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The Determinants of Child Health and Nutritional Status in Punjab: An Economic Analysis

Uzma Afzal

Centre for Research in Economics and Business
Lahore School of Economics

Centre for Research in Economics and Business (CREB)

Lahore School of Economics

Intersection Main Boulevard Phase VI, DHA and Burki Road
Lahore 53200, Pakistan
Tel: 042-36561230; 042-36560936
Email: creb@lahoreschool.edu.pk

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Uzma Afzal
Senior Teaching and Research Fellow (CREB)
Lahore School of Economics

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Lahore School of Economics
Intersection of Main Boulevard, Phase VI, DHA and Burki Road
Lahore 53200, Pakistan
Tel.: +92 42 3656 1230
creb@lahoreschool.edu.pk
www.creb.org.pk

Price: Rs100

Preface

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About the Author

Uzma Afzal is a senior teaching and research fellow at the Lahore School of Economics. She completed her MPhil (Economics) from the Lahore School and BA (Hons) from the Lahore University of Management and Sciences. Her research interests are education, poverty, economic development and labor markets. She can be contacted at uzma@lahoreschool.edu.pk.

Abbreviations

OLS	ordinary least squares (method)
MICS	Multiple Indicator Cluster Survey
SD	standard deviation
HAZ	height for age
WAZ	weight for age

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Abstract

Child health is considered a key indicator of economic development and the quality of life in developing countries. It is also closely related to other development indicators such as adult health, educational attainment, income, and occupational productivity. In the past few years, despite having had clear health targets in the form of the Millennium Development Goals, Pakistan has been unable to attain significant progress in improving child and maternal health. This study focuses on the health and nutritional status of children in Punjab. It attempts to identify the socioeconomic factors that affect child health at the household level, and presents policy recommendations based on its findings. The study's theoretical framework is based on the household production model, and we use the instrumental variable technique for estimation purposes. The Multiple Indicator Cluster Survey for 2007/08, a household-level dataset gathered by the Punjab Bureau of Statistics, provides our sample data. The study's results imply that maternal education and health knowledge are important determinants of child health, among other significant indicators.

JEL classifications: I120, I100.

Keywords: Child health, nutritional status, maternal education, health knowledge, instrumental variable technique, Punjab.

The Determinants of Child Health and Nutritional Status in Punjab: An Economic Analysis

1. Introduction

Child health is considered a key indicator of both economic development and the quality of life in developing countries. It is also closely related to other development indicators such as adult health, educational attainment, income, socioeconomic status, and occupational productivity (see, for instance, Behrman & Deolalikar, 1987; Case, Lubotsky, & Paxson, 2002; Chen & Li, 2006; Glewwe, 1999). This study focuses on the health and nutritional status of children in Punjab. By conducting a cross-sectional empirical analysis for the year 2007/08, we attempt to identify the socioeconomic factors that affect child health at the household level, and present policy recommendations based on these findings.

In 2000, 189 member countries of the United Nations adopted the Millennium Development Goals (MDGs), of which at least four of eight goals directly address the issues of child health or nutritional status (Chen & Li, 2006).[1] Pakistan is also a signatory to the MDGs and much of its health policy revolves around achieving the objectives laid out by the United Nations mandate. Since then, however, child healthcare has not improved by much—estimates indicate that about 38 percent of under-five children are underweight while 12 percent are severely underweight. The infant mortality rate stands at 63.3 per 1,000 live births, and the under-five-child mortality rate is 89 per 1,000 children (Khan, 2011). The figures for infant and child mortality, life expectancy, and population growth rate for Pakistan are worse than those of Sri Lanka, Nepal, the People's Republic of China, Indonesia, the Philippines, Malaysia, and—with the exception of life expectancy—India and Bangladesh as well (Khan, 2010).

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[1] These goals are to (i) reduce child mortality, (ii) improve mothers' health, (iii) combat disease, and (iv) eradicate hunger.

Given the need to improve child health in Pakistan, there is a surprising dearth of empirical studies on Pakistan (see Alderman & Garcia, 1994; Alderman, Behrman, Lavy, & Menon, 2001; Arif, 2004; Aslam & Kingdon, 2010; Iram & Butt, 2006; Mahmood & Kiani, 1994; Shehzad, 2006). The bulk of research on health economics in Pakistan is based on simplified assumptions and estimation techniques and, therefore, renders questionable results. Although recent literature on other countries might provide valuable insights into the area of health, the importance of local conditions for developing social policies remains significant. The need for more intensive analysis of health in Pakistan is critical and, keeping in mind the diversity that exists across the four provinces, research should take place not just at the national level but also at the subregional level. This study derives its relevance against the backdrop discussed above. The paucity of empirically sound studies on child health in Pakistan—and even fewer on Punjab—makes this study an important contribution to the existing literature.

The study draws on data from the Multiple Indicator Cluster Survey (MICS) for 2007/08—a cross-sectional micro-level dataset based on over 90,000 household surveys conducted by the Punjab Bureau of Statistics. The MICS includes a number of comprehensive sections on child and maternal health and is, therefore, suited well to the study's purposes. The theoretical framework employed is the household production function presented in Behrman and Deolalikar's (1988) seminal work. We use the instrumental variable technique to estimate the determinants of child health by controlling for endogenous variables, with the choice of instruments for endogenous variables based on the existing literature. The results highlight the importance of health knowledge and mothers' education for both the short- and long-term health of children. The channel through which maternal education affects child health is believed to be better nurturing and healthcare since the income effect of education is controlled by household income.

The rest of the paper is organized as follows: Section 2 reviews the literature on child health, Section 3 presents the study's theoretical framework, and Section 4 examines the data used and provides a set of summary statistics. Section 5 explains the empirical strategy used, and Section 6 discusses the study's results and empirical findings obtained.

2. A Review of the Literature

While child health is studied as an input for economic development, it is also considered an outcome of the development process. A vast body of literature examines child health as a contributing factor to future socioeconomic status and human capital development (see, for instance, Behrman & Deolalikar, 1987; Case & Paxson, 2010; Case et al., 2002; Currie, 2008; Glewwe & Jacoby, 1995; Olsen & Wolpin, 1983). At the other end of the spectrum, there are extensive studies that examine the determinants of child health (see, for instance, Alderman & Garcia, 1994; Alderman et al., 2001; Arif, 2004; Chen & Li, 2006; Currie & Stabile, 2003; Curtis, Dooley, Lipman, & Feeny, 2001; Glewwe, 1999; Thomas, Strauss, & Henriques, 1991). This working paper aims to contribute to the latter perspective on child health.

Among the various determinants of child health, parents' education—particularly mothers' education—has been the focus of several studies. The importance of maternal education for better child nutrition and health is well established (see Aizer & Stroud, 2010; Barrera, 1990; Behrman & Deolalikar, 1988; Glewwe, 1999; Thomas et al., 1991). Yet, despite its accepted importance for children's wellbeing, most studies have failed to identify the underlying mechanisms through which education impacts health.

Some exceptions, however, are Glewwe (1999) and Thomas et al. (1991). The latter identify three mechanisms through which mother's education might affect child health. The most obvious instrument of influence is (i) enhanced earning capability or permanent income, followed by (ii) improved cognitive abilities and (iii) constructive community interaction. Additionally, education can also give mothers up-to-date information on modern health facilities and treatments for various diseases, which directly translates into improved child health (Glewwe, 1999). Empirical analysis, however, explains that much of the mother's-education effect operates through the availability of health knowledge and access to information, and a smaller part through literacy and income (Glewwe, 1999; Thomas et al., 1991). In the case of Morocco, Glewwe (1999) finds that, even though schools do not directly impart knowledge on health, the literacy and numeracy skills learnt at schools help in obtaining health knowledge outside the classroom.

Kovsted, Pörtner, and Tarp (2002) point out that most studies on child health use data from areas where malnutrition is widespread—the conclusions drawn from such studies, therefore, could have limited application in areas where malnutrition is low. The authors attempt to isolate the impact of parental knowledge of child health from estimates of the effects of parental education on child health. Kovsted et al.'s geographical focus is Bandim, a district in Bissau (the capital of Guinea-Bissau) that is marked by high infant mortality rather than malnutrition. The conclusions they draw are in line with the recommendations made by Glewwe (1999) and Thomas et al. (1991): Mothers' education is not significant when health knowledge is accounted for.

An interesting observation in the literature is that health knowledge is endogenous. Parents with less-healthy children are more likely to attain information on child health compared to parents with healthier children. Not taking this endogeneity into account would result in a downward bias when estimating the effect of health knowledge on child health (Kovsted et al., 2002). On the contrary, health knowledge does not always dampen the effect of parental education. In the Philippines, education and access to health services has a complementary impact on communities (Barrera, 1990). Hence, it is erroneous to expect the role of a particular variable to be the same across different societies, especially if community and regional influences play an important role in the transmission of that variable's impact (Handa, 1999).

According to Alderman et al. (2001), "Improved child health and nutrition are welfare-enhancing in themselves. Better health and child nutrition are widely thought to improve various dimensions of child school performance, and therefore subsequent post-school productivity" (p. 185). Using longitudinal data for 1986–1991 (collected by the International Food Policy Research Institute), the authors study the effect of child health on rural school enrolment in four districts of Pakistan. According to this study, household decisions pertaining to investments in children's human capital are reflected both in their health status and schooling performance. Most research studies on children's school enrolment and performance tend to ignore the behavioral decisions behind child health, including it as an exogenous variable in their models. Such models are considered "naïve" since their results tend to be biased. Once household choices and the existence of unobserved factors such as health endowments and preferences are taken into account, it appears that child health is about three times as important for enrolment as proposed by the naïve models.

When determining the characteristics of child health, studies include not only child characteristics, but also household- and community-level variables (see, for instance, Alderman & Garcia, 1994; Handa, 1999; Mosley & Chen, 1984; Thomas et al., 1991). Even if a study aims to examine the impact of a particular factor, e.g., immunization, on child health, the empirical analysis has to be conducted over a well-defined set of variables. Additionally, since physical and social conditions change across geographical boundaries, studies on health must successfully identify important indigenous variables.

The proximate-determinants framework establishes the influence of all socioeconomic factors on child survival through five major categories. Mosley and Chen (1984) identify several categories consisting of variables that increase the threat of morbidity and mortality in young children. The first, most obvious category is maternal factors such as age, parity,[2] and birth interval. A mother's health can directly impact fetus wellbeing as well as infant survival after birth. Environmental contamination takes into account different mediums through which disease and infections are most likely to be transmitted to children. These include mainly air, water, human contact (mostly through fingers), food, and insect vectors. Absence of nutrient deficiency owing to insufficient intake of calories, proteins, vitamins, and minerals not just in children but also in mothers (during pregnancy and lactation) is fundamental for child survival. Injury, whether accidental or intentional, may be considered a random event, but repeated patterns affecting particular regions of the body could represent environmental hazards that are spatially indigenous. The last factor is control over personal illness, consisting of preventive and curative measures taken by individuals to avoid and fight disease. These can be drawn from traditional practices that might deem taboo certain types of behavior or from modern forms of immunization, and prenatal and postnatal measures.

Geography also plays a significant role in the social development of societies through the availability of essential minerals. Field, Robles, and

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[2] "A commonly used clinical definition of parity is the number of births (both live born infants and stillbirths) of at least 20 weeks of gestation that a woman has experienced" (Simonsen & Varner, 2010).

Torero (2008), for instance, examine the impact of iodine deficiency on children's cognitive development. Mineral iodine is produced in the ocean and subsequently deposited in the soil. People in African countries such as Tanzania suffer from iodine deficiency disorders due to its low mineral content in the area's soil. Studying the impact of an iodized oil capsule distribution program across Tanzania, the authors conclude that the first three months of fetal growth play a critical role in cognitive development. Children who received adequate iodine supplements during the first trimester of pregnancy attained 0.36 to 0.51 years more of education compared to children with iodine deficiency. Field et al. (2008) also highlight that micronutrient deficiencies have a greater impact on the cognitive development of females than that of males, since the female fetus is more sensitive to maternal thyroid deprivation.

Several studies have also focused on the role of income in children's wellbeing (see, for instance, Behrman & Deolalikar, 1987; Case & Paxson, 2010; Case et al., 2002; Currie, 2008; Currie & Stabile, 2003; Curtis et al., 2001). Case et al. identify the existence of a gradient in health status, which implies that wealthier people enjoy better health and longevity across the entire income distribution. The study presents a strong positive relationship between family income and health for children up to the age of 17; this correlation tends to become stronger as children grow older. Even though parental education dampens part of the impact of income, when education is controlled for, doubling income can increase the probability of a child being in excellent health by four percentage points (Case et al.). Among children with any given chronic health condition such as asthma, epilepsy, heart conditions, etc., those from wealthier backgrounds enjoy better health than those from lower-income households. Case et al. also find that "the buffering effect of income is cumulative [over years]" (p. 1319). The study does not, however, adequately reflect on the role of genetic transfer of diseases across generations.

Currie and Stabile (2003) stipulate that children of low socioeconomic status experience deteriorating health with age, not due to lack of resources but mostly because of the greater frequency of adverse health shocks such as accidents and nutrition-related disorders such as diabetes. The intergenerational transmission of economic wellbeing to health is evident from the low stock of health endowment for children from lower-income families (Currie, 2008). While some studies consider health stock at the time of birth to be exogenous and genetically determined, other more recent studies indicate that fetal health depends on adult risk of disease. Low socioeconomic-status children are born with a low health stock due to surrounding conditions at the time of birth rather than poor genetic endowment. This highlights the need to protect the health of expecting mothers in order to enhance the wellbeing of young children (Currie, 2008).

Unobserved heterogeneity at the household level, arising from variations in factors not taken into account, can result in misleading estimates of causal relationships on health. Rosenzweig and Wolpin (1988) explore possible unobserved sources of heterogeneity at the household level, identifying two such sources when determining the impact of parental behavior on child health. The first source of heterogeneity arises from differences in endowments at the household level at which behavioral decisions about resource allocations are made. These can be a result of different health conditions, e.g., mosquito infestations, parents' health endowments, or poor sanitary conditions in the residential area. Taking into account such family or community fixed effects in the analysis can help overcome the problem of unobserved heterogeneity.

Rosenzweig and Wolpin (1988) trace the second source of heterogeneity to disparities in children's inherent endowments such as health or intelligence. Parents can be expected to invest in their children based on such factors, which studies often fail to capture. The authors explain this with the following example. It is established that breast milk is vital to an infant's health, but the amount of milk intake depends on the infant's ability to suckle. Due to this, ill or premature infants may receive insufficient levels of breast milk. If such factors are not taken into account, estimating the impact of breastfeeding on children's nutritional status can be biased upward. Taking into consideration inter- as well as intrahousehold heterogeneity is therefore crucial for a sophisticated empirical analysis.

To control for heterogeneity, we follow the methodology of Alderman and Garcia (1994) and implement community averages as instruments for potentially endogenous variables. This approach helps capture the effect of variables at the community level (which, in turn, influence household decisions) that may be correlated with other exogenous variables and/or the error term. Also, by including certain household-level variables we can control for different endowments at the household level and, therefore, help curtail heterogeneity problems.

The health and nutritional status of children in Pakistan has been examined to some extent (see, for instance, Alderman & Garcia, 1994; Alderman et al., 2001; Arif, 2004; Aslam & Kingdon, 2010; Iram & Butt, 2006; Mahmood & Kiani, 1994; Shehzad, 2006). Most studies have conducted their analyses using simple ordinary least squares (OLS) to determine which major factors affect child health. Arif (2004) implements an extensive selection of variables stemming from family, household, and community-level characteristics to determine their impact on child morbidity and malnutrition. Mahmood and Kiani (1994) conduct a similar regression analysis to isolate the effect of healthcare factors such as immunization, breastfeeding, sanitation, etc., on child survival rates in Pakistan.

A major shortcoming of studies on Pakistan is, however, that they do not take into account the possibility of endogeneity and omitted variables.[3] Our discussion of the literature above has established that a simple regression analysis of a complex subject such as health cannot produce accurate results. Using a sample of 1,000 households, Aslam and Kingdon (2010) study the effect of parental education on child health.[4] Their study provides an in-depth analysis and implements a fixed effects model and instruments to overcome the possible endogeneity that might bias the model, but the small sample size means that their results cannot be generalized for Pakistan as a whole.

This study aims to contribute to the existing literature on health in Pakistan by using a more sophisticated analysis than most other Pakistan-focused studies. We use the instrumental variable technique to identify the key determinants of health and the nutritional status of children in Punjab. This method helps isolate the impact of endogenous factors such as income, health knowledge, food intake, and community-levels of illness on child health. Furthermore, we use the most recent household-level dataset—the MICS for 2007/08—for estimation, which, to the best of our knowledge, has not been used by other studies on child health.

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[3] With the exception of Alderman and Garcia (1994), Alderman et al. (2001), Aslam and Kingdon (2010), and Iram and Butt (2006).

[4] The estimation technique followed in this paper may bear some similarities to Aslam and Kingdon (2010). However, since work on this paper started in 2009 as part of the author's MPhil thesis, any likeness to the former is coincidental.

3. A Theoretical Framework

Becker (1965) was responsible for putting "family" on the map of academic research in economics in the 1960s. The simplicity and applicability of his models demonstrate the practicality of research at the household level (Gronau, 1997; Grossman, 2003; Pollak, 2002). Most studies on health and nutrition employ the Beckerian model of household utility where utility is derived both from purchased and home-produced goods (Alderman & Garcia, 1994; Arif, 2004; Chen & Li, 2006; Glewwe, 1999; Handa, 1999; Kovsted et al., 2002; Thomas et al., 1991).

According to theory, households purchase goods and combine them with time into a household production function to produce commodities. The purpose of purchased goods and time is to serve as inputs to the acquisition of commodities, which, in turn, enter the household's utility function. For example, if "quality of children" is a commodity, then related inputs might include food, vaccinations, schooling, and parental time. Another example of a commodity is "sleep," which would depend on the availability of a bed, house, and time (Pollak & Wachter, 1975). Information on inputs is thus essential to estimate the parameters of the production function. Inputs and outputs can often be jointly determined. For example, unobserved—i.e., to researchers—sick individuals are more prone to using health-related inputs, which could cause the estimated results of health inputs to be biased downward (Behrman & Deolalikar, 1988). The simultaneity bias caused by joint input-output demands can be removed by implementing instruments such as prices into the function (Thomas et al., 1991).

Behrman and Deolalikar (1988) consider different cases of the household production model. The first case is that of a household-firm decision-making unit. The model consists of a household that maximizes a single-preference function subject to a set of constraints. A one-period model is considered such that the period is long enough to capture the effects of household choices on health. The model also assumes lack of uncertainty. As per the simple neoclassical household model, individuals are risk-averse and apt to recoil from choices that might bear uncertain consequences. Although "uncertainty" about decisions on health and nutrition may be a realistic argument, many studies fail to incorporate this into their models due to the complex estimation involved.

Behrman and Deolalikar's (1988) second case is that of a one-period household-firm model with constrained maximization of a joint utility function (p. 639). The household's preference function is:

$$U = U\left(H^i, C^p, C^i, T_L^i, E^{i/c}, S, \varepsilon\right),\ i = 1, 2, 3 \ldots . I \tag{1}$$

H^i is the health of household member i, C^i is the consumption of household member i with the superscript p referring to pure public goods, T_L^i is the leisure time of household member i, $E^{i/c}$ is the education level of household child i, S is the number of surviving children, ε stands for taste norms, and I is the number of individuals in the household. All these variables may consist of multiple dimensions.

The preference function is maximized subject to two sets of constraints for a given level of assets and prices: production functions and income constraints (the income constraint is less relevant to this study and will be touched on briefly). The constraint set of production functions can be subdivided into three categories: (i) production functions, which produce health and nutrition; (ii) functions where health and nutrition affect other outcomes; and (iii) functions in which neither health nor nutrition enter. We are interested in the first category.

Production functions determining health, mortality, and nutrient intake consist of choices made by and the education and endowments of the individual and of key persons in the household:

$$H^i = H(N^i, C^i, C^p, I, E^i, E^m, T_L^i, T_H^i, T_H^m, \eta^i, \Omega) \tag{2}$$

N^i is the nutrient intake of the ith individual, E^i is the education of the ith individual where the superscript m refers to the mother or caregiver's level of education. T_H^i is the time devoted to health-related procedures (the superscript m refers again to mother/caregiver). η^i refers to the individual's endowment—genetic makeup, age, and initial health—and Ω is the endowment of the household (general environment). All these variables are considered important in the determination of health (Behrman & Deolalikar, 1988).

When evaluating estimated results based on the production equation, some considerations need to be accounted for. As already mentioned, the possibility of a simultaneity bias due to joint demand for inputs and outputs must be taken into account. The system of instrumental equations can be useful in removing this endogeneity. The problem of omitted variables also needs to be noted since there may be a number of unobserved variables, which, if correlated with the included variables, can result in biased estimates (Behrman & Deolalikar, 1988). Another concern is that the distribution of resources across households might not be uniform, so that estimates based on household averages could be misleading. Finally, although the production functions represent a one-period framework for the purpose of simplicity, some inputs in the function could have lagged outcomes and so the estimated results may understate the impact of those variables (Behrman & Deolalikar, 1988).

The second set of constraints includes household-level income and time constraints (full-income constraints). The constraint equates income earned from all sources with the total expenditures of the household by incorporating the prices of all variables (Behrman & Deolalikar, 1988). The constrained maximization of preferences is often followed by reduced-form demand functions. Endogenous variables in the household model are dependent variables whereas the instruments and other exogenous variables fall on the right-hand side of the reduced-form demand functions. The aim is to determine the fitted values of endogenous factors, which can be entered into the production functions.

According to Alderman and Garcia (1994), unobserved heterogeneity at the household level can cause the observed variables to be correlated with the error term of the health production function. To curtail this problem, production functions and input demand functions should be estimated simultaneously (see also Behrman & Deolalikar, 1988). Modeling community variables makes it possible to capture the effects of unobserved factors that might influence household decisions. In the presence of heterogeneity, Alderman and Garcia assume the error structure of the health production and input demand functions to be

$$H_{vi} = Y_{vi}\alpha + \omega_{Hv} + \mu_{Hvi} \quad (3)$$

and

$$Y_{vi} = X_{vi}\delta + Z_v\tau + \omega_{Yv} + \mu_{Yvi} \quad (4)$$

H_i is the health of household member i subscript v denotes the village or community. Y_{vi} is any input into the production of health. Unobserved community characteristics affecting health production and input demand are represented by ω—since these factors may be different for both functions, different subscripts are used for each. μ reflects individual-specific health endowments that are exogenous to both functions. X represents household-specific variables and Z denotes community characteristics including prices.

Since community variables are mostly constant at the village level, it may be possible to adopt a community fixed-effects model, in which deviations from the village means are formulated. Since community effects across communities are assumed as fixed, the Z term is dropped. This approach, however, discourages the implementation of instruments in such a framework, especially since instruments for the Z vector are more easily available than those for vector X (Alderman & Garcia, 1994).

Alderman and Garcia (1994) adopt a slightly different approach. They include a cluster mean value[5] of the dependent variable in the input demand function as an explanatory variable for the same equation. The mean is expected to contain information on prices and infrastructure, which can help capture the effect of unobserved factors. According to the authors, cluster means are potent instruments in themselves—although they do not fully explain how prices and quality vectors affect community averages of the inputs, they do help in recognizing the role of different inputs in the production function. Furthermore, district dummies are included in the production functions in order to capture the effect of unobserved community-specific factors.

4. Description of Data and Summary Statistics

The MICS for 2007/08 is a household-level dataset comprising 91,075 households and over 592,843 listed members. The dataset encompasses 71,507 children under five and 70,266 child questionnaires that were completed in the survey. The MICS spans all 35 districts of Punjab and covers households from major cities, and both urban and rural areas. The data is representative at the *tehsil* (administrative unit) level. Enumeration areas were selected from the sample domains, from among which random samples were collected at the cluster level, each comprising 12 to 16 households (for more detail about the sample design, see Punjab Bureau of Statistics, 2009).

[5] This cluster mean value is exclusive of the household being estimated, which is why it is also known as a “nonself” cluster mean.

According to Thomas et al. (1991), children's weight tends to fluctuate in the short run and so is representative of their current health status. Height, on the other hand, is an indicator of stunting and reflects a child's health over a longer time horizon; height also captures the wealth effect on child health. Based on the choice of variables used in the literature, we measure child health in terms of the height and weight of children under the age of five. Children's height and weight levels are standardized according to the World Health Organization (WHO)'s international reference standards, which are based on a sample of children from developed and developing countries and provide a suitable reference for standardizing our sample of children by age and gender.

Based on data for Punjab, Table 1 shows that the mean z-score for height-for-age[6] (HAZ) in the sample is –1.83, which means that, on average, a child in Punjab is 1.83 standard deviations (SD) below the median for a child of the same age and sex from the reference population. About 26 percent of children in our sample are severely stunted, i.e., below –3 SD of the reference (National Health Service, 2010; WHO, 2010), and 20 percent are moderately stunted. According to the weight-for-age z-scores (WAZ), an average child in Punjab weighs about 1.38 SD less than an average child of the same age and sex from the reference population. However, the percentage of children who are severely underweight is much smaller than HAZ and stands at 11 percent of the under-five population.[7]

Table 1: Nutritional status of children in Punjab (aged 0–59 months)

Variable	Observations	Mean	SD	Moderate (–2 to –2.99 SD)	Severe (< –3 SD)
Height for age	63,695	–1.83	1.87	19.9%	26.2%
Weight for age	67,395	–1.38	1.39	18.3%	11.6%

Source: Based on author's calculations.

[6] We use the z-score values for height-for-age and weight-for-age. Children's height and weight are standardized according to the following formula: $Z = (x - \mu)/\sigma$, where x is the raw score and μ and σ are the mean and standard deviation, respectively (WHO, 2010).
[7] According to the WHO z-scores technique, z-scores that fall within an improbable range of standard deviations are flagged and dropped from the analysis. The flagged ranges are HAZ < –6 and HAZ > 6, and WAZ < –6 and WAZ > 5.

The summary statistics of the study's variables are presented in Table 2, categorized under five major classifications. Given the multidimensionality of health, it is important to include a wide array of variables to ascertain which factors are more likely to determine child health.

The category "household characteristics" includes choices made both at the individual and household level. A household's environment is captured by including information on income, parents' level of education, household size, and ownership of durables, etc. While household income is known to have a direct effect on children's health, sick children can negatively affect their parents' labor supply (Chen & Li, 2006). To remove this endogeneity or potential reverse causality, Kovsted et al. (2002) use the father's level of education and ownership of land as proxies for permanent income. Handa (1999) uses a set of instrumental variables such as ownership of durables, income from property, access to a telephone, type of residence, and material used to construct house walls.

Alderman and Garcia (1994) follow a similar approach. They estimate predicted annual expenditures per capita in order to determine long-run income. The instruments used to predict expenditures are: (i) total dry and irrigated landholdings, (ii) land in tree crops, (iii) value of vehicles, (iv) livestock and physical capital, (v) parents' education, and (vi) household size. The MICS 2007/08 provides information on income at the household level, as well as on several potential instrumental variables for income such as ownership of residence, land, livestock, durables, and type of residence.

The summary statistics show that over 90 percent of children under two in Punjab were breastfed, and that over 80 percent of children under five have been given vitamin A at least once in their lives and have BCG vaccination scars. About 17 percent of children under five had suffered diarrhea or coughs in the past two weeks. Over 12 percent of children were reported to have had a cough for 0.12 days on average in a two-week period, and about 7.6 percent of children had suffered diarrhea for 0.08 days in a two-week period (Punjab Bureau of Statistics, 2009).

Alderman and Garcia (1994) consider some of the early childcare variables to be endogenous and include community averages along with other variables as instruments. Their endogenous variables are: (i) the number of days a child has been ill with diarrhea in the last two weeks, (ii) the number of days a child has had any other illness in the last two weeks, (iii) whether a child was exclusively breastfed, (iv) whether a child has been vaccinated, and (v) whether a child was born in a hospital. They argue that the incidence of these variables at the community level will affect an individual household's likelihood of the same. For example, if a large number of children in the community have diarrhea, the possibility of diarrhea being transmitted from one child to another increases. Similarly, if in a particular locality the incidence of breastfeeding is high, it may positively influence other mothers to breastfeed their children. The same can be assumed about vaccinations and hospital births. Therefore, community practices can influence parents' actions either by disseminating knowledge about healthy practices or by influencing their decisions concerning healthcare measures.

Table 2: Descriptive statistics

Variable	Mean	SD	Observations
Height for age	–1.83	1.87	63,695
Weight for age	–1.38	1.39	67,395
Household characteristics			
Sex (female = 0, male = 1)*	0.51	-	71,510
Child's age in months	29.34	17.52	70,658
Log of total household income	8.84	1.48	71,510
Number of household members	8.23	3.75	71,510
Sex of household head (female = 0, male = 1)*	0.97	-	71,510
Number of rooms used for sleeping	2.19	1.24	71,405
Household owns radio/tape recorder*	0.37	-	71,261
Household owns television*	0.59	-	71,442
Household owns refrigerator/freezer*	0.37	-	71,407
Household owns bicycle*	0.50	-	71,314
Household owns motorcycle or scooter*	0.26	-	71,333
Household owns car or truck*	0.09	-	71,292
Household owns animal-drawn cart*	0.07	-	71,232
Mother educated up to primary level*	0.15	-	71,440
Mother educated up to middle level*	0.07	-	71,440
Mother educated up to secondary level*	0.10	-	71,440

Continued...

Variable	Mean	SD	Observations
Mother educated up to higher level*	0.08	-	71,440
Household head educated up to primary level*	0.15	-	71,387
Household head educated up to middle level*	0.12	-	71,387
Household head educated up to secondary level*	0.17	-	71,387
Household head educated up to higher level*	0.09	-	71,387
Housing characteristics			
House has permanent/reinforced roof*	0.82	-	71,463
House has permanent/reinforced walls*	0.74	-	71,447
House has no or straw walls*	0.02	-	71,447
Wood, shrubs, coal, kerosene, charcoal, dung, or crop residue used as cooking fuel*	0.76	-	71,466
Access to electricity*	0.92	-	71,465
Prenatal, delivery, and early childhood care			
Child has been breastfed*	0.96	-	27,522
Child has been given vitamin A*	0.83	-	69,727
Child has BCG scar*	0.86	-	68,898
Child was born in a hospital*	0.36	-	47,296
Number of dead children	0.38	0.85	69,778
Number of stillbirths	0.08	-	68,255
Child has been ill with a cough in the last two weeks*	0.12	-	69,569
Child has had diarrhea in the last two weeks*	0.08	-	69,515
Lady health worker has visited household in the last month*	0.58	-	68,052
Health environment and community-level infrastructure			
Household has piped water*	0.18	-	71,370
Household has well dug inside or outside*	0.04	-	71,370
Household has access to spring, tanker, surface water, or other water source*	0.03	-	71,370
Household uses bottled water*	0.02	-	71,370
Household has flush toilet*	0.54	-	71,322

Continued...

Variable	Mean	SD	Observations
Household has pit latrine*	0.13	-	71,322
Type of nearest health facility (private = 0, public = 1)*	0.59	-	71,195
Solid waste disposal by municipal agency*	0.07	-	71,360
Solid waste disposal by waste management department*	0.01	-	71,360
Solid waste collected by private company vehicle from household site*	0.03	-	71,360
Distance to nearest health facility = within 29 minutes	0.74	-	71,119
Health knowledge and practices/access to information			
Has heard of HIV or AIDS*	0.29	-	70,254
Is aware of the use of iodized salt*	0.55	-	71,407
Has used a contraception method before*	0.38	-	69,021
Makes water safe for drinking*	0.05	-	71,329
Some household members wash their hands with soap after having used the toilet*	0.36	-	71,359
All household members wash their hands without soap after having used the toilet*	0.10	-	71,359
No household members wash their hands after having used the toilet*	0.06	-	71,356

Note: * = dummy variable: the mean represents the proportions for this variable.
Source: Based on author's calculations.

To gauge health knowledge at the household level, we use the results for a number of health-related questions asked as part of the MICS in order to determine how conscious people are about health-related issues. In our sample, less than 40 percent of people had never used a contraceptive and even fewer had ever heard about HIV/AIDS. Similarly, slightly more than half the sample population was aware of the use of iodized salt and even fewer were conscious of the importance of personal hygiene. Determining the impact of parents' health knowledge on their children's health is a relatively new approach and few studies have taken it into account. Kovsted et al. (2002) and Glewwe (1999) treat health knowledge as an endogenous variable and use the instrumental variables approach to control for the feedback effect.

Mortality selection in surveys has been noted as an endogenous variable as children entering the survey may not be a random sample of the children born, owing to the fact that only surviving children enter household/health surveys (Kovsted et al., 2002). However, this problem can be overlooked considering that children's health is measured at an early age and they may still face the danger of mortality after having been measured. Similarly, fertility selection bias refers to the fact that the children born are not a random sample of the potential number of births to a family since parents do not treat all the health outcomes of their children equally. Nevertheless, due to data limitations, not much can be done beyond acknowledging the existence of this problem.

5. Estimation Strategy

Our estimation strategy is based on the household production model. The selection of explanatory variables given in Table 3 is drawn from the choice of variables in the literature and the availability of those factors in the MICS 2007/08.

We estimate two regression equations. The potentially endogenous variables discussed in Section 4 are instrumented according to Alderman and Garcia's (1994) methodology. The two-stage least squares approach is applied as follows: (i) the endogenous explanatory variable is regressed on one or more suitable instruments that are correlated with the endogenous variable and uncorrelated with the error term of the main equation; and (ii) the fitted values of the endogenous variable from the first estimation are used to estimate the main equation.

The two equations estimating the nutritional status of children are

$$Y_i = \beta_0 + \beta_1 H_i + \beta_2 K_i + \beta_3 P_i + \beta_4 E_i + \beta_5 A_i + \varepsilon_1 \quad (5)$$

$$W_i = \alpha_0 + \alpha_1 H_i + \alpha_2 K_i + \alpha_3 P_i + \alpha_4 E_i + \alpha_5 A_i + \varepsilon_2 \quad (6)$$

Y_i is the HAZ and W_i the WAZ of child i in the household (children under five are considered for the entire analysis). H_i is a vector for household characteristics; K_i represents housing characteristics; P_i denotes prenatal, delivery, and early childhood care; E_i comprises health, environment, and community-level infrastructure; A_i is health knowledge and practices and access to information; and ε_i is the error term.

6. Results and Empirical Findings

In the first-stage regression, we use simple OLS to estimate the three endogenous variables and their instruments (see Table A1 in the Appendix). Of all the possible endogenous variables, three (income, diarrhea, and vitamin A supplements) fail the exogeneity test and are, therefore, instrumented. The standard Durbin-Wu-Hausman and over-identification tests are used to test the necessity and validity of the instruments for instrumental variable estimations.[8]

The instruments used for income are ownership and size of agricultural land, type of dwelling, ownership of residence, and livestock. All the instruments are significant for income and are positively related to income at the household level. The instrument for vitamin A intake is the community-level intake of vitamin A excluding households' own observations. The joint F-statistic for all the sets of instruments for the endogenous covariates is far greater than 10, which implies that these instruments are highly relevant.

Following Alderman and Garcia's (1994) methodology, we use the nonself community average for diarrhea incidence and the interactive dummy variables of mothers' education and community prevalence of diarrhea as instruments for diarrhea. However, the instruments' signs are not in line with theoretical reasoning. Higher levels of diarrhea prevalence in the community should increase the likelihood of a child being prone to diarrhea. Similarly, children with better educated mothers should be less likely to suffer diarrhea.

These incorrect signs can, however, be attributed to the following factors. The MICS dataset records morbidity as recalled for the last two weeks for every child in the household, and recall error can drastically affect the quality of data. Moreover, if the respondent is not the child's mother, illness recall may be even more unreliable. Finally, the definition of illness can vary across households from different socioeconomic backgrounds. The positive correlation between the maternal education interaction dummy and incidence of diarrhea could

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[8] The Durbin-Wu-Hausman test determines the endogeneity of the suspected variable and, therefore, establishes whether or not an instrumental variable analysis is necessary. The Hansen J-test of over-identification is relevant whenever an endogenous variable is over-identified, i.e., when the number instruments is greater than the number of endogenous variables. The J-test determines if the instruments are correlated with the structural equation's residuals, in which case the instruments become invalid (Wooldridge, 2002).

be because educated mothers are better able to recall their children's illnesses than illiterate mothers.

All estimations are controlled for heteroscedasticity of unknown form by implementing robust standard errors at the cluster level. District dummies are included in all regressions to control for affective factors at the district level. Urban district dummies are created by interacting district dummies with an urban-rural dummy variable—these are included as control variables. In the second-stage estimation, the predicted values from the first-stage regressions are used as exogenous indicators along with other explanatory variables. The regression results for children's WAZ and HAZ are reported in Table 3.

The signs of majority of the variables in the estimated equations are in accord with the literature on child health. Columns 1 and 2 give the estimation results for children's HAZ and WAZ—a 1-percent increase in a household's predicted income leads to an increase of 0.21 and 0.23 SD in children's height and weight, respectively. Similarly, a percentage increase in income transfers (remittances, pensions, and government transfers) has a significant positive effect on children's physical wellbeing. As expected, parental education has a positive effect on children's short- and long-term nutrition. Given that higher levels of education could translate into greater income levels for both parents, including household income allows us to capture the true impact of education. The results imply that the impact of mothers' education on child health is both significant and positive.

Table 3: Determinants of child health: Second-stage results

	Height for age (z-score)		Weight for age (z-score)	
Independent variable	**Coefficient**	**t-statistic**	**Coefficient**	**t-statistic**
Household characteristics				
Household income [p]	0.207	3.22***	0.232	4.70***
Income transfers to household	0.014	3.44***	0.016	5.27***
Child suffered from diarrhea in the past two weeks [a]	0.535	2.95***	–0.145	–5.96***
Child has suffered from cough in the past two weeks	0.013	0.51	–0.015	–0.73
Child's age in months	–0.086	–5.57***	–0.025	–2.18**
Age squared	0.001	5.94***	0.0003	1.92*

Continued...

	Height for age (z-score)		Weight for age (z-score)	
Independent variable	**Coefficient**	**t-statistic**	**Coefficient**	**t-statistic**
Sex (female = 0, male = 1)	–0.086	–5.60***	–0.110	–9.85***
Number of household members	–0.033	–4.53***	–0.033	–5.87***
Sex of household head (female = 0, male = 1)	–0.663	–3.75***	–0.633	–4.70***
Wealth index	0.058	1.75*	0.014	0.57
Household owns radio/tape recorder	–0.008	–0.42	–0.022	–1.51
Household owns television	0.061	2.90***	0.029	1.84*
Household owns refrigerator/freezer	0.089	3.23***	0.063	3.11***
Mother educated up to primary level	0.073	2.75***	0.014	0.75
Mother educated up to middle level	0.101	2.84***	0.082	3.07***
Mother educated up to secondary level	0.175	4.41***	0.051	1.70*
Mother educated up to higher level	0.271	4.62***	0.181	4.11***
Household head educated up to primary level	0.024	0.96	0.031	1.66*
Household head educated up to middle level	0.007	0.26	0.052	2.52**
Household head educated up to secondary level	0.032	1.18	0.026	1.28
Household head educated up to higher level	0.057	1.41	–0.007	0.24
Prenatal, delivery, and early childhood care				
Child has been given vitamin A [p]	0.032	0.09	0.275	1.06
Child has BCG scar	0.028	1.13	0.020	1.05
Number of stillbirths	0.011	0.46	0.015	0.85
Number of dead children	–0.037	–3.80***	–0.013	–1.70*
Lady health worker has visited household	–0.031	–1.27	–0.046	–1.45
Health environment and community-level infrastructure				
Household has piped water	–0.011	–0.43	–0.017	–0.90
Household has well dug inside or outside	0.011	0.24	0.013	0.38

Continued...

	Height for age (z-score)		Weight for age (z-score)	
Independent variable	**Coefficient**	**t-statistic**	**Coefficient**	**t-statistic**
Household has access to spring, tanker, or surface water	–0.013	–0.24	–0.066	–1.67*
Household uses bottled water	–0.044	–0.57	–0.043	–0.71
Household has flush toilet	0.123	4.67***	0.088	4.52***
Household has pit latrine	0.014	0.43	0.047	1.98**
Solid waste disposal by municipal agency	0.119	2.67***	0.098	3.15***
Solid waste disposal by waste management department	0.218	2.62***	0.099	1.48
Solid waste collected by private company vehicle	–0.107	1.52	0.110	2.23**
Distance to nearest health facility = within 29 minutes	0.026	1.08	0.020	1.15
Type of nearest health facility (private = 0, public = 1)	–0.015	–0.59	–0.053	–2.87***
Health facility * urban dummy	0.012	0.27	–0.145	–0.44
Area (rural = 0, urban = 1)	–0.185	–1.69*	–0.093	–1.31
Health knowledge and practices/access to information				
Makes water safe for drinking	0.011	0.25	0.024	0.75
Some household members wash their hands with soap after having used the toilet	–0.001	–0.03	–0.031	–1.93*
All household members wash their hands without soap after having used the toilet	–0.017	–0.50	–0.047	–1.81*
No household members wash their hands after having used the toilet	–0.038	–1.03	–0.089	–3.04***
Has used a contraceptive method	0.015	0.62	0.039	2.91***
Has heard of HIV or AIDS	0.098	3.95***	0.083	4.45***
Is aware of the use of iodized salt	0.073	3.66***	0.061	4.07***
R^2	0.1110		R^2	0.0708
F (114, 6169)	39.62		F (114, 6184)	28.20
N	55,135		N	58,074

Note: * = significant at 10 percent, ** = significant at 5 percent, *** = significant at 1 percent, a = predicted value for HAZ, p = predicted value for HAZ and WAZ.
Source: Based on author's calculations.

In the case of working mothers, the income effect of their level of education is captured by the household income variable and the direct impact of their level of education is transmitted through efficient child-rearing practices and information acquisition. Children whose mothers have been educated up to primary level are taller by 0.07 SD compare to children with illiterate mothers. Since primary education is not sufficient to open up the job market to women, this level of education influences child rearing mostly through better maternal practices. As mothers' level of education rises, children's HAZ scores increase progressively by up to 0.27 SD for those whose mothers have received higher education. This indicates that, over the years, educated mothers are better able to nurture their children than uneducated women. The current health status of children is significantly improved when their mothers are educated up to middle[9] and higher level, with WAZ scores increasing by 0.08 and 0.18 SD, respectively.

Since information on fathers' education is not available, we use the household head's level of education. Household heads educated up to primary and middle level effect an increase in children's weight by 0.03 and 0.05 SD, respectively. Household-level income is likely to capture part of the impact of the household head's level of education on child health, which is why the former does not emerge very strongly in the estimations. Controlling for wealth and income, the mother's level of education has a greater impact on child health than the household head's at almost every education level.

The sickness variables of cough infections and diarrhea are also included as explanatory variables for child health. Cough infections do not emerge as a significant explanatory variable, but diarrhea has a strong negative effect on weight. When the predicted values of the diarrhea variable are used to calculate HAZ, the coefficient has the incorrect sign. When the unpredicted values of the diarrhea variable are used to estimate HAZ, the diarrhea dummy becomes insignificant and has a negative coefficient. The incorrect results generated when using the predicted diarrhea dummy are perhaps a consequence of poor-quality data.

Child height-for-age varies considerably with child age (in months), which is consistent with other studies on Pakistan as well as other countries (see,

[9] Primary level = grades 1–5, middle level = grades 6–8, secondary = grades 9–10, higher = grades 11–12, and tertiary = above grade 12.

for instance, Alderman & Garcia, 1994; Chen & Li, 2006; Glewwe, 1999; Handa, 1999). This is because malnutrition rises with age for children in the first two years of life: their main source of nutrition at this stage is breast milk; once weaning ends, malnutrition levels off and may even decline with age (Glewwe, 1999). The gender dummy for children is negative but significant, which implies that there is no discrimination against female children and, on the contrary, male children are more likely to be undernourished. This may be due to social factors where male children are allowed to spend more time outside the house playing or participating in other activities compared to female children.

The coefficients of household size for HAZ and WAZ are negative (–0.03 and –0.03, respectively) showing that being born into larger households has a strong adverse effect on children's health. As already mentioned, this can be attributed to congestion and that, when scarce resources are distributed among more family members, children—as the most vulnerable group—tend to suffer most. The presence of a male household head has a strong negative effect on children's height and weight z-scores; this contradicts the literature where it is assumed that female-headed households are poorer and that children should, therefore, be weaker. However, the contradiction is explained when examining the data: over 96 percent of households in Punjab are male-headed (Punjab Bureau of Statistics, 2009) and since there is not enough variation in the dataset the result from the variable cannot be generalized for Punjab.

Among household durables, ownership of a refrigerator positively affects children's growth and weight as it allows households to store food longer and, therefore, induce better-quality nutritional intake. Although television ownership does not directly affect children's physical wellbeing, its presence in a household appears to increase children's height and weight by 0.06 and 0.03 SD, respectively. This could be for two reasons: first, owning a television implies financial wellbeing, even if nominal; second, television can be a source of health-related knowledge for some parents and thus have a positive spillover effect on children's health.

A wealth index comprising housing conditions and household assets[10] is created using the principal component analysis. A 1-percent rise in the

[10] The wealth index comprises the following variables: Number of rooms used for sleeping; ownership of bicycle, motorcycle/scooter, car/truck, or animal-drawn cart; household with finished roof and/or walls; and type of fuel used for cooking.

wealth index increases a child's height by 0.06 SD. The wealth index also has a positive effect on WAZ, but the result is not statistically significant. In another set of estimations, variables employed in the wealth index were included as independent exogenous variables: ownership of a motorcycle reflected a strong positive effect on children's long- and short-term health, possibly because owning a motorcycle is not only indicative of financial wellbeing, but also means that, in case of illness, children can be more easily transported to a health facility.

Neither vitamin A intake nor BCG vaccination have a significant effect on children's z-scores. As previously mentioned, this could be because the majority of children in the MICS sample had already received vitamin A supplements and been vaccinated, and so the indicators do not show enough variation across the observations. As expected, the number of dead children has a significant and negative effect on the WAZ and HAZ of a mother's surviving children. Although data on the cause of death among such children is not available, one could assume that, if death had occurred due to inherited conditions, household environment, or poor parenting owing to lack of knowledge or concern for children, these factors would continue to adversely affect the household's surviving children.

The z-scores for height and weight improve by 0.12 and 0.09 SD in households with flush toilets (connected to a sewer or septic tank). The strong impact of a toilet facility on children's wellbeing highlights the importance of sanitation at the household level. Access to a pit latrine in the house also improves children's WAZ compared to children without access to proper toilet facilities. Effective waste management also emerges as an important variable: The results in Table 3 show that children in households whose waste is collected by municipal institutions, waste management departments, or private vehicles have higher z-scores for height and weight than children living in households where waste is dumped in open streets and fields.

Interestingly, access to a nearby public rather than private health facility reduces a child's WAZ by 0.05 SD, suggesting that private health facilities offer better services than public facilities and, therefore, have a statistically strong positive impact on children's short-term health. Living near a city or urban area has a negative effect on child health: The area dummy has a negative coefficient both for height and weight z-scores, but the results are significant only for the former and translate into a 0.19-SD decline.

Parental knowledge of general health concerns is gauged by questions on their awareness of the use of iodized salt and of HIV/AIDS. In our sample, health knowledge and practices have a very strong positive impact on children's short- and long-term health status. The use-of-iodized-salt and HIV/AIDS dummies are significant at 1 percent both for HAZ and WAZ, indicating that parents with greater health awareness are liable to raise healthier children. Contraceptive use has a positive effect on children's WAZ—an increase of 0.04 SD. Households where only some or no members wash their hands with soap after using the toilet appear to have weaker children (with a lower WAZ) than households where the practice is common to all members. A household's daily sanitary habits (or lack thereof) can cause simple illnesses and have a significant effect on children's short-term—but not necessarily long-term—wellbeing.

Table A2 in the Appendix presents a parsimonious model that comprises fewer variables of interest. While the importance of maternal and household head education has already been established, the estimated coefficients of these variables increase in size and significance in the parsimonious model. As in the main model, the impact of mothers' education on child health is much larger than that of the household head, controlling for household wealth and income. Similarly, the wealth index, which was not previously significant for WAZ, is now significant at 1 percent for both HAZ and WAZ. This could be because the index used in the parsimonious model now captures the effect of excluded household-level variables such as durables, community infrastructure, and environment. Households' predicted income has a significant but smaller impact on height and weight z-scores than in the main estimation model. Finally, the estimated coefficient for the type of health facility closest to a household does not change much for the height and weight equations, and remains significant only for WAZ.

7. Conclusion and Policy Recommendations

This working paper has examined the determinants of child health in Punjab, using the instrumental variables approach. The results show that income, whether in the form of money generated by household members or that of transfer payments, has a direct effect on children's wellbeing. While this might not be a novel finding, it does reiterate the drastic effects of poverty on child health. In our estimations, housing characteristics is the richest category in terms of number of indicators, as well as their significance on height and weight z-scores. Since children under the age of five are not of school-going age and can be expected to spend most of their time within the domain of their homes, household dynamics—the number of household members, ownership of durables such as televisions and refrigerators, and mothers' level of education—prove to significantly affect the health of children in that household.

The effect of the surrounding environment and community-level infrastructure on our estimates is transmitted mainly through the sanitary disposal of waste. Proper waste disposal can be extremely effective in curtailing the spread of communicable diseases that can be life threatening for children. Moreover, household members' personal hygiene, which we have gauged as the practice of washing hands with soap after using the toilet, also has a significant impact on children's current health. Prenatal to early childhood care variables—apart from the number of deceased children born to a mother—do not surface as significant variables in our estimated results, although this cannot undermine the importance of prenatal/antenatal care for children. Since most of the prenatal and antenatal care questions included in the MICS for 2007/08 cover children below the age of two, we have not included these variables in our study owing to sample attrition.

Some interesting conclusions can be drawn from the study's empirical results. The impact of mothers' education on the wellbeing of children in Punjab reaffirms the findings of other studies on this topic. Educated mothers have healthier children and this positive impact has a long-term effect on child health. The impact of maternal education is transferred through better nurturing and domestic practices. This result has an important implication for policymaking as it suggests that female education and child health are interrelated goals—educating women today has a causal effect on the health of the next generation.

Parents' knowledge of health practices and its impact on their children's wellbeing is a relatively untapped albeit emerging area of research, especially in Pakistan's context. Some basic questions asked of respondents in the MICS 2007/08, e.g., on the use of iodized salt and knowledge about HIV/AIDS, have produced significant results: parents who are more aware about health issues have healthier children. While it is true that a more detailed survey on parental health knowledge would better support this argument, our study's results strongly imply that better access to information can translate into better child-rearing practices. By creating public awareness of health-related issues, especially regarding prenatal and antenatal care, the state can improve Pakistan's abysmal child and maternal mortality rates. Television and radio, for instance, are accessible even in the most underdeveloped communities in Punjab and in Pakistan at large, and would serve as efficient and economical instruments of information dissemination to rural and remote communities.

Although it is generally presumed of South Asian countries that female children face more discrimination than male children at the household level, our results reject this presumption on the grounds that male children—at least under the age of five—have lower z-scores than female children. On the healthcare front, even though the results for BCG vaccinations and vitamin A intake are not significant, that the majority of children in Punjab are now being immunized and vaccinated is commendable.

Appliance ownership in Punjab has surged over the past few years: Ownership of refrigerators/freezers has increased from 27.9 percent in 2003/04 to 40.3 percent in 2007/08 (Punjab Bureau of Statistics, 2009). This may be due to increased access to credit, which has allowed households to purchase durables on the basis of installments. A household's ownership of a motorcycle or scooter is also seen to improve children's wellbeing. Although such durables are not direct inputs to nutrition, their ownership has positive spillover effects on child health. Complementary policies, such as microfinance or easy installment schemes, can thus prove to be beneficial.

Apart from the recommendations above, this paper has highlighted the importance of overall social developments in child health. Children are not only affected by their food intake or the kind of prenatal care they get, they are also sensitive to factors that go beyond the domain of the household. There is need to expand the parameters of research on child health and focus on areas that are yet untapped: intergenerational effect of education on child health, channels through which health knowledge is transmitted and what kind of knowledge is most useful, the significance of community networking in information dissemination, impact of contraception and birth spacing on child health. Moreover, this study has focused on Punjab, and although some results can be generalized for Pakistan, there is need to study each region separately so that effective policies are designed to target the constraining factors.

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Appendix

Table A1: Determinants of child health: First-stage instrument equations

Independent variable	Log of income	Diarrhea	Vitamin A
Ownership of agricultural land	0.211 (10.00)***	-	-
Size of agricultural land	0.004 (2.09)**	-	-
Independent house/compound	0.072 (3.63)***	-	-
Ownership of house	0.047 (2.40)**	-	-
Livestock	0.088 (4.76)***	-	-
Nonself community average	-	–0.049 (–2.19)**	0.194 (13.50)***
Community prevalence of diarrhea x mother's education (primary)	-	0.066 (16.30)***	-
Community prevalence of diarrhea x mother's education (middle)	-	0.069 (12.26)***	-
Community prevalence of diarrhea x mother's education (secondary)	-	0.078 (16.81)***	-
Community prevalence of diarrhea x mother's education (higher)	-	0.072 (12.40)***	-
	F (80, 6255) = 118.5	F (80, 6200) = 48.8	F (79, 6197) = 309.75

Note: * = significant at 10 percent, ** = significant at 5 percent, *** = significant at 1 percent. Figures in parentheses are t-values.

Table A2: Parsimonious model of determinants of child health: Second-stage results

	Height for age (z-score)		Weight for age (z-score)	
Independent variable	**Coefficient**	**t-statistic**	**Coefficient**	**t-statistic**
Household income [p]	0.077	1.88*	0.086	2.68***
Wealth index	0.150	4.08***	0.102	3.59***
Mother educated up to primary level	0.201	8.19***	0.118	6.65***
Mother educated up to middle level	0.296	9.11***	0.235	9.93***
Mother educated up to secondary level	0.425	12.89***	0.261	10.73***
Mother educated up to higher level	0.622	14.38***	0.475	14.84***
Household head educated up to primary level	0.039	1.66*	0.049	2.78***
Household head educated up to middle level	0.039	1.42	0.077	3.90***
Household head educated up to secondary level	0.097	3.77***	0.096	5.00***
Household head educated up to higher level	0.154	4.13***	0.125	4.64***
Type of nearest health facility (private = 0, public = 1)	–0.014	–0.70	–0.048	–3.30***
Area (rural = 0, urban = 1)	–0.034	–0.34	0.053	0.75
R^2	0.054		R^2	0.056
F (80, 6339)	29.22		F (80, 6350)	32.09
N	62, 338		N	65, 925

Note: * = significant at 10 percent, ** = significant at 5 percent, *** = significant at 1 percent, p = predicted value.

Table A3: Parsimonious model of determinants of child health: First-stage instrument equations

Independent variable	Log of income
Ownership of agricultural land	0.186
	(8.00)***
Size of agricultural land	0.005
	(2.33)**
Independent house/compound	0.218
	(9.94)***
Ownership of house	0.048
	(2.25)**
Ownership of livestock	0.207
	(9.82)***
	F (83, 6356) = 81.74

Note: * = significant at 10 percent, ** = significant at 5 percent, *** = significant at 1 percent. Figures in parentheses are t-values.

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