Does mother’s education matter in child’s health? Evidence from South Africa.[♦]

Patricia Medrano[♠] Catherine Rodríguez Edgar Villa[♣]

Abstract

This paper studies the effect that mother's education as knowledge has on child health using height for age as health measure. Using cross sectional data from de 1993 South Africa Integrated Household Survey, and health measures form de National Center for Health Statistics, we find a significant and positive effect of mother's education on the height of a child. Specifically comparing a woman without any education with one with eight years of schooling implies that on average a two-year old child would be a half centimeter higher. In order to isolate de knowledge effect of mother’s education, we control for household and community resources. Additionally, we test for a differential impact of mother’s education depending on the age of the child. We observe a more important impact on children between 3 and 6 years old. Finally, our results suggest a complementarity between mother’s and father’s education.

Keywords: Economic development, health production, returns to schooling.

[♦] We are grateful for useful comments from Julie Schaffner, Dilip Mookherjee, Minsoo Park and Rodica Cnobloch. The remaining errors are ours.

[♠] Responsible for submitting the paper.

[♣] Medrano: Boston University and Universidad de Chile (Email: pmedrano@econ.uchile.cl); Rodriguez: Boston University (E-mail: cahtero@bu.edu); Villa: Boston University (E-mail: evilla@bu.edu)

1. Introduction

This paper tries to asses the impact of mother's knowledge on children's health. Naturally, conditions within a household are important determinants of child health and as one might expect parents play a central role in "producing children with good health". Specifically the "mother" has been described as the most important health worker in the household. Nonetheless, how well a mother performs this task may depend on several factors such as her schooling and her own health. In particular, it has sometimes been argued that schooling equips the mother with a specific *knowledge* that enhances her ability to generate healthier children. This paper finds a positive effect of mother's education on child's health using South African data from 1993.

We will base our measure of the child's health status on the anthropometric measures contained in the dataset: weight and height for age. The weight of a child relative to the age is a short-term measure of child nutrition, since it responds to changes in health and nutritional status very quickly. On the other hand the effect on height is cumulative and can be perceived only in the long run. It is well known that poor child nutrition has long-term effects in physical and mental capacities which would probably yield low productivity in their adult age. Therefore we will focus on the height for age z-score to assess the relative poverty in child health at the household level when compared with the same measures of a standard well nourished population.

The first question we address is whether maternal education, through the knowledge channel described above, has a positive effect on long term child health measured through height for age. The answer to this question has important policy implications, namely if there is a positive effect of mother's education as knowledge on child health certain type of policies concerning the diffusion of specific information at community levels can be called for. For example, one important channel through which mother's education as knowledge can affect child's health at a community level is through the usage of health facilities which can serve as a complement or even as a substitute for the mother's education. Therefore a policy concern that we examine in this paper is the impact of health facilities interacted with mother's education as knowledge.

We are also interested in looking at the differential impact depending on the age of the child. The medical and public health literature shows that young children (ages 0 to 2) undergo a critical transition period, namely they have underdeveloped immune systems and are relatively more vulnerable to infections and disease. This age period is characterized by fast growth that coincides with a changing diet from breast milk to prepared foods. At a certain time, breastfeeding alone becomes inadequate for their nutrient requirements which can generate trauma and stress in their transition to prepared foods if the diet deteriorates in quality and perhaps in quantity. It is not surprising therefore that child's health outcomes have generally exhibited a decline from six months of age through the second year of life, followed by a turnover and a continuous improvement thereafter.[1] This suggests a U shape pattern in the transition period from breastfeeding intakes to prepared food intakes. Therefore, our final concern is to check if due to this U shape pattern on child health, mother's education affects in different ways children of different age groups.

South Africa is a very good place to examine these questions because of the wide disparity in income and health between poor and rich households. South Africa in the 1990s was an environment where the black communities in the rural areas did poorly on most of the indicators of well-being. This allows us to assess the impact of mother's education as knowledge more accurately on long term child's health since the other channels through which mother's education affect child's health like wealth status for example could be milder than in other parts of the world.

Following this introduction we develop a conceptual framework to explain the possible transmission channels of mother's education. We then proceed to review some of the existing literature on this and related topics. Section four describes the dataset we use for

[1] Barrera [1990].

our empirical application and section five presents our findings. Section six ends with conclusions.

2. Conceptual Framework

Poverty can be thought as a vicious circle. Low income households have less education and are probably less healthy, which in turn affects their productivity and their current income making it very difficult for them to leave that state through their own work and effort. It seems reasonable to argue that health and education related investments would help break this vicious circle since it could enhance households' future income through their children's future productivity.

As mentioned above the mother has been identified as the most important health worker in the household. Therefore we will focus on the role that mother's knowledge can play in enhancing future household productivity through child health investments. However we should be cautious in interpreting the different channels through which mother's education could affect children's health. Obviously, mother's education can have implicitly a permanent income effect that can enhance the household resources through the mother's own work. It is also not implausible to think that there could exist assortative mating, namely more educated women tend to mate with more educated men and therefore the schooling of the mother can implicitly capture a wealth and social status. Disentangling these different channels is crucial to assess the specific impact of mother's education as knowledge on children's health.

Specifically, mother's education can affect child health through various channels:

i. It increases economic resources of the family by increasing own earnings.
ii. It increases efficiency in the usage of available health facilities.
iii. It can affect household preferences.
iv. It improves allocation of resources due to better knowledge and information.
v. It can indicate wealth status and assortative mating.

We are primarily interested on how better knowledge and information may improve the allocation of the existing resources (iv). This question motivates the following framework which assumes that household i's utility is an increasing function of the consumption of child health (H_i) and other non-health related commodities of the household (Z_i),

$$U_i=U(H_i, Z_i)$$

Child health is an output of a production function that depends on the *effective units* of mothers input, X_i*, and on other resources available at the household and community level, I. We summarize it as:

$$H_i = h(X_i*, I_i)$$

Reasonably we assume that greater effective units of mother's education as well as greater resources at the household and community level have a positive effect on health i.e. $\partial h/\partial X*>0$ and $\partial h/\partial I>0$.

We assume that the effective units of mothers input depend on several factors. It depends on mother's education (MED), father's education (FED), health facilities infrastructure at the community level (HF), and other inputs that may affect maternal effectiveness through household acquisitions of other goods (W). This functional relation can be represented by:

$$X_i*=k(MED_i, FED_i, HF_i, W_i)$$

Where $k(\cdot)$ represents the functional form by which the effective units of mothers input is formed.

Nonetheless the *variation in effective units* can come from different channels:

i) It seems reasonable to assume that mother's education as knowledge has a direct positive effect $\partial k/\partial MED>0$,

ii) It is also reasonable to assume that an increase in FED can have a direct positive effect on child health $\partial h/\partial FED>0$. However it can also have an indirect (negative or positive) effect on MED by acting as a complement or a substitute for MED which makes the sign of $\partial^2 k/\partial MED \partial FED$ ambiguous.

iii) HF increases the effective units of mother's education as knowledge $\partial k/\partial HF>0$ but it can have an ambiguous effect on overall utility since households may have to pay for using these facilities. Hence even though HF enhances the maternal effect in effective units it can show up having no impact for poor households that would not use these facilities if it decreases their income and overall utility. Therefore, HF can have ambiguous effects on $\partial k/\partial MED$ since it can serve as a complement or a substitute for MED which makes in principle the sign of $\partial^2 k/\partial MED \partial HF$ also ambiguous.

The budget constraint that the household faces is:

$$Y_i= P_W W_i + P_I I_i + P_Z Z_i,$$

where P_j is the price of the goods j=W,Z, I and Y is the income of the household.

The household maximizes utility subject to its budget constraint and the production function of health. The model yields a reduced form demand function for child health given by:

$$H_i = g(MED_i, FED_i, HF_i, Y_i, HC_i) \qquad (1)$$

Where HC is a set of household and village characteristics.

As mentioned above the measure of long-term child health we use is height for age. Since height is a relative measure with respect to age it is better to work with standardized measures like a z-score which subtracts off the mean and divides by its standard deviation. We will use a linear specification for (1). This motivates various types of models captured by the following specification:

$$H_i = \alpha + \beta MED_i + \gamma DW_i + C_i'\delta + error_i \qquad (2)$$

where DW_i is a race dummy variable equal to one if the child is white and zero otherwise. C_i will vary according to the specification but will always include age of the child, it's square, mother's age and proxies for permanent income like per-capita monthly consumption expenditure or land holding. The specification can include community level variables like health facilities and urban-rural dummies or cluster dummies.

Our strategy is to start with a simple regression of child health on mother's education controlling for race. This regression surely has omitted variables and identification problems since it has implicitly the various channels through which mother's education can affect child health which where mentioned above. To minimize the omitted variable bias problem we include other variables that help explain children's health like mother's age, hospital and health facility dummies, urban and cluster dummies.

At the community level we will also control for the interaction terms between mother's education and health facilities/hospitals and for the relative education of the mother with respect to the father which could also proxy wealth status and an assortative mating channel.

$$H_i = \alpha + \beta MED_i + \gamma(MED_i * HF_i) + C_i'\delta + error_i \qquad (3)$$

3. Literature Review

Part of the literature on human capital investment focuses on education and health using reduced form models that integrates the health production process with a model of household choice.[2] The demand studies for health outcomes usually use variables such as household and community level characteristics, like availability of health facilities, to see their effect on the child's health.

[2] Strauss-Thomas [1988].

Three important studies of health demand functions have been made for Nicaragua. Blau (1984) studies the impact of women's education through the first channel above mentioned; that is, he tries to determine how increases in economic resources of the family through an increase in the mothers own earnings might affect the child's health. The author predicts the mother's formal and informal sector wage rates and, after controlling for mother's age, education, urban origin and other income of the household, finds a significant positive effect of the predicted formal sector wage on the child health. In the other studies made for the same country, Behrman and Wolfe (1982, 1987) find that urbanization, parental schooling and family size have a positive association with child's health and nutrition. However, in one of them after including the mother's childhood background as explanatory variables the positive effect of mothers education disappears.

Other studies, like Barrera (1988), try to assess the efficiency and allocative effect. Using data from the Philippines he finds a positive impact of maternal education, which is stronger for younger children.

The literature has also addressed the question of gender bias. Thomas (1994) using data from USA, Brazil and Ghana finds that maternal education and non labor income have a bigger impact on the height of a daughter relative to a son. On the other hand, paternal education has the opposite effect. Namely father's education has a bigger impact on a son relative to a daughter. More recently, Shariff (1996) using Indian data finds that maternal education has a positive and large effect on child's health for both genders. However, he finds that for all the other explanatory variables, there appears to be a discriminatory effect against girls. Duflo (2000) gives evidence that households do not function as a unitary entity. Using data from South Africa she finds that there exists a positive effect on girl's anthropometric measures if a grandmother rather than a grandfather receives cash transfers by a social security program and but no apparent effect on boy's health status.

4. South Africa and Data Description

The most important aspect that characterized the recent history of South Africa is the legacy of Apartheid. As is well known, at the beginning of the 1990s South Africa started dismantling the apartheid system and hence at the time of the 1993 household survey it is reasonable to believe that the black population was still in a disadvantage position with respect to the white population.

Apartheid was practiced until the early 1990s in most hospitals, specifically its policies led to inferior health services to the poor, who were mainly black. While wealthy white areas averaged one doctor per 1200 individuals in the black homelands there was only one per 13000 individuals. Amazingly 40% of all South Africans lived and still live in poverty and 75% of these have stayed in rural areas where health services were least developed. South Africa's population in general had relatively good health compared with other African countries in the 1990s, for example, rural health care compares favorably well with Kenya and Nigeria. Nonetheless, malnutrition has been a problem in South Africa as of 1994, an estimated 2.3 million South Africans (5% of the population) suffer from malnutrition, where 40% of these are between 6 months and 5 years of age. Sadly 28% of African children between 7 months and 5 years old have a height for age z-score less than -2. [3]

Unfortunately, most deaths among children are because of poor nutrition, communicable diseases like measles, tetanus, etc and non-communicable diseases like gastro-enteritis and pneumonia. An indicator of the low health status of the children was that in 1994 Mandela implemented a free health care program for children under 6 years old (Nationwide immunization programs).

On the other hand black women in South Africa have been discriminated by their race, class and gender. In general, all racial and ethnic groups in South Africa have long-standing beliefs concerning gender roles and most are based on the premise that women

[3] See below where we explain a z-score.

are less important, or less deserving of power, than men. Even in the 1990s, in some rural areas of South Africa, for example, wives walk a few paces behind their husbands in keeping with traditional practices. Religious beliefs include a strong emphasis on the theoretically biblical based notion that women's contributions to society should normally be approved by men. Twentieth-century economic and political developments presented South African women with obstacles and opportunities, for example, labor force requirements in cities and mining areas have often drawn men away from their homes for months at a time and as a result women have borne many traditionally male responsibilities in the village and home.

In 1993 it was estimated that 50% of the rural population was illiterate, where illiteracy was based on a definition which included all those who had not reached Standard 8 level in formal schooling (See Table A). Overall there was little difference in the levels of literacy of men and women.

Table A
Illiteracy-urban, rural and metropolitan areas (1993)

Area	African	Colored	Indian	White	Total
Rural	61%	68%	-	8%	50%
Urban	47%	45%	16%	14%	38%
Metropolitan	39%	26%	22%	9%	27%

The data used in this paper is a cross-section type of data that comes from the 1993 South Africa Integrated Household Survey which randomly selected 9000 households from all races and areas throughout the country. It contains anthropometric measures for children aged less than seven years, socioeconomic variables for all members of the household and community level characteristics. With the anthropometric information we constructed the height for age z-scores based on the National Center for Health Statistics (NCHS) from the US. This measure reports the standardized deviation of the height of the child with respect to the median height of the age-gender group in a reference population of well nourished children. Our reference population is the U.S. population. Hence the height for age z-score will be computed by:

$$H_i = \frac{height_i - mean^g}{std.dev^g} \tag{4}$$

where g indicates the age and gender group. Therefore a z-score of zero implies that the child's height is equal to the median height of a well nourished child. Following the recommendation of the World Health Organization we will focus on children between 6 months and 6 years old. Limiting the analysis of height measures in this interval is due to measurement errors for the new born and environmental factors that affect the older ones. We also dropped children in the highest and lowest five percent of the z-scores since they seem very unrealistic for children in this age range. Descriptive statistics of this dataset show that girls seem to be taller than boys. However this difference is not statistically significant, so we did not distinguish by gender in our analysis[4]. Some descriptive statistics are presented in Table B.

We can observe that the South African population is worse-off with respect to the reference population. This difference is substantially smaller for whites, followed by Indian and Coloured. Clearly the Black children population has the lowest z-scores. It is also evident that the rural regions had the lowest z-score. This motivates the introduction of dummies for whites and urban areas[5].

[4] Separating the analysis by gender did not change significantly the parameters of interest.
[5] Urban dummy takes the value of one for urban and metropolitan areas.

Table B

	Number of Children	Mean Child Height z-score
All Children	3991	-1.083
		1.187
Blacks	3327	-1.185
		1.168
Coloured	325	-0.936
		1.131
Indian	94	-0.319
		0.916
Whites	245	-0.193
		1.110
Rural	2382	-1.220
		1.170
Urban	770	-0.974
		1.134
Metro	839	-0.794
		1.220

Standard Deviations in parenthesis
Source: 1993 South Africa Integrated Household Survey

Other important variables that will be used are the health facilities in the villages where two sets of dummies were used. DH indicates if there exist or not a Hospital in the cluster while DHF indicates if there exist any of the following five possible health facilities: Dispensary, Pharmacy, Maternity Home, Clinic or Health Post and Family Planning clinic.

Table C

	Number of households that have:
Own Land	**204**
Access to Hospital	**268**
Access to other Health facilities	**1434**
Live in Urban Area	**1606**

Total sample contains 3979 households
We have1435 missing values for land ownership
Source: 1993 South Africa Integrated Household Survey

From Table C we see that about 40% of the households we have in our sample live in urban areas, only a 5% has private owned land, 7% has access to Hospitals, and a 36% has access to other health facilities.

In Table D we see that the average education level for mothers and fathers is around 7 years. This is consistent with the general data for South Africa presented above. We restricted father age to be at least 18 years and mothers age to be at least 15 years.[6]

A fact to point out is the limited number of households that have access to hospital and own land. This will restrict our ability to use land ownership as a measure of permanent income. Finally it is important to notice that half of the children in our sample do not have information about their fathers.

Table D

Variable	N. of Obs	Mean	Std. Dev.	Min	Max
Mother's Education	3525	7.432	3.945	0	16
Child's Age (months)	3525	37.228	18.285	6	72
Child's Age Squred	3525	1720.181	1416.335	36	5184
Mother's Age	3525	30.151	7.483	15	80
Total pc Consumption	3525	95.386	73.126	0.571	756.216
Land dummy	2267	0.078		0	1
Hospital dummy	3525	0.071		0	1
Health Facilities dummy	3525	0.370		0	1
Urban dummy	3525	0.410		0	1
Father's Education	1998	7.322	4.542	0	16
Father's Age	1972	37.778	9.064	19	82

Source: 1993 South Africa Integrated Household Survey

5. Results for Mother's Education as Knowledge

Table 1 (Appendix) shows the estimates of the coefficient of mother's education (MED) obtained in the different specifications for the sample of South Africa. Model 1 is a naïve regression that assess the benchmark overall effect of the impact of MED on child's health measured by height for age z-score and only has as another explanatory variable a dummy for race (W=1 if white) included due to the strong differences between the races caused by the Apartheid system. As seen from the table, MED has a positive and significant impact of approximately 0.03. Comparing a woman without any education

[6] We lost 2 observations due to the limit in fathers' age, and 39 due to the mothers' age restriction.

with one with 8 years of schooling[7] implies that on average a two-year-old child would be half centimeter higher. As expected due to the strong race discrimination, in this and in all the following specifications, the race dummy has a positive and significant effect in the determination of child's health status.

However, this naïve regression encompasses two problems that do not allow us to identify the knowledge channel we are interested in assessing. The first one is an omitted variable problem that if not taken into account could bias the coefficient estimates. Clearly there exists other type of variables that help determine a child's health status that might be correlated with MED and hence should be included in a more comprehensive model. The second problem is that, as described before, there are other channels through which MED might affect children's health and where a more efficient allocation of resources due to better knowledge is just one of them. To deal with this issue, we included variables that might control for permanent income, productivity of health inputs and wealth that otherwise the MED coefficient might have picked up.

To deal with the omitted variable problem the first type of controls we included were the child's characteristics. Specifically we included the children's age and age square to allow differences depending on how young the child is. This variable was also included because as mentioned before the effect of MED might vary according to the child's age. The coefficients and the standard deviation of MED did not change much once the child characteristics were included. We find that the child age coefficients are negative and significant. This result by itself implies that as children get older, differences in the height for age measures for American and South African children increase with age.

We included controls for other household characteristics like mother's age. Not only it's not the same to be a mother at age 16 than at age 30, where the women are more mature and physically better prepared, but more importantly there can also be a difference in the way people assimilate and use new information depending on their age and the stage of

[7] We computed eight years of education because it corresponds to two standard deviations above the sample mean.

life they are in. We expect that eight years of education might affect in a very different way a teenager than an older woman. Specifically the older the woman, the bigger the education effect will be. This implies a positive correlation between age and education. On the other hand, there might be a negative correlation between the two variables if for example education has been rising due to government programs. Therefore we cannot assess the direction of the bias that can appear if mother's age is not controlled for. After including this variable we found that the MED coefficient increases in magnitude and significance. This suggests that controlling for mother's age does increase the impact of our variable of interest.

Another important household characteristic that could be picked up by the mother's education coefficient is the family's permanent income which is consistent with our theoretical model. It could be the case that more educated women come from a wealthier household and hence their children will not only be better fed but will also be in a healthier environment. This could create an upwards bias in the MED coefficient. To deal with this potential bias we included per capita total monthly consumption. Table 1 shows that the coefficient of interest decreases sharply suggesting that MED was positively correlated with permanent income. Since income is one of the channels that can affect mother's knowledge as we describe in the conceptual framework it is important to control for this effect.

An alternative control for permanent income is the private land ownership. The problem with this variable is that only less than half of the households where the children lived answered the land ownership question. Among them the great majorities were rural households and those that were urban or metropolitan were households that answered affirmatively to the question: "Does any person in the household have the right to use any land for arable farming?" And "Is this land private (Own Farm)?" Hence, to deal with this selection problem we imposed a value of zero to the land dummy (DL) for the urban and metropolitan households that did not respond. To asses the bias that the non inclusion of land ownership might bring to the MED coefficient we constructed Model 5 which has the same specification as in Model 4 but uses only the non-missing land respondents' information. As seen in the table, even though we lost 1258 observations the MED coefficient does not vary that much compared to Model 4. Model 6 includes the land dummy (DL) for the same sample as in Model 5 and hence allows us to compare the MED coefficient in both of them. We found that our coefficient of interest increased both in magnitude and significance. When we include both proxies of permanent income in the next specification (Model 7) MED coefficient returns to the benchmark value 0.03. Due to the loss of observations and the low percentage of own land reported we think it is not a good proxy for permanent income. Therefore we decided to keep only the first proxy as a control variable and return to our original sample.

It could also be the case that mother's education coefficient is picking up a community level effect. We expect that better educated women come from wealthier communities, where the children might be better off compared to those from less richer ones due to differences such as infrastructure and availability of health care. This again might cause an upwards bias in the MED coefficient that we should try to correct for. To do this, we considered two different approaches. The first one tries to model explicitly the factors that can vary across communities like the availability of hospitals and other type of health facilities and an urban dummy. The second one includes cluster level dummies that can capture all differences among them. For policy recommendation the first approach would be preferable because it can shed light on which are the most important variables that can influence directly children's health. However the second approach can soak up all differences among clusters reducing the bias in the mother's education coefficient.

Model 9 follows the first approach where the health dummies try to capture the differences in infrastructure, while the dummy variable for urban areas is a naïve way of controlling for prices of health services, medicine, food and other factors that as the conceptual framework suggests are also important in the determination of the child's health demand. It is difficult to assess what impact this last variable will have on child's health. One might think that the fact that children are in an urban area can increase the probability to have access to better infrastructure and health facilities, therefore having a positive effect. On the other hand, it might also be the case that children in rural areas are better nourished than poor children in the cities since their parents are able through farming to supply more and better quality food, therefore having a perverse effect. After controlling for the infrastructure effect with the Hospital and Health facility dummies we found that the coefficient of mother's education reduces slightly with respect to Model 4 suggesting that this estimated effect is robust. Model 10 follows the second approach including "capture all" cluster dummies. Under this specification the MED coefficient is reduced by approximately 27%, indicating that there was a big upward bias due to the omitted community characteristics.

The previous regressions have dealt with the omitted variable bias problem. In the next two regressions we would like to disentangle the different channels through which MED might affect children's health. We focus on mother's education relative to father's education and the efficiency channel in the usage of health inputs.

Consistent with the theoretical framework father's education can play an important role. The effect of father's education is ambiguous theoretically and could affect positively or negatively if it acts as a complement or a substitute of mother's education. We included a relative measure of mother's education defined by the ratio of mother's to father's education. A negative coefficient on this relative measure suggests that more educated father's enhances mother's efficiency in the production of child's health. This effect is what we call complementarity between mother's and father's education. It would have been ideal to have father's age and education for the whole sample. However there is a big tendency in the data for the children not to live with their fathers, specifically 1458 out of 3565[8] of the households have an absentee father. This causes a problem in interpreting the results of the regression that includes father's characteristics since it could be that absent fathers selected themselves to leave and work away from their home. There might be an endogeneity problem but we are unable to assess the direction of the simultaneity bias. As noted above, the Apartheid system generated that fathers in the black homelands were usually absent due to work restrictions making women head of households in precisely the poorest regions of the country. Additionally, we observe a

[8] In addition 42 of the fathers don't report age.

higher percentage of fathers reporting zero years of schoolings than mothers do[9] which suggests that interviewers may have assigned a zero to some absent fathers. We decided to do the regressions both using the information as given and a second one treating zero fathers' education as missing values. Even though we would have liked to control for these two problems, we were unable to do it and just report the results in Model 11 ignoring those observations where the father reported zero education. We see that there is a positive significant effect of mother's education and a negative coefficient on mother's relative education meaning that, as explained above, father's education enhances mother's efficiency in child health production[10, 11].

Model 12 includes interaction terms between MED and health facilities to assess the impact of the efficiency channel in the usage of health inputs. We did not include mother's relative education because we do not know the interpretations of the results in the selected sample. As Table 1 shows there is not a significant change on the MED coefficient with respect to Model 9. The coefficients of the interaction terms are positive but not significant suggesting complementarity between MED and health facilities[12]. The lack of significance could be due to the cost of using these health inputs. Even if health facilities are available mothers may choose not to use them for various reasons such as transportation costs, monetary costs of using the health facilities and the opportunity cost of time.

Finally, we explored with the main empirical specifications the differential impact of the mother's education on children's health depending on their age. The sample was divided in two age groups: those between ages six months and 3 years old and those between 3 and 6 years old. We expect that younger children are more dependent of their mothers (but not on her education) than older ones, and hence their coefficient on MED should be smaller than those obtained using the full sample of children. Furthermore, the medical

[9] In the data 12.5% of mothers' report zero years of schooling compared to 15.1% of the fathers'.
[10] The expected marginal effect of MED taking into account the direct effect and the indirect effect through mother's relative education is $\partial E(hz)/\partial MED=\beta+(\gamma/FED)$, where FED is evaluated at the mean of sample.
[11] When we took into account the fathers who reported zero education we obtained the same results but with attenuated significance.

literature reports a U pattern in children's health which shows age specific differences in the children's health production. The results found are summarized in Table 2 (Appendix). In the first specification we included all the control variables to deal with the omitted variable bias problem. We found that MED is more important for older than younger children which is in line with the literature. When we include mother's relative education and father's age, we see that even though mother's and their relative education have a significant effect, the direct impact of MED on older children is lower than on the younger ones. The total marginal effect of an increase of one year in MED on child health production is also greater for younger children. We do not have a good intuition for this result which goes against what the medical literature has found. Finally, when we include the efficiency channel of the interaction between MED and health facilities, we see that the impact of MED goes back to being higher for older children.

6. Conclusions

Several studies in different countries have found that mothers education affect positively and significantly child's health outcomes. In this paper we show that South Africa is no exception to that rule. Children with more educated mothers have a better long term relative health status. Eight more years of education of the mother increases a 2 year child's height by approximately 0.5 centimeters on average. This finding is important since as previous studies have found healthier adult individuals are related with better labor market outcomes[13].

Across the different specifications considered we gradually controlled for several channels through which mother's education can affect child's health. The objective was to isolate the knowledge channel in order to assess the reallocation of resources due to better knowledge and information. Two interesting results emerge from here. The first one is that father's education enhances that of the mother's suggesting complementarity between the two. Secondly, neither health facilities nor their interaction with mother's

[12] The expected marginal effect of MED taking into account the direct effect and the indirect effect through the usage of health facilities is $\partial E(hz)/\partial MED=\beta+\delta_1+\delta_2$.

education appear to have a positive significant effect on the height for age of the children between six months and six years of age. The intuition is that even if health facilities are available to the households these may choose not to use them if the cost of doing so is too high. The two results have important policy implications since they suggest that governments should invest the scare resources primarily in parent's education and perhaps subsidize the use of local health facilities for the poorer households.

[13] For literature review on health and market outcomes see Strauss-Thomas (1995).

References

Barrera, A., "The role of maternal schooling and its interaction with public health programs in child health production", Journal of Development Economics, 32, 1990.

Behrman, J. and A. Deolalikar, "Health and Nutrition". Handbook of Development Economics, V1, 1988.

Behrman, J. and B. Wolfe, "How does mother schooling affect family health, nutrition, medical care usage, and household sanitation?", Journal of Econometrics 36, 1987.

Behrman, J. and B. Wolfe, "Determinants of child mortality, health, and nutrition in a developing country". Journal of Development economics 11, 1982.

Blau, D. M. "A model of child nutrition, fertility, and women's time allocation: the case of Nicaragua". In: T.P. Schultz and K. I Wolpin, eds., Research in Population Economics, 5. JAI Press.

Shariff, Abusaleh, "Gender, Population and Development", Maithreyi Krishnaraj, Ratna M Sudarshan Editors. Oxford India Paperbacks, New Delhi, 1999.

Strauss, J. and D. Thomas, "Human Resources: Empirical Modeling of Household and Family Decisions". Handbook of Development Economics, V3 1995.

Thomas, D. "Like Father like Son or like Mother like Daughter: parental education and child health". Journal of Human Resources, 29, 1994.

Table 1
Dependent Variable: Height for Age (z-score)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
					only land	
Mother's Education	0.034	0.034	0.038	0.029	0.031	0.039
	(0.005)	(0.005)	(0.005)	(0.006)	(0.007)	(0.007)
White's dummy	0.797	0.803	0.784	0.481	0.520	0.779
	(0.08)	(0.08)	(0.081)	(0.09)	(0.096)	(0.086)
Child's Age (months)		-0.023	-0.023	-0.024	-0.020	-0.020
		(0.005)	(0.005)	(0.005)	(0.006)	(0.006)
Child's Age Square		0.000	0.000	0.000	0.000	0.000
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Mother's Age			0.009	0.008	0.007	0.008
			(0.003)	(0.003)	(0.004)	(0.004)
Total pc Consumption				0.002	0.002	
				(0.000)	(0.000)	
Private Ownership land dummy						-0.236
						0.089
Hospital dummy						
Health Facilities dummy						
Rural dummy						
Cluster dummies						
Mother's relative Education						
Father's Age						
MED*DH						
MED*DHF						
Constant	-1.372	-1.003	-1.290	-1.383	-1.421	-1.275
	(0.044)	(0.095)	(0.129)	(0.129)	(0.164)	(0.165)
R^2	0.059	0.065	0.068	0.084	0.097	0.083
Number of Observations	3525	3525	3525	3525	2267	2267

Reference Population is non-white, urban and metropolitan, non-health facilities
* OLS regressions with robust standard error in parenthesis. All regressions account for the sampling weights of the survey.
**Cluster dummies coefficients are not reported

Table 1 (cont)
Dependent Variable: Height for Age (z-score)

	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Mother's Education	0.031	0.028	0.026	0.022	0.034	0.024
	(0.007)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)
White's dummy	0.519	0.463	0.452	0.579	0.393	0.446
	(0.096)	(0.091)	(0.091)	(0.236)	(0.1)	(0.091)
Child's Age (months)	-0.020	-0.024	-0.024	-0.024	-0.011	-0.023
	(0.006)	(0.005)	(0.005)	(0.005)	(0.007)	(0.005)
Child's Age Square	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.)	(0.000)
Mother's Age	0.007	0.008	0.007	0.004	0.021	0.007
	(0.004)	(0.003)	(0.003)	(0.003)	(0.006)	(0.003)
Total pc Consumption	0.002	0.002	0.002	0.001	0.002	0.002
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Private Ownership land dummy	-0.213					
	(0.088)					
Hospital dummy		0.029	0.017		0.014	-0.074
		(0.086)	(0.086)		(0.104)	(0.214)
Health Facilities dummy		0.071	0.067		0.126	0.036
		(0.044)	(0.044)		(0.059)	(0.096)
Rural dummy			0.076		0.131	0.078
			(0.044)		(0.059)	(0.044)
Cluster dummies				Yes**		
Mother's relative Education					-0.001	
					(0.002)	
Father's Age					-0.009	
					(0.005)	
MED*DH						0.010
						0.023
MED*DHF						0.004
						0.011
Constant	-1.391	-1.411	-1.405	-0.667	-1.692	-1.389
	(0.165)	(0.129)	(0.130)	(0.382)	(0.195)	(0.133)
R^2	0.099	0.085	0.086	0.218	0.118	0.086
Number of Observations	2267	3525	3525	3525	1960	3525

Reference Population is non-white, urban and metropolitan, non-health facilities

* OLS regressions with robust standard error in parenthesis. All regressions account for the sampling weights of the survey.

**Cluster dummies coefficients are not reported

Table 2
Dependent variable: Height for Age (z-scores)

	0.5 -3 years	3 - 6 years	0.5 -3 years	3 - 6 years	0.5 - 3 years	3 - 6 years
Mother's Education	0.025	0.027	0.041	0.028	0.020	0.028
	(0.009)	(0.007)	(0.012)	(0.009)	(0.011)	(0.009)
White's dummy	0.450	0.460	0.324	0.455	0.448	0.465
	(0.15)	(0.111)	(0.165)	(0.122)	(0.15)	(0.112)
Child's Age (months)	-0.071	0.111	-0.042	0.137	-0.071	0.111
	(0.018)	(0.032)	(0.026)	(0.04)	(0.018)	(0.032)
Child's Age Squred	0.001	-0.001	0.000	-0.001	0.001	-0.001
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Mother's Age	0.005	0.010	0.012	0.028	0.005	0.010
	(0.004)	(0.004)	(0.009)	(0.008)	(0.004)	(0.004)
Total pc Consumption	0.002	0.003	0.002	0.002	0.002	0.003
	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)
Hospital dummy	0.234	-0.177	0.214	-0.125	0.260	-0.323
	(0.117)	(0.122)	(0.15)	(0.144)	(0.281)	(0.319)
Health Facilities dummy	0.040	0.075	0.082	0.152	-0.069	0.133
	(0.065)	(0.058)	(0.092)	(0.073)	(0.15)	(0.123)
Rural dummy	0.112	0.071	0.188	0.093	0.114	0.072
	(0.064)	(0.058)	(0.092)	(0.075)	(0.064)	(0.058)
Mother's relative Education			-0.001	0.001		
			0.003	0.002		
Father's Age			-0.003	-0.015		
			0.007	0.006		
MED*DH					-0.004	0.017
					(0.031)	(0.033)
MED*DHF					0.014	-0.008
					(0.017)	(0.014)
Constant	-0.792	-4.697	-1.317	-5.198	-0.758	-4.704
	(0.221)	(0.832)	(0.341)	(1.064)	(0.227)	(0.831)
R^2	0.101	0.107	0.135	0.149	0.101	0.108
Number of Observations	1735	1790	909	1051	1735	1790

Reference Population is non-white, urban and metropolitan, non-health facilities

* OLS regressions with robust standard error in parenthesis. All regressions account for the sampling weights of the survey.