Maternal Education, Linkages and Child Nutrition in the Long and Short-run: Evidence from the Ethiopia Demographic and Health Surveys

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Abstract: We used the 2000 and 2005 Ethiopian Demographic and Health Surveys to analyze the effect of maternal education and its pathways on chronic (long-run) and acute (short-run) malnutrition in Ethiopia. The pathways examined in this study are socioeconomic status, maternal health-seeking behavior, maternal knowledge of health and family planning and reproductive behavior. We find that maternal education works through all except health-seeking behavior. We also find that maternal education and its pathways are more relevant and robust in explaining chronic than acute malnutrition. Socioeconomic status is the most important factor linking maternal education and child nutritional status. Although girls' education is a high policy priority, it may take time before its direct and indirect impacts materialize and substantially improve child health outcomes. Faster results would require direct interventions on key elements of socio-economic status.

1. Introduction

The strong relationship between maternal education and child health outcomes is widely documented and largely undisputed (Frongillo & Hanson, 1997; Variyam et al., 1999; Alderman et al., 2000; Smith and Haddad, 2000). A large body of literature documents that maternal education works through a number of pathway variables that directly affect child health outcomes. The list includes a number of maternal, household, and community characteristics such as socioeconomic status, geographic residence, nutritional and health knowledge, autonomy, and health-seeking and reproductive behavior (Desai & Alva, 1998; Glewwe, 1999; Webb & Block, 2004; Frost, Forste, & Haas, 2005).

Therefore, the pure impact of education on child health is greatly attenuated when selected mediating factors are included in the model. However, there is a broad disagreement on the role of the various linkages through which the impacts of maternal education on child health outcomes are transmitted. Moreover, it is noted that the impact of maternal education could be different to different measures of child nutritional status (Webb & Block, 2004).

This study models selected pathways linking maternal education and child nutritional status in Ethiopia using the 2000 and 2005 Ethiopia Demographic and Health Surveys (EDHS). The study investigates how maternal education and its various pathways affect chronic (height for age) and acute (weight for height) malnutrition in children younger than five years. The study addresses the following three questions: (1) Does maternal education work through selected pathways such as socioeconomic status, maternal health-seeking behavior, and maternal knowledge of family planning and health? (2) How do maternal education and its pathways perform in models of different types of child malnutrition? (3) What are the policy and program implications?

The study is motivated by some recent developments on child nutritional status in Ethiopia. First, the 2005 EDHS shows significant improvement in child nutritional status when compared to the results of the preceding survey conducted in 2000. Second, the changes have been different for different types of child malnutrition. Chronic malnutrition declined while acute malnutrition remained the same on average (Central Statistical Authority, 2001; ORC Macro, 2006). Third, the availability of comparable data would provide an opportunity to investigate the performance of the determinants of child nutritional status over time. Fourth, malnutrition is a leading cause of child death in developing countries (Black, Morris & Bryce, 2003), and reducing child mortality is among the top priorities included in the Millennium Development Goals (MDGs). Because prevalence of child malnutrition and infant mortality in Ethiopia is among the highest in developing regions, the issue is of national and international concern.

Previous studies on child nutritional status in Ethiopia focused on identifying the determinants of chronic malnutrition from a one-time survey (Girma & Genebo, 2002) or without sufficient consideration of the impact of education in various contexts (Christiaensen & Alderman, 2004). Our study expands the discussion in two ways. First, the study analyzes the effect of maternal education on child nutritional status considering a more comprehensive array of linkages. Second, the study considers both chronic and acute malnutrition.

The rest of the paper proceeds as follows: Section 2 presents a brief summary of previous studies. Section 3 provides a background on the prevalence and recent changes in child nutritional status in Ethiopia. Section 4 describes the multivariate analysis including the empirical framework and the data. Section 5 discusses the results, followed by concluding remarks in Section 6.

2. Previous Studies

Education determines health knowledge and other socioeconomic outcomes that are essential to child health. Therefore, the quest for the links through which maternal education influences child health has been an important area of research and policy dialogue (Desai & Alva, 1998; Frost, Forste & Haas, 2005). The pathways considered usually include nutritional knowledge, health knowledge, socioeconomic status, attitude toward modern health care services, autonomy, and reproductive behavior, and even place of residence (Desai & Alva, 1998; Glewwe, 1999; Frost Forste, & Haas, 2005).

The inquiry to the relationship between maternal education and its pathways has touched on several aspects of the issue. One of these concerns is the relationships between formal schooling and nutritional and health knowledge (Glewwe, 1999; Webb & Block, 2004). Glewwe (1999) argues that there exist three possible mechanisms through which formal schooling influences maternal health knowledge. First, future mothers directly acquire health knowledge from formal schooling. Second, the literacy and numeracy skills acquired in school assist future mothers in diagnosing and treating child health problems. Third, exposure to modern society through formal schooling makes women more receptive to modern medical treatments. Based on data from Morocco, Glewwe finds that "mother's health knowledge alone appears to be the crucial skill for raising child health." He then suggests that health education should be directly taught in schools at a young age so that girls will have some knowledge even if they drop out of school early.

The multidimensional impacts that education and its pathways have on child health outcome are far from trivial. Important connections exist not only between maternal education and its linkages but also between the linkages themselves. Socioeconomic status affects health-seeking behavior by facilitating access to modern health care utilization. Socioeconomic status also enhances maternal nutritional and health knowledge. Nutritional knowledge may also augment the impact of income or socioeconomic status on child health.

Christiaensen and Alderman (2004) explore the role of maternal nutritional knowledge in augmenting the impact of income on child stunting in Ethiopia. In their study, maternal nutritional knowledge is measured by the "community's diagnostic capability of growth faltering." Using data from three consecutive welfare-monitoring surveys over the period 1996–1998, they find that that household resources, food prices, and parental education are key determinants of child malnutrition. Most importantly, Christiansen and Alderman show that maternal nutritional knowledge plays an important role in the determination of child malnutrition.

The available findings on the relationships between maternal education and child health are also challenged by the choice of a proxy for child health. Unlike most of the literature that does not discriminate between types of malnutrition, Webb and Block (2004) investigate the effect of formal schooling and mother's nutritional knowledge on chronic and acute malnutrition. Using data from rural Central Java, Indonesia, Webb and Block argue that it is critical to distinguish the effects of formal schooling from the effects of specific nutrition knowledge. Their findings show that formal schooling is more responsive to long-term malnutrition than short-term. They also note that formal schooling is among the important sources of nutrition knowledge.

Another aspect of the debate on maternal education and child nutritional status deals with the effectiveness of the links. Some studies argue that the effect of maternal education on child health is fully mediated by selected pathways. For instance, Desai and Alva (1998) analyze the effect of maternal education on three measures of child health: infant mortality, height for age, and immunization status. Based on the first round of DHS data from 22 developing countries, they argue that education is a proxy for socioeconomic status and geographic residence. Therefore, they argue that, when these variables are incorporated in the model, the effect of maternal education largely disappears and only retains its significance in "a handful of countries."

However, recent evidence shows that the direct effect of education remains significant in fully specified models. In this regard, Frost, Forste, and Haas (2005) consider a more comprehensive list of pathway variables. Using data from the 1998 Bolivian DHS, they examine selected pathways, including "socioeconomic status, health knowledge, modern attitudes toward health care, female autonomy, and reproductive behavior" (p. 400).[1] They find that socioeconomic factors are the most important pathways linking education and child nutritional status. They also find that the effect of maternal education remains significant after controlling for all pathway variables as well as geographic regions and place of residence.

The review presented here is brief, focusing only on major debates regarding maternal education and child health outcomes. However, at least two observations can be noted from the on-going debate. First, although the role of maternal education on child health outcome is obvious, there is a broad disagreement on the channels through which maternal education influences child health in the long term (chronic case) and the short term (acute case). Second, most of the empirical evidence is on chronic than acute malnutrition. This study aims to add to the existing literature by considering the effect of maternal education and selected pathway variables on chronic and acute child malnutrition in Ethiopia.

3. Background: Child Nutritional Status in Ethiopia

The conventional measures of child anthropometrics show that the prevalence of child malnutrition in Ethiopia is among the highest in sub-Saharan Africa. In 2003, 52% of children were suffering from chronic malnutrition (stunting), 11% from acute malnutrition (wasting), and 47% from underweight. During the same period, the average prevalence of stunting, wasting, and underweight for African countries were 39%, 9%, and 29%, respectively. A recently completed survey in Ethiopia, the 2005 EDHS, shows a similar profile of under-five malnutrition (Table 1).

Another important feature of child nutritional status in Ethiopia is that the prevalence can be distinguished by selected background characteristics. Table 1 presents the prevalence of child nutritional status by maternal education and place of residence in 2000 and 2005. It shows that the incidednce of malnutrition among children whose mothers have some education is lower than those whose mothers with no education. The percent of children malnourished consistently declines as the highest level of education attained by the mother increases from no education to primary education, and then to secondary and higher education. The trend is consistent across different indicators of child malnutrition and survey years.

[1] All except reproductive behavior are constructed by principal component analysis from a number of related variables included in the Bolivian DHS. Each pathway incorporates several interrelated indicators. For instance, socioeconomic status is measured by household wealth (owning a television, radio, refrigerator, or phone) and household environment (electricity, piped water, flush toilet, and non-dirt floor) (see Frost, Forste, and Haas, 2005, p. 400)

Table 1. Child Malnutrition by Maternal Education and Place of Residence

	% of children suffering from								
	Stunting			Wasting			Underweight		
Background	2000	2005	% Change	2000	2005	% Change	2000	2005	% Change
Maternal education									
No education	52.9	49.1	-7.2	11.4	11.2	-1.8	49.6	41.4	-16.5
Primary	49.1	39.8	-18.9	8.8	10.1	14.8	40.4	32.0	-20.8
Secondary & higher	32.9	24.0	-27.1	6.7	1.3	-80.6	27.7	13.6	-50.9
Place of residence									
Urban	42.3	29.8	-29.6	5.5	6.3	14.6	33.7	22.9	-32.1
Rural	52.6	47.9	-8.9	11.1	10.9	-1.8	48.7	39.7	-18.5
Total	51.5	46.5	-9.7	10.5	10.5	0.0	47.2	38.4	-18.6

Source: 2000 and 2005 EDHS (Central Statistical Authority, 2001; ORC Macro, 2006)
Note: Stunted = height for age z-scores below –2; wasted = weight for height z scores below –2; and underweight = weight for age z scores below –2 (World Health Organization, 1986).

Table 1 also shows that the prevalence of malnutrition in general is lower in 2005 than in 2000. The percentage declines over the period 2000–2005 show that the reductions in child malnutrition (for stunting and underweight) is the highest for the highest level of maternal education (which is "secondary and higher education") and the lowest for the lowest level of education (which is "no education"). However, there is no consistent decline for wasting. This could be due to the fact that stock variables such as education and place of residence better explain chronic outcomes such as stunting than acute fluctuations in nutritional status.

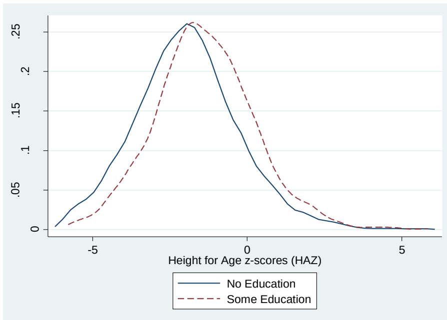
As expected, the urban advantage presented in Table 1 is unambiguous when the performance of child nutritional status is disaggregated by place of residence without controlling for other factors. In addition, the comparison between the 2000 and 2005 survey results shows that the reductions in child stunting and underweight are larger in urban than in rural areas. However, a number of studies find that any conclusion based on a simple bivariate relationship would be misleading because the "advantage" often disappears when other important variables are included (Fotso, 2006).

The kernel density plots in Figures 1 and 2 corroborate the results in Table 1. Figure 1 shows that the distributions can be differentiated by maternal education in national, rural, and urban samples. In each panel, the dashed lines are to the right of the solid lines showing the expected differences in height for weight z-scores (HAZ) and weight for height z-scores (WHZ) of children by maternal education. The impact of maternal education is larger in HAZ and than in WHZ (compare columns: Panels A1, B1, and C1 vs. Panels A2, B2, and C2). It is also larger in rural than in urban areas (compare rows Panel B1 and B2 vs. Panels C1 and C2).

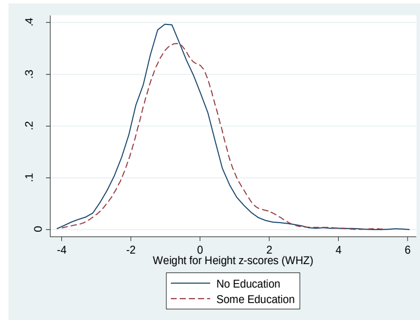
Similarly, Figure 2 shows kernel density plots of HAZ and WHZ for national (all), rural, and urban children by survey year. Each panel comprises two plots for each survey year. The objective of the plots in each panel is to show if there were changes in the distribution between the two surveys. Panels D1 and D2 are for the national sample, Panels E1 and E2 are for the rural sample, and Panels F1 and F2 are for the urban sample. In all the three cases, the densities in 2005 are to the right of that of the 2000, implying improvements in child nutrition in 2005.

The statistical significance of the differences in child nutritional status by background characteristics and time presented above (Figures 1 and 2 and Table 1) is checked by executing a Kolmogorov-Smirnov (KS) test of equality between the two empirical distributions. In this test, the three null hypotheses are (1) H_0: $F_{\text{some education}}(z) = F_{\text{no education,}}(z)\ \forall z$, (2) H_0: $F_{\text{urban}}(z) = F_{\text{rural}}(z)\ \forall z$, and (3) H_0: $F_{2005}(z) = F_{2000}(z)\ \forall z$. The KS test is based on the largest absolute gap between the cumulative distributions of F_1 and F_0 where there are *m* observations for distribution *1* and *n* observations for distribution 0, i.e., $F_0(z) = \frac{1}{n}\sum_{1}^{n}\begin{cases}1 & y_i \le z\\ 0 & otherwise\end{cases}$ and $F_1(z) = \frac{1}{m}\sum_{1}^{m}\begin{cases}1 & y_i \le z\\ 0 & otherwise\end{cases}$, where z is an indicator of child nutritional status, including HAZ, WHZ, and WAZ. Then, the test statistic is obtained from the supermom of the absolute values of the differences in the two empirical cumulative distribution functions, i.e., $D = \max_z \left|F_0(z) - F_1(z)\right|$.

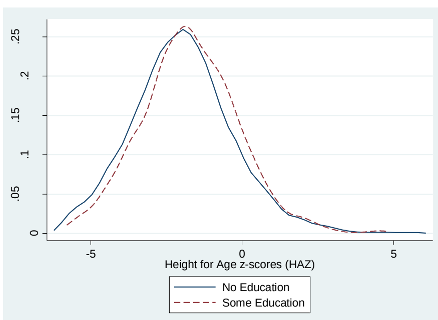
Figure 1. Density Estimates of HAZ and WHZ by Maternal Education



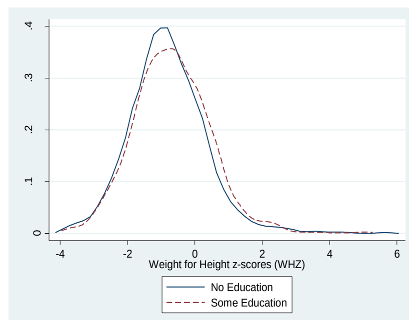
(A1) HAZ by Maternal Education: National Sample



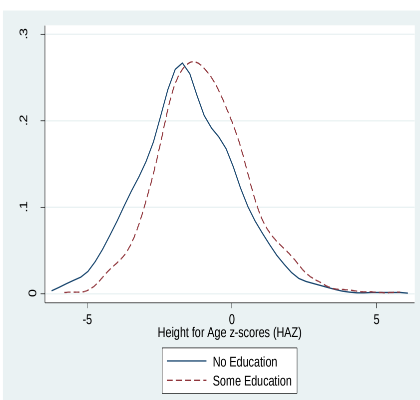
(A2) WHZ by Maternal Education: National Sample



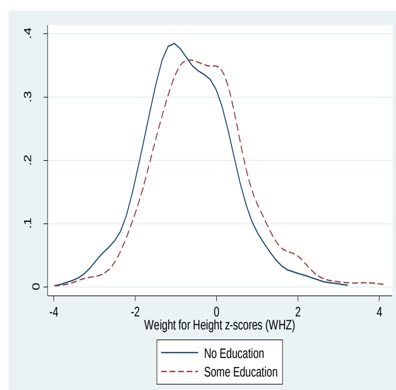
(B1) HAZ by Maternal Education: Rural Sample



(B2) WHZ by Maternal Education: Rural Sample

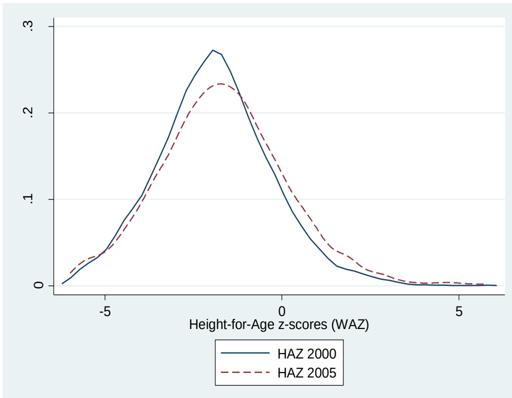


(C1) HAZ by Maternal Education: Urban Sample

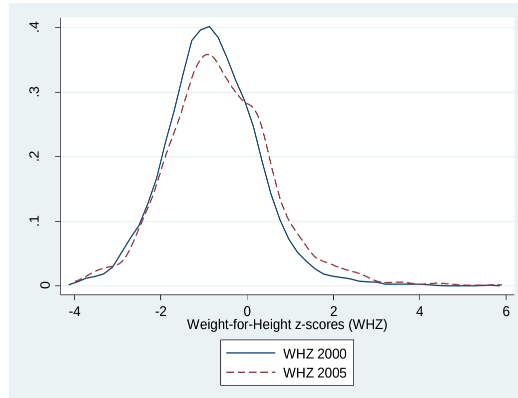


(C2) WHZ by Maternal Education: Urban Sample

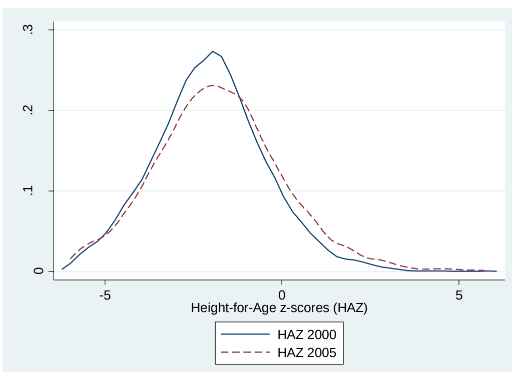
Figure 2 Density Estimates of Stunting and Wasting by Survey Year in 2000 and 2005



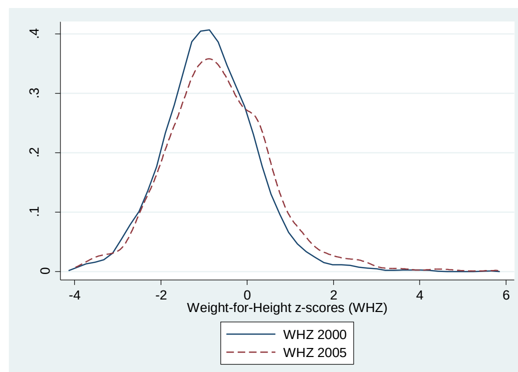
(D1) HAZ by Survey Year: National Sample



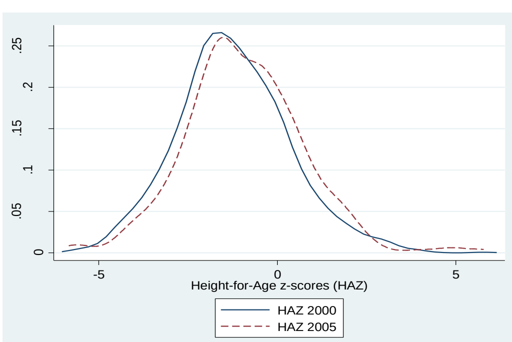
(D2) WHZ by Survey Year: National Sample



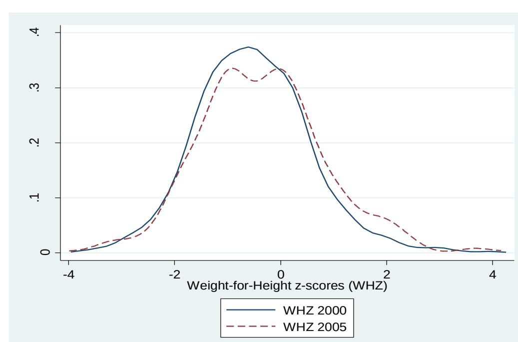
(E1) HAZ by Survey Year: Rural Sample



(E2) WHZ by Survey Year: Rural Sample



(F1) HAZ by Survey Year: Urban Sample



(F2) WHZ by Survey Year: Urban Sample

Table 2 presents results of the KS test of equality of distributions for wasting[2], stunting, and underweight for national, rural, and urban samples. The p-values show that, in all three cases, the null hypothesis that the two distributions are the same is rejected at less than 1% level of significance. Therefore, consistent with the density plots in Figure 2, the test result indicates significant improvement in child nutritional status.

Table 2. Kolmogorov-Smirnov Test of Equality of Distributions of HAZ, WHZ, and WAZ

Test category	Nutrition Indicator	Sample		
		National	Rural	Urban
Maternal education: Some education vs. No education	HAZ	0.150**	0.077**	0.154**
	WHZ	0.115**	0.067**	0.132**
	WAZ	0.182**	0.093**	0.182**
Place of residence: Urban vs. rural	HAZ	0.207**	-	-
	WHZ	0.125**	-	-
	WAZ	0.246**	-	-
Survey year: 2005 vs. 2000	HAZ	0.074**	0.079**	0.090**
	WHZ	0.080**	0.084**	0.090**
	WAZ	0.080**	0.089**	0.123**

Note: The test compares cumulative distributions of each malnutrition indicator in 2000 and 2005; ** = p-value < 0.01.

It is important to note that the reductions in stunting and underweight during the period 2000–2005 are not only statistically significant but also numerically substantial, carrying important economic implications. In 2005 about 13 million (17%) of the total Ethiopian population of 77.4 million were between ages 0 and 4. Therefore, the decline in stunting by 5 percentage points, i.e., from 51.5% in 2000 to 46.5% in 2005, implies that there were 653,000 fewer stunted children in 2005 than there would have been if the percent of stunting remained the same as in 2000. Similarly, the decline in underweight by 8.8 percentage points (from 47.2% in 2000 to 38.4% in 2005) would mean that there were 1.15 million fewer underweight children than there would have been if the percent of underweight remained the same as in 2000. Therefore, these developments again motivate the questions: what are the relevant factors, and to what extent do maternal education and its pathways explain child malnutrition in Ethiopia?

[2] Although the test of equality of distribution shows that wasting has significantly declined in 2005, the improvement in z-scores is to the right of the cutoff point, -2SD (Figure 2, Panel D2). Therefore, the proportion of wasted children remains the same. However, the results in Table 2 imply that those children who were not wasted in the 2005 sample had a better nutritional status than those in the 2000 sample

4. Multivariate Analysis

The Empirical Framework

The standard procedure of identifying the determinants of child health outcomes involves maximizing the household's utility function subject to the biological or anthropometric production function and other constraints (Pitt & Rosenzweig 1985; Thomas, Lavy, & Strauss, 1996; Webb & Block, 2004). Equation (1) presents the household's utility maximization problem, which is a function of H_i (health status), F_i (food intake), L_i (leisure), and G_i (consumption of other goods). Health of household members and food intake enter directly and separately into the utility function because health is good in itself and food is taken for reasons other than nutritional value. The utility function may also be conditioned by observable individual characteristics (X_i), household characteristics (X_h), community characteristics (X_c), and unobserved heterogeneity of preferences (ψ_i).

$$\max_{H,F,L,G} U = U(H_i, F_i, L_i, G_i; X_i, X_h, X_c, \psi_i) \qquad U'(\cdot) > 0, U''(\cdot) < 0 \qquad (1)$$

The household maximizes the utility function subject to a budget constraint and a biological health production function given by

$$H_i = H(F_i, M_i, X_i, X_h, X_c, \eta_i), \qquad (2)$$

where Hi is nutritional status as measured in anthropometrics outcomes (e.g., height or weight), Mi are non-food health inputs, ηi is unobserved individual health endowments, and all other variables are as defined earlier. Then, the maximization problem leads to a reduced form demand function for nutritional status:

$$H_i = h(X_i, X_h, X_c, \nu_i), \qquad (3)$$

where ν_i is unobserved nutritional outcome. Equation (3) provides a benchmark specification for empirical analysis.[3] Equation (3) basically specifies nutritional status as a function of individual, household, and community characteristics. An important limitation of this approach is that it does not allow inferring structural coefficients. However, the reduced form equation is still informative about the effects on nutrition of changes in the explanatory variables thereof.

There are a wide range of variations in the specification of the empirical model of child nutritional status in the literature. Variants of the empirical models derived from Equation (3) often emanate from the choice of the dependent variable as well as the definition and measurement of individual, household, and community characteristics. The availability of data also dictates the

[3] Estimating structural equation involves endogenous factors such as child health inputs. However, due to difficulties in finding instruments, most studies estimate a conditional demand function given by Equation (3) (e.g., Glewwe, 1999; Christiaensen and Alderman, 2004; Webb and Block, 2004; Frost, Forste, and Haas, 2005).

empirical specification. Equation (3) can be rearranged to specify an empirical model that distinguishes maternal education, pathway variables, and other control variables.

Incorporating Pathway Variables

Four key pathways are considered: (1) socioeconomic status, (2) health-seeking behavior, (3) knowledge of health and family planning, and (4) reproductive behavior.

Socioeconomic status. Maternal education has a clear connection with the various key elements of socioeconomic status, including high-income job, possession of assets, better health, and sanitary conditions, to mention but a few. The empirical evidence demonstrates the existence of a strong positive relationship[4] between socioeconomic status and child health outcomes. Therefore, socioeconomic status stands out to be an important pathway channel between maternal education and child health.

Health-seeking behavior. Education can also influence health care utilization and reproductive health behavior. As Pongou, Ezzati, and Salomon (2006) note, in some traditional societies, education would provide the mother with the capacity to break with some traditional practices and taboos. Education promotes modern attitudes, and hence mothers with higher levels of education are more likely to seek health care services from health centers and health professionals. Educated mothers are also more likely to accept and use family planning methods, including contraceptives.

Knowledge of family planning and health. Education enhances mother's knowledge of health, which is an important predictor of child health outcome (Glewwe, 1999; Webb and Block, 2004). Health knowledge can directly be acquired from formal education. Education can also facilitate the mother's ability to understand the causation and prevention methods of illness. It also enhances her knowledge of nutrition and family planning. However, Frost, Forste, and Haas' (2005) review indicates that the available empirical evidence on the relationship between maternal health knowledge and child health is inconclusive.

Reproductive behavior. Reproductive behavior is another important link through which education influences child health outcome. In general, educated women have more control over their reproductive behavior and make conscious decisions—for example, on the number of births and intervals. Reproductive behavior is proxied by mother's age and selected child demographic characteristics. Relevant child characteristics include age, sex, birth order, and preceding birth interval.[5]

Vast evidence shows that the risk of child malnutrition increases with age in developing countries. Webb and Block (2004, p. 812) find, though, that HAZ and WHZ decline with age with

[4] Strong positive relationship with nutritional status means strong negative relationship with stunting and wasting.
[5] It should be noted that, not all these demographic variables are responsive to maternal education. Therefore, some such as sex and age of child are included as additional control variables.

a positive second derivative. An explanation for this relationship is the nutritional value of breastfeeding that protects young children from the risk of stunting or wasting at early age (Pongou, Ezzati, & Salomon, 2006) and, potentially, shortage of supplemental food in later months. In addition, some measures of malnutrition, such as stunting, are results of cumulative process of inadequate dietary intake and illness. Therefore, younger children are at lower risk (Webb & Block, 2004).

The rationale for including gender in the model of child nutrition is to capture the presence of male-bias in intra-household allocation of resources (Behrman, 1997).[6] However, the empirical evidence supporting this hypothesis remains scarce. Based on a review of 306 child nutrition surveys conducted since 1985 in a number of developing countries, Marcoux (2002) finds no sex differences in 227 surveys. In fact, the evidence from Africa and some other developing countries in Asia and Latin America shows that, when significant differences exist, boys are more likely to be malnourished than girls.

Birth order measures parity while birth interval captures the care and support that have been made available to the child. The empirical evidence on parity is mixed. For example, in India, Jeyaseelan and Lakshman (1997) find that malnutrition is higher among children of higher birth order (5+). On the other hand, in Ethiopia, Girma and Genebo (2002) find that the risk of stunting is higher among first births. However, it is common to find that the risk of malnutrition declines with birth interval (Pongou, Ezzati, & Salomon, 2006).

Finally, place of residence and geographic regions are included as control variables in most specifications. It should be noted however that these controls are also influenced by maternal education. Education increases mobility and creates more opportunities in urban than rural areas. Desai and Alva (1998) find that in addition to socioeconomic factors, geographical controls are important links through which the impact of maternal education on child health outcome is mediated.

Data and Measurement of Variables

The data. This study uses two waves of the Ethiopia Demographic and Health Survey (EDHS) available at the time of writing (Central Statistical Agency, 2001; ORC Macro, 2006). The first survey was completed in 2000 and the second survey in 2005. The EDHS sample is stratified, clustered, and collected with a two-stage probabilistic sampling technique based on the list of enumeration areas of the 1994 Population and Housing Census of Ethiopia. Therefore, the description and analysis undertaken in this study take into account the nature of the data.

[6] Another form of gender biased human capital outcome would result from fertility behavior. Jensen (2002) argues that female children may have more siblings than male children as a result of son-preferring differential-stopping behavior in fertility, i.e., on average, females come from a larger family size where all children are worse off. Therefore, even if there is equal treatment at the household level, there may be unequal outcome at aggregate level. In some traditional societies, son-preferring behavior would result in inequalities in nutritional outcomes (Tarozzi and Mahajan, 2007).

Accordingly, the sample weight, sample strata, and primary sampling units are included. At the first sampling stage in the 2000 survey, 539 (138 urban and 401 rural) clusters were selected. In the 2005 survey, 540 (145 urban and 395 rural) clusters were selected. The second stage consisted of the selection of a representative sample of households and women aged 15–49 years old in each household. Accordingly, in the 2000 survey, 15,367 women from 14,072 households were selected. In the 2005 survey, 14,070 women from 14,500 households were selected. In both surveys, women were asked questions about their children, especially for those younger than 5, and anthropometric measurements (height and weight) were taken. In the 2000 and 2005 surveys, the total number of children measured and whose mothers were also interviewed were 9,774 and 4,296, respectively.

Measurement of variables

***Dependent Variable: Child Nutritional Status*.** Long-term or chronic malnutrition is measured by height for age (HAZ), while short-term or acute malnutrition is measured by weight for height (WHZ). A child is deemed stunted if HAZ score is less than –2SD and wasted if WHZ score is less than –2SD. Therefore, the dependent variable is a dichotomous variable that takes 1 if the child is stunted or wasted, and 0 otherwise.

***Explanatory Variables*.** The primary variables of interest are *maternal education* and *pathway variables*. The models are also controlled for geography (place of residence and regions) and survey year. The variables are measured as follows.

The DHS data compile *maternal education* in two different forms: single years and highest level of education. For ease of interpretation, six categories are considered following the DHS classification. These are: (1) no education, (2) incomplete primary education, (3) complete primary education, (4) incomplete secondary education, (5) complete secondary education, and (6) higher education. The corresponding values from the smallest to the highest education category range from 0–-5.

Socioeconomic status is measured differently in different studies. Frost, Forste, and Haas (2005) construct two index variables from selected household assets and dwelling characteristics. However, for this study the DHS wealth index is used because in addition to a number of household assets and dwelling characteristics, it considers the household's demographic structure.[7] Assets and amenities included in the DHS wealth index range from the possession of items (e.g., bicycles, cars, radios, sofas, and televisions); dwelling characteristics, such as type of flooring material or the level of overcrowding; household facilities such as source of drinking water, type of toilet facility, and type of cooking fuel; and other characteristics related to wealth status.

[7] The pros and cons of the DHS wealth index have been noted. On the one hand, the DHS surveys are often implemented in countries where income itself may not be the most reliable—or even available—way of measuring socioeconomic status. On the other hand, the index is constructed from urban-based social and economic amenities and may be measuring urbanicity instead of socioeconomic status.

Mother's health-seeking behavior is an index variable constructed from utilization of selected preventive health care services. It is constructed by principal component analysis from four related variables included in the EDHS (Table 3). These are: (1) received prenatal services from a health professional or a trained birth attendant; (2) delivered a baby at a health center (hospital, clinic, others); (3) have used contraceptive; and (4) received tetanus injection before birth.

Similarly, maternal knowledge of family planning and health is an index variable constructed by principal component analysis from selected variables available in the 2000 and 2005 EDHS. Health knowledge is measured by knowledge of oral rehydration therapy, i.e., if the woman heard of or used oral rehydration therapy. Family planning knowledge is measured by knowledge of ovulation cycle, i.e., if the woman knows when during her ovulation cycle she can get pregnant. Additional factors included in the knowledge index are proxies of family planning information from radio, TV, newspaper, and frequencies of reading newspaper, listening to radio, and watching TV (Table 3).

Reproductive behavior is proxied by maternal age and selected child characteristics such as age, sex of child, birth order, and birth interval. Child age is in months and maternal age is in years. Both are in logs. The remaining—namely, sex of child, birth order, and preceding birth intervals—are dummy variables.

Table 3. Factor Analyses of Health-Seeking Behavior and Knowledge Indices

Variable	Sample Mean	Factor Loadings	α
Health-Seeking Behavior Index			
Delivered a baby in modern health facility	0.051	0.491	
Received prenatal from a health professional	0.276	0.546	
Received tetanus injection before birth	0.313	0.490	
Used contraceptive	0.186	0.470	0.718
Knowledge Index			
Has heard of oral rehydration therapy	0.570	0.185	
Knows when in ovulation cycle can get pregnant	0.408	0.135	
Frequency of reading newspaper	0.062	0.377	
Frequency of listening to radio	0.457	0.381	
Frequency of watching TV	0.099	0.439	
Heard of family planning from radio	0.176	0.378	
Heard of family planning from TV	0.026	0.429	
Read about family planning from newspaper	0.019	0.376	0.716

Source: EDHS 2000 and 2005 (Central Statistical Authority and ORC Macro, 2001, 2006)

Note: α is a reliability coefficient or Cronbach's alpha. It is greater than 0.7 in both cases, which is within acceptable range.

Finally, Table 4 presents descriptive statistics of the model's variables included in the regressions, excluding control dummy variables for place of residence and geographic regions.

Table 4. Descriptive Statistics of Model Variables

Variables	2000 EDHS				2005 EDHS			
	Min	Max	Mean	SD	Min	Max	Mean	SD
Height for age (HAZ) z-score	-5.99	5.84	-2.06	0.03	-5.98	5.78	-1.77	0.05
Weight for height (WHZ) z-score	-3.99	5.71	-0.78	0.02	-3.99	5.91	-0.58	0.03
Stunted (HAZ<-2SD=1) (b)	0	1	0.51	0.01	0	1	0.46	0.01
Wasted (WHZ<-2SD=1) (b)	0	1	0.11	0.01	0	1	0.11	0.01
Maternal education	0	5	0.30	0.02	0	5	0.32	0.02
Wealth index	-1.05	3.43	-0.41	0.02	-3.10	3.76	-0.36	0.02
Health index	-1.16	4.85	-0.29	0.04	-1.16	3.68	-0.09	0.04
Knowledge index	-1.20	9.94	-0.23	0.03	-1.20	9.94	-0.18	0.03
Child: Gender (Male=1) (b)	0	1	0.51	0.01	0	1	0.51	0.01
Child: age (months & in logs)	0.00	4.09	3.14	0.01	0.00	4.09	3.10	0.01
Child: age squared	0.00	16.76	10.62	0.05	0.00	16.76	10.45	0.07
Child: Birth order >3 (b)	0	1	0.51	0.01	0	1	0.53	0.01
Child: Birth interval > 2years (b)	0	1	0.65	0.01	0	1	0.65	0.01
Mother: age (years & in logs)	2.71	3.89	3.36	0.00	2.71	3.89	3.35	0.00
Mother: age squared	7.33	15.14	11.33	0.03	7.33	15.15	11.27	0.03

Source: 2000 and 2005 EDHS (Central Statistical Authority and ORC Macro, 2001, 2006).
Note: (b)= binary indicators; Min = minimum value; Max = maximum value; and SD = standard deviations.

5. Results and Discussion

The multivariate analysis results are based on the estimation of the various specifications of Equation (3). As indicated earlier, the dependent variable is a dichotomous variable. Therefore, the models are estimated using logistic regression. The logistic regression model fits the log odds or logits by a linear function of the explanatory variables as follows: $\text{logit}(p_i) = \ln[\frac{p_i}{1-p_i}] = \alpha + \mathbf{x'\beta}$, where p_i is the probability that the child is stunted or wasted conditional on $\mathbf{x}$, which is a vector of explanatory variables included in Equation (3); $\ln[\frac{p_i}{1-p_i}]$ is the log odds of the outcome; and α and β are the parameters to be estimated.

Maternal Education and Chronic Malnutrition

Table 5 reports the log odds of various specifications of chronic malnutrition, stunting. Model 1 is the baseline model with only maternal education included as a primary explanatory variable after controlling for survey year.[8] Model 2 adds geographic controls (place of residence and regions) to Model 1. Models 3–6 each add a pathway variable to the baseline model after

[8] The pooled (2000 and 2005) data are used in all models. Therefore, all are controlled for by a survey year dummy.

controlling for place of residence, regions, and survey year. In this row, Model 3 is the socioeconomic status model; Model 4 is the health-seeking behavior model; Model 5 is the knowledge model; and Model 6 is the reproductive behavior model. Finally, Model 7 presents the full model with all the primary explanatory variables and control variables included.

Maternal education is significant in the baseline model (Model 1), where it is controlled only for survey year. Model 2 shows that the addition of geographic controls to the baseline model reduces the education effect while the significance of the education variable remains unchanged. Models 3–6 show that, except for the health-seeking behavior, all other pathways (socioeconomic status, knowledge, and reproductive behavior) are significant, and the education effect is significant but lower in absolute value when compared to the baseline model. However, in the full model (Model 7), maternal education, socioeconomic status and some reproductive behavior variables are significant. The decline in the significance of some of the pathway variables could be due to multicollinearity either with maternal education or socioeconomic status or both.

The top row of Table 5 shows that the log odds associated with maternal education decline from 0.27 to 0.16 in absolute value. It appears that each level of education decreases the relative probability of stunting by 24% (= [1-exp (log odds)]*100) in the baseline model.[9] The impact declines to 15% in the full model (see also Table 7). Therefore, the decline in the direct effect of education from 24% to 15% means that the pathways and geographic controls explained only about 38% of the education effect.

Referring to the full model (Table 5, Model 7), the important predictors of stunting are, therefore, maternal education, socioeconomic status, and reproductive behavior. Socioeconomic status is the most important predictor of stunting as demonstrated by the magnitude of the coefficient (log odds) and its significance. The likelihood of stunting also increases with child age at a decreasing rate and increases with maternal age at a decreasing rate. Similar to earlier findings in Africa and other developing countries (e.g., Marcoux, 2002), but in contrast to other studies on Ethiopia (e.g., Girma and Genebo, 2002), the male dummy is significant, implying that male children are more likely to be stunted than females.

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[9] For a unit increase in the j^{th} regressor, the derivation and interpretation is as follows: $\exp(\mathbf{x}'\boldsymbol{\beta})$ increases to $\exp(\mathbf{x}'\boldsymbol{\beta} + \beta_j) = \exp(\mathbf{x}'\boldsymbol{\beta}) * \exp(\beta_j)$. Hence the odds ratio $[\frac{p_i}{1-p_i}]$ increases by a multiple $\exp(\beta_j)$. Thus, for example, the logit slope parameter of 0.1 means a unit increase in the regressor multiplies the initial odds ratio by exp(0.1) = 1.105, which is a proportionate increase of 0.105 times the initial odds ratio. Therefore, the relative probability of being stunted increases or decreases (depending on the sign of the coefficient in the logit model) by 10.5 percent (Cameron and Trivedi, 2005, p. 470).

Table 5. Logistic Estimates of Child Stunting (pooled sample)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Maternal education	-0.27**	-0.23**	-0.19**	-0.23**	-0.17**	-0.23**	-0.16**
	(-7.41)	(-5.46)	(-4.31)	(-4.70)	(-3.56)	(-5.44)	(-2.65)
Socioeconomic status			-0.28**				-0.37**
			(2.96)				(-3.40)
Health-seeking behavior				-0.04			-0.05
				(-1.38)			(-1.60)
Knowledge					-0.08**		-0.04
					(-2.07)		(-0.80)
Reproductive behavior						0.09	0.17**
Child: gender (Male=1)						(1.94)	(2.89)
Child: age (ln)						3.86**	3.85**
						(11.18)	(9.51)
Child: age squared						-0.52**	-0.50**
						(-9.34)	(-7.40)
Child: birth order > 3						0.28**	0.12
						(3.58)	(1.23)
Child: birth interval > 2						-0.08	-0.11
years						(-1.34)	(-1.38)
Mother: age (ln)						7.76**	6.87*
						(2.63)	(2.09)
Mother: age squared						-1.21**	-1.07**
						(-2.78)	(-2.21)
Residence: (Urban=1)		-0.06	0.25	-0.01	0.04	-0.09	0.34
		(-0.35)	(1.15)	(-0.05)	(0.18)	-(0.49)	(1.33)
Survey year: (2005=1)	-0.19**	-0.18**	-0.16**	-0.11	-0.17**	-0.22	-0.08
	(-3.06)	(-2.97)	(-2.62)	(-1.49)	-(2.84)	(-3.36)	(-1.12)
	0.13	-0.54**	-0.43*	-0.53**	-0.53**	-19.77**	-18.20**
Constant	(3.38)	(-2.70)	(-2.24)	(-2.67)	(-2.78)	(-3.94)	(-3.29)
Regional variation? [a]	Yes	Yes	Yes	Yes	Yes	Yes	No[b]
Pseudo R square	0.01	0.02	0.10	0.02	0.02	0.10	0.13
Log Likelihood	-9,704	-9,632	-9,620	-6,484	-9,556	-8,844	-5,681
LRChi2	186**	331**	355**	245**	343**	1,909**	1,764**
# of observations	12,463	12,463	12,463	8,572	12,350	12,463	8,498

Note: t-statistics in parentheses; * and ** denote significance at 5% and 1% level, respectively; [a] regional variation refers to the 11 geographic regions with Addis Ababa as a reference category; [b] no variation for most regions except for Dire, Dawa, and Gambella regions, where they are found better than the reference category.

The place of residence dummy (urban = 1) is insignificant in all models. The result is expected in multivariate setting due to the fact that the “urban advantage” is captured by other better measures of urban-based social and economic amenities (Fotso, 2006). However, some regions (Tigray, Afar, Amhara, Oromyia, Somali, and SNNP) are found significantly different from the reference region, Addis Ababa (Model 2). A child from one of these regions is more likely to be stunted when compared to a child from the reference region, Addis Ababa. The regional variation obtained in Models 2–6 could be due to differences in the level of urbanization.

Finally, the discussion in Section 3 suggested significant changes in stunting occurred over time. However, the results of the full model in Table 5 show that the survey year dummy is insignificant, suggesting the absence of difference between 2000 and 2005 when other factors are considered. Thus, the observed change in stunting over time is attributable to changes in other factors including maternal education, socioeconomic status and reproductive behavior.

Table 6. Logistic Estimates of Child Wasting (pooled sample)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Maternal education	-0.23**	-0.11	-0.06	-0.10	-0.08	-0.12	-0.081
	(-4.05)	-(1.88)	(-0.87)	(-1.48)	(-1.21)	(-1.90)	(-0.98)
Socioeconomic status			-0.42**				-0.41**
			(-3.10)				(-2.63)
Health-seeking behavior				-0.06			-0.04
				(-1.26)			(-0.79)
Knowledge					-0.04		0.03
					(-0.77)		(0.58)
Reproductive behavior						0.14	0.20*
Child: gender (Male=1)						(1.81)	(2.35)
Child: age (ln)						3.13**	3.44**
						(6.11)	(5.21)
Child: age squared						-0.59**	-0.64**
						(-6.64)	(-5.39)
Child: birth order >3						0.12	-0.03
						(1.11)	(-0.25)
Child: birth interval >2						0.14	0.23*
						(1.55)	(2.08)
Mother: age (ln)						7.84	7.84
						(1.57)	(1.54)
Mother: age squared						-1.07	-1.15
						(-1.56)	(-1.54)
Residence: (Urban=1)		-0.56**	-0.11	-0.45*	-0.52*	-0.54**	-0.01
		(-2.83)	(-.45)	(-2.07)	(-2.43)	(-2.63)	(-0.04)
Survey year: (2005=1)	-0.01	-0.07	-0.04	-0.08	-0.07	-0.06	-0.05
	-(0.16)	(-0.79)	(-0.78)	(-0.82)	(-0.76)	(-0.67)	(-0.51)
Regional variation? [a]	Yes	Yes	Yes	Yes	Yes	Yes	N0
Pseudo R square	0.00	0.01	0.01	0.01	0.01	0.03	0.04
Log likelihood	-4,820	-4,790	-4,780	-3,518	-4,756	-4,669	-3,399
LRChi2	33.3**	94.6**	113.7**	75.4**	94.9**	342**	284**
# of observations	12,637	12,637	12,637	9,601	8,660	12,637	8,585

Note: t-statistics in parentheses; * and ** denote significance at 5% and 1% level, respectively; [a] regional variation refers to the 11 geographic regions with Addis Ababa as a reference category; [b] no variation for all regions except for Somali Region where the likelihood of child wasting is found larger than the reference category.

Maternal Education and Acute Malnutrition

Table 6 reports logistic regression results of acute malnutrition, wasting. The presentation in Table 6 follows the same approach used earlier in Table 5. Therefore, the first row in Table 6 demonstrates how the effect of education on wasting changes as a new pathway variable is added to the baseline model.

The comparison of results in Table 5 and Table 6 would show the differences and common features of models of chronic and acute malnutrition. First, in Table 6, maternal education is insignificant in all except the baseline model. Second, both education and the two pathway variables of health-seeking behavior and knowledge are also insignificant as shown in models 4 and 5. However, similar to the chronic malnutrition case, socioeconomic status and selected reproductive behavior variables are significantly related to acute malnutrition. In addition, geographic and survey year controls are found to have a similar pattern.

Robustness Tests: Alternative Sample Domains

Tables 7 and 8 report logistic regression results of the full models of stunting and wasting, respectively, based on alternative sample domains. The estimations are based on a disaggregated data by survey year and place of residence. Each table incorporates four models. The first two models are for each survey year: 2000 and 2005. The third and the fourth models are for rural and urban children, respectively.

Table 7. Logistic Estimates of Child Stunting by Survey Year and Place of Residence

	2000		2005		Rural		Urban	
Maternal education	-0.14	(-1.76)	-0.18	(-2.04)*	-0.21	(-2.73)**	-0.07	(-0.63)
Socioeconomic status	-0.37	(-2.74)**	-0.48	(-2.33)*	-0.36	(-2.60)**	-0.61	(-2.71)**
Health-seeking behavior	-0.05	(-1.35)	-0.06	(-0.98)	-0.03	(-0.73)	-0.13	(-1.98) *
Knowledge	-0.05	(-0.80)	-0.01	(-0.20)	-0.05	(-0.95)	0.00	(-0.02)
Reproductive behavior								
Child: gender (Male=1)	0.16	(2.42) *	0.19	(1.80)	0.23	(3.75)**	-0.38	(-1.92)
Child: age (ln)	3.70	(7.46) **	4.27	(6.84) **	4.03	(9.94)**	1.91	(1.55)
Child: age squared	-0.47	(-5.71)**	-0.58	(-5.42)**	-0.53	(-7.68)**	-0.19	(-0.93)
Child: birth order >3	0.08	(0.63)	0.26	(1.59)	0.16	(1.66)	-0.08	(-0.19)
Child: birth interval >2	-0.17	(-1.68)	0.02	(0.17)	-0.09	(-1.11)	-0.23	(-1.08)
Mother: age (ln)	10.35	(2.61) **	-2.93	(-0.52)	5.89	(1.76)	16.49	(1.27)
Mother: age squared	-1.56	(-2.69)**	0.34	(0.41)	-0.93	(-1.89)	-2.43	(-1.26)
Residence: (Urban=1)	0.36	(1.04)	0.26	(1.02)	-	-	-	-
Survey year: (2005=1)		--	-	-	-0.07	(-0.84)	-0.37	(-1.67)
Constant	-23.97	(-3.58)**	-1.94	(-0.21)	-16.63	(-2.95)**	-31.07	(-1.48)**
Regional Variation?		No		No		Yes		Yes
Pseudo R square		0.14		0.14		0.14		0.15
Log Likelihood		-4,014		-1,654		-5,079		-550
LRChi2		1,254		527		1,586		194
# of Observations		5,971		2,527		6,600		1,450

Note: t-stat in parenthesis; * and ** denote significance at 5% and 1% level, respectively; pooled data is used for rural and urban models; urban regions (Addis Ababa, Dire Dawa, and Harari) are excluded in the rural model and the reference category in the rural model is Tigray; the reference category for regional dummies in all other models is Addis Ababa.

The results in Table 7 are generally similar to the results in Table 5. Accordingly, socioeconomic status is significant in all cases. Education retains its significance in two of the four cases. Health-seeking behavior and knowledge are insignificant in most cases. However, health-seeking behavior appears significant in the urban model. Likewise, the results in Table 8 are similar to those of Table 6. In most cases maternal education and its pathways are insignificant.

Table 8. Logistic Estimates of Child Wasting by Survey Year and Residence

	2000		2005		Rural		Urban	
Maternal education	0.03	(0.36)	-0.35	(-2.33)*	-0.15	(-1.48)	0.09	(0.51)
Socioeconomic status	-0.34	(-1.82)	-0.63	(-1.88)	-0.41	(-2.05)*	-0.35	(-1.31)
Health-seeking	-0.01	(-0.21)	-0.08	(-0.93)	-0.03	(-0.61)	-0.09	(-0.90)
Knowledge	-0.04	(-0.62)	0.15	(1.54)	0.03	(0.40)	-0.01	(-0.11)
Reproductive behavior								
Child: gender (Male=1)	0.18	(1.72)	0.26	(1.71)	0.19	(2.06)*	0.45	(1.31)
Child: age (ln)	4.46	(6.06)**	1.75	(1.62)	3.40	(4.93)**	4.40	(2.05)*
Child: age squared	-0.81	(-6.21)**	-0.34	(-1.74)	-0.63	(-5.10)**	-0.78	(-2.04)*
Child: birth order >3	0.03	(0.21)	-0.07	(-0.29)	-0.07	(-0.51)	0.26	(0.56)
Child: birth interval >2	0.45	(3.48)**	-0.33	(-1.66)	0.24	(2.08)*	0.21	(0.51)
Mother: age (ln)	2.37	(0.39)	21.11	(2.27)*	9.63	(1.82)	-11.16	(-0.52)
Mother: age squared	-0.35	(-0.39)	-3.09	(-2.26)*	-1.40	(-1.81)	1.55	(0.48)
Residence (Urban=1)	-0.12	(-0.36)	0.20	(0.35)				
Survey year (2005=1)					-0.04	(-0.37)	-0.15	(-0.28)
Constant	-12.14	(-1.17)	-40.40	(-2.58)**	-22.97	(-2.57)**	11.37	(0.33)
Regional variation?		No		No		Yes		Yes
Pseudo R square		0.05		0.06		0.04		0.10
Log likelihood		-2,405		-947		-3,149		-224
# of observations		6,058		2,527		6,682		1,454

Note: t-stat in parenthesis; * and ** denote significance at 5% and 1% level, respectively; pooled data is used for rural and urban models; urban regions (Addis Ababa, Dire Dawa, and Harari) are excluded in the rural model and the reference category in the rural model is Tigray; the reference category for regional dummies in all other models is Addis Ababa.

6. Discussion

Table 9 summarizes the results and compares the effect of maternal education on child nutritional status by model type and measure of malnutrition. The log odds effects of education in Table 9 are obtained from the first rows in the previous tables (Tables 5–8). The impact of each level of education on the relative probability of being stunted or wasted is calculated accordingly, i.e., (1-exp(log odds)).

Table 9. The Effect of Maternal Education and Pathway Variables on Stunting and Wasting by Model Type

	Chronic Malnutrition (Stunting)				Acute Malnutrition (Wasting)			
Model Type	log odds	1-exp (log odds)	Education significant?	Pathway variable significant?	log odds	1-exp (log odds)	Education significant?	Pathway variable significant?
Baseline	-0.27	0.24	Yes	_	-0.23	0.20	Yes	_
Geographic	-0.23	0.21	Yes	Yes	-0.11	0.10	No	Yes
SES	-0.19	0.17	Yes	Yes	-0.06	0.05	No	Yes
Health-seeking	-0.23	0.21	Yes	No	-0.10	0.10	No	No
Knowledge	-0.17	0.16	Yes	Yes	-0.08	0.08	No	No
Reproductive	-0.23	0.21	Yes	Yes	-0.12	0.11	No	Yes
Full model								
National	-0.16	0.15	Yes	Yes[a]	-0.12	0.11	No	Yes[a]
Rural sample	-0.21	0.19	Yes	Yes[a]	-0.15	0.14	No	Yes[a]
Urban sample	-0.07	0.07	No	Yes	-0.09	0.09	No	No
2000 sample	-0.14	0.13	No	Yes	0.03	-0.03	No	No
2005 sample	-0.18	0.16	Yes	Yes	-0.35	0.30	Yes	No

Note: SES is socioeconomic status; [a] some pathways only (mostly SES).

Table 9 indicates that the maximum effect of maternal education on stunting and wasting is observed in the baseline model. It is 24% for stunting and 20% for wasting. In the full model, the effect declines to 15% for stunting and 11% for wasting. The table also shows that maternal education and its pathways are more relevant in explaining stunting than wasting. Except for the baseline model, maternal education is not significant in all other models of wasting. Another important observation is that the direct effect of maternal education is larger in the rural than urban areas. Each level of maternal education in the rural sample reduces the relative probability of stunting by 19%. However, it is not significant in the urban areas.

Socioeconomic status is the most important factor of all pathways in mediating the impact of maternal education on child nutritional status. It is significant in all sample categories of stunting and in the national and rural models of wasting.[10] The results imply that policies and programs intended to reduce child malnutrition and hence child mortality would primarily focus on targeting the various key elements of socioeconomic status. Socioeconomic status in this study is measured by the DHS wealth index. Unfortunately, its specific misgivings would make it less amenable to policy. First, the key elements from which the DHS wealth index is constructed are predominantly urban based. Therefore, the index could simply be measuring urbanicity. Second, different elements contribute to the index differently. Therefore, the individual part of the index that essentially is driving the impact on child health needs further study.

Overall, the results obtained for chronic and acute child malnutrition are in line with earlier related studies on other countries, including Frost, Forste, and Haas (2005) for Bolivia, and Webb

[10] The minimum level of statistical significance employed in this study is 5%. However, socioeconomic status is significant at the 10% level in the 2000 and 2005 samples. All other pathways are very far from that value (Table 7).

and Block (2004) for Indonesia. The findings are also robust to changes to sample domains. Disaggregating the sample by survey year and place of residence did not change the results substantially. However, the inability to explain the full effects of maternal education in chronic malnutrition and its erratic relationships with acute malnutrition is a noted limitation to the analysis presented in this study. The problem could be due to the importance of other channels that are not considered in this study or measurement error in the variables from which the indices of the pathways are constructed. Future work on the issue using a different data set and a different country would add more insight in the relationship between maternal education and child nutritional status.

Summary and Conclusions

This study models the impact of maternal education and its pathways on chronic and acute child malnutrition in Ethiopia using the 2000 and 2005 Demographic and Health Surveys. The pathways examined in this study are socioeconomic status, maternal health-seeking behavior, maternal knowledge of health and family planning, and reproductive behavior. The logistic models of stunting and wasting are estimated for various sample categories, including the national, rural, and urban samples, and the 2000 and 2005 samples.

The results indicated that maternal education works through all pathways except health-seeking behavior. Each level of maternal education reduces the relative probability of being chronically malnourished by 15%. However, after incorporating pathway variables, no direct effect of maternal education is obtained on acute malnutrition. Overall, maternal education and its pathway explain chronic malnutrition better than acute malnutrition. The claim that maternal education is the single most important predictor of malnutrition appears to be an oversimplification.

Socioeconomic status is the most important pathway linking maternal education and child nutritional status. It is significant in both models of chronic and acute malnutrition. Although girls' education is a high policy priority, our finding suggests that it may take time before its direct and indirect impacts to materialize and substantially improve child health outcomes. Faster results would require direct interventions on key elements of socioeconomic status.

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