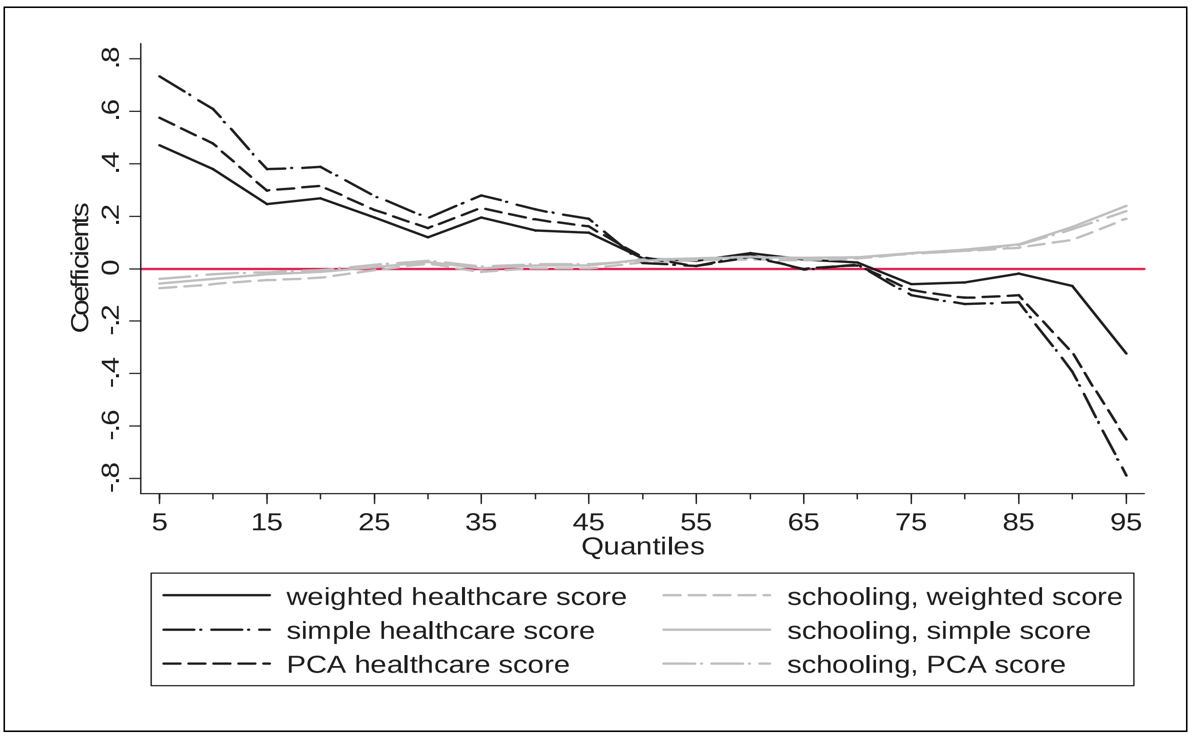
Table 5: 2SLAD estimation results of health care scores and schooling on height-for-age, rural areas

Regressions with:	Weighted score				Simple score				PCA score			
Results for:	Health care knowledge		Schooling		Health care knowledge		Schooling		Health care knowledge		Schooling	
	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE
2SLAD for τ:												
0.05	**0.472**	0.229	-0.074	0.078	**0.734**	0.361	-0.056	0.072	**0.575**	0.276	-0.039	0.061
0.10	**0.379**	0.176	-0.059	0.068	**0.609**	0.274	-0.040	0.061	**0.478**	0.208	-0.020	0.054
0.15	**0.245**	0.142	-0.043	0.058	**0.379**	0.226	-0.021	0.052	**0.299**	0.173	-0.014	0.048
0.20	**0.269**	0.130	-0.035	0.049	**0.389**	0.210	-0.013	0.045	**0.316**	0.160	-0.005	0.040
0.25	0.196	0.140	-0.006	0.048	0.277	0.217	0.007	0.043	0.224	0.165	0.015	0.037
0.30	0.119	0.143	0.019	0.046	0.194	0.226	0.025	0.040	0.155	0.169	0.030	0.033
0.35	0.196	0.142	-0.013	0.044	0.281	0.223	0.001	0.039	0.232	0.163	0.008	0.032
0.40	0.147	0.133	0.002	0.045	0.226	0.212	0.013	0.041	0.188	0.156	0.017	0.034
0.45	0.136	0.130	0.001	0.045	0.190	0.209	0.013	0.041	0.161	0.155	0.017	0.035
0.50	0.039	0.120	0.024	0.043	0.021	0.192	0.035	0.037	0.043	0.144	0.031	0.032
0.55	0.030	0.116	0.032	0.041	0.010	0.187	0.039	0.036	0.010	0.140	0.039	0.032
0.60	0.059	0.120	0.036	0.042	0.052	0.190	0.044	0.036	0.045	0.144	0.045	0.032
0.65	0.036	0.125	0.032	0.043	-0.003	0.199	0.041	0.037	0.000	0.147	0.040	0.033
0.70	0.024	0.125	0.039	0.045	0.016	0.194	0.043	0.039	0.014	0.146	0.043	0.035
0.75	-0.059	0.125	0.059	0.047	-0.102	0.192	0.060	0.041	-0.081	0.147	0.056	0.037
0.80	-0.053	0.127	0.068	0.049	-0.135	0.202	**0.072**	0.043	-0.110	0.151	**0.069**	0.039
0.85	-0.019	0.151	0.080	0.050	-0.127	0.248	**0.093**	0.044	-0.102	0.183	**0.090**	0.037
0.90	-0.066	0.205	**0.109**	0.066	-0.392	0.324	**0.160**	0.056	-0.320	0.240	**0.151**	0.047
0.95	-0.323	0.275	**0.191**	0.092	**-0.789**	0.427	**0.239**	0.080	**-0.650**	0.317	**0.220**	0.067
Observations	2221				2300				2221			

Only for children under age two; significant coefficients in bold (significant at 10 % or less).

It turns out that there are indeed different effects of knowing simple health care techniques at different quantiles of the distribution. I find robust significant positive effects in the lowest quintile of the height-for-age Z-score distribution, with the largest effects in the 5th and 10th quantile. Hence, the strongest effects of maternal health care knowledge exist in the area where severe stunting occurs while the effects on moderately stunted and non-stunted children are small to non-existent. Maternal schooling appears to have significant effects only in the highest quintile, with especially large effects in the 90th and 95th quantile. The results for schooling are very robust to the choice of health care score. Indirect effects of schooling exist through its positive effect on health care knowledge (first-stage results not shown). Figure 1 shows clearly how the difference in effects at different quantiles of the distribution could lead to a mean effect which is not representative for the entire distribution.

Figure 1: Quantile effects of knowledge indices and schooling on height-for-age Z-scores, rural areas



Source: DHS data, coefficient estimates from Table 5.

A separate analysis for urban children showed that neither schooling nor health care knowledge had positive effects in any of the quantiles. This suggests that maternal health care knowledge can be beneficial to children's height-for-age especially in areas characterised by low levels of schooling and where community resources, such as health facilities or other infrastructure, are scarce. The results suggest that in rural areas, maternal health care knowledge is one possible area of intervention to tackle the problem of severe stunting.

5. Conclusion

The Mozambican Demographic and Health Survey 2003 is used to analyse the worrisome situation of low height-for-age, an indication of chronic malnutrition, of children in their early childhood. I analyse height-for-age Z-scores of under two year old children in rural Mozambique where nearly half of the children are stunted and one child in five is severely stunted.

Maternal education and nutrition knowledge are typically considered to have large beneficial effects on child anthropometrics. I analyse the effect of maternal education and knowledge of simple preventive health care techniques but rather than analysing them via a two-stage least squares approach, a two-stage least absolute deviations approach is used. Doing so allows for the possibility that variables, typically considered beneficial for mean child anthropometrics, may not have the same positive effects on all quantiles in the height distribution. To test robustness of the results, I investigate the effect of three differently composed health care scores.

The results suggest that both maternal schooling and health care knowledge and practice are positive determinants of height-for-age of rural Mozambican children, but where maternal schooling appears to have positive effects only on children in the highest quintile of the distribution, maternal health care knowledge has strong positive effects especially in the lowest quintile.

Improving maternal knowledge of simple health care techniques could be beneficial for severely stunted children in rural Mozambique, where health care knowledge can compensate for the low levels of schooling and health infrastructure.

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Annex

Table A1: Variables used to construct *weighted score* and scoring system

Variable	-1	0	+1
Knowledge			
ORS			Heard of ORS
Liquids when diarrhoea	Less liquid	Same amount liquid	More liquid
Practice lastborn			
Vitamin A fruit (lastborn)	Not given last 7 days	Given during last 7 days (excl. last 24h)	Given during last 24 hours
Prenatal care (lastborn)	Not weighed during pregnancy		
Child specific practice			
Iron during pregnancy			Iron taken
Breastfeeding	Never breastfed		
Vitamin A			VitA given last 6m or during 1st 2 months
Vaccinations	No vaccinations for children >3m	Some vaccinations given	Measles for >9m DPT1,2,3
Prenatal care	No prenatal care	TBA	Formal care
Use of mosquito nets	No children under net	At least 1 but not all	All children under net