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M. Phil Economics Thesis

An Economic Analysis of the Determinants of Health and Nutritional Status of Children in Punjab

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Abstract

Child health is considered a key indicator of the quality of life as well as economic development in developing countries. It is also closely related to other development indicators such as adult health, educational attainment, income, socioeconomic status and occupational productivity. In the past few years, despite having clear health targets in the form of Millennium Development Goals, Pakistan has been unable to attain significant progress in child and maternal health. This study attempts to determine the factors that affect child health in Punjab. The theoretical framework is based on the household production model and the instrumental variable technique has been implemented for estimation. The household level dataset of Multiple Indicator Cluster Survey (MICS) 2007-08 has been used for this study. From the estimation results, maternal education and health knowledge surface as important determinants of child health among other significant indicators.

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Introduction

Provision of better health and nutrition are fundamental goals of most developing countries. These goals are not just predecessors of growth but are important achievements in themselves. Assuming that human capital is strongly affected by the health and nutritional status of the labor force, countries which are on the path to increasing productivity and economic development cannot succeed without undertaking the real challenge of physical and mental wellbeing of its population.

Child health is considered a key indicator of the quality of life, as well as economic development in developing countries. It is also closely related to other development indicators such as adult health, educational attainment, income, socioeconomic status and occupational productivity (Chen and Li, (2006), Case et. al. (2002), Glewwe (1999)). In 2000, 189 member countries of the United Nations adopted the Millennium Development Goals (MDGs) and at least four out of eight goals directly addressed the issues of child health or nutritional status (Chen and Li, 2006)[1].

Pakistan is also a signatory of the Millennium Development Goals and much of its health policy revolves around achieving the objectives laid out by the United Nations mandate. With slowing growth rates, rising food prices and unstable social conditions, the country is struggling through its journey to achieving most of the goals. On the poverty front, in 1990-91, Pakistan's percentage of poor population according to the head count ratio was 58.5%. The target according to the MDGs is to halve this percentage by the 2015 (UNDP Pakistan). According to the Pakistan Economic Survey 2009-10, Pakistan achieved this goal in 2005-06 with a head count ratio of 22.3%. Although, there has been progress in curbing absolute

[1] The goals are: reduce child mortality, improve mother's health, combat diseases and eradicate hunger

poverty, there are other dimensions of poverty which must also be considered. Eradication of hunger is also part of the MDGs, and the target is to halve the proportion of underweight children under 5 years and population below the minimum level of dietary energy consumption. According to the UNDP –Pakistan and Ministry of Health (National Nutrition Survey 2001-02) both these indicators worsened during the period of 1990-91 to 2001-02. The proportion of underweight children under 5 rose from 40 to 41.5% and that of population below the minimum level of dietary energy consumption increased from 25 to 30%. Currently about 38 percent of children less than five years are underweight and 12 percent are severely underweight (Economic Survey 2010-11).

Curtailing the infant mortality rate is another central objective of the government. According to the Population Reference Bureau's 2009 World Population Data Sheet, household surveys in Pakistan show some progress in the area of child health during the period 1991-2007. The coverage of immunization for five recommended diseases among children below 1 year reached 47% in 2007 (from 22% in 1990). Also, delivery of babies in health facilities rose from 13% in 1990-91 to about 33% by 2007 (Population Data Sheet, 2009). However, Pakistan still has a long way to go before it can achieve the MDGs. Today, Pakistan has an infant mortality rate of 63.3 per thousand live births and the goal is to reduce this rate to 40 by 2015. The child mortality rate of children under 5 is 89 per 1000 and to meet the target this rate should come down to 52 by 2015 (Pakistan Economic Survey 2010-11). Furthermore, when compared to other developing countries in the region, Pakistan's performance is alarming. Pakistan's figures for infant and child mortality, life expectancy and population growth rates are worse than those of Sri Lanka, Nepal, China, Indonesia, Thailand, Philippines and Malaysia, and with the exception of life expectancy, India and Bangladesh as well (Pakistan Economic Survey, 2009-10). Improvement in maternal health

and prevention of diseases are also part of the MDGs. Several targeted public health programs such as the National T.B. Control Program, Expanded Program on Immunization and National Program for Family Planning and Primary Health Care are currently in progress at the rural and urban levels (Pakistan Economic Survey, 2009-10).

This study derives its relevance in the backdrop of the above discussion. Identifying the key determinants of child health is crucial for pertinent and well-targeted health policies. Once the issues are identified, only then can Pakistan attain the MDGs and more. The main data source for this study is the Multiple Indicator Cluster Survey (MICS) 2007-08. The MICS 2007-08 for Punjab is a cross-sectional micro-level dataset. It was conducted by the Punjab Bureau of Statistics, and consists of household surveys of over 90,000 households and 70 indicators at the Tehsil level. It comprises of comprehensive sections on child and maternal health and is therefore, ideal for a study on health.

Literature Review

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

Among the various determinants of child health, parents' education, particularly mother's education, has been the focus of several studies. The importance of mother's education in better child nutrition and health is well established (Aizer and Stroud (2010), Glewwe (1999), Thomas, Strauss & Henriques (1991), Barrera (1990), Behrman & Deolalikar (1988)). Yet, despite the accepted importance of maternal education on children's wellbeing, most papers have failed to identify the underlying mechanisms through which education impacts health (some exceptions are Glewwe (1999) and Thomas et. al. (1991)). Thomas et.al. (1991) identify three mechanisms through which mother's education might affect child health.

The most obvious instrument of influence is enhanced earning capabilities or permanent income, followed by improved cognitive abilities and constructive community interaction (Thomas et.al 1991). Additionally, education can also help mothers attain up-to-date information on modern health facilities and treatments for various diseases, which directly translate into improved health of children (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 (Thomas et.al, 1991, Glewwe, 1999). 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 assist in obtaining health knowledge outside the classroom.

Kovsted et.al. (2002) point out that most studies of child health use data from areas where malnutrition is widespread. Therefore, conclusions drawn from such studies could have limited application in areas where malnutrition is low. The authors attempt to isolate the impact of parent's knowledge of child health, from the estimates of the effects of parental education on child health. Bandim, a district in Bissau (capital of Guinea-Bissau) is the area

of interest. This district is marked by high infant mortality instead of malnutrition. The conclusions drawn from this paper are in line with the recommendations made by Glewwe (1999) and Thomas et.al. (1991): Mother's education is not significant when health knowledge is accounted for.

An interesting observation is that health knowledge is endogenous. Parents with less healthy children are more likely to attain information on child health, as compared to parents with healthier children. Not taking this endogeniety into account would result in a downward bias in 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 have a complementary impact on the communities (Barrera, 1990). Hence, it is erroneous to expect the role of a variable to be the same across different societies; especially if the community and regional influences play an important role in the transmission of the variable's effect (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" (p185). Alderman et.al. (2001) study the effect of child health on rural school enrolments in four districts of Pakistan. The research uses longitudinal data from 1986 to 1991 collected by International Food Policy Research Institute (IFPRI). According to the authors, household decisions pertaining investments in children's human capital are reflected in both, health status and schooling performance of children. Most research studies on children's school enrolments and performance often tend to ignore the behavioral decisions behind the health status of children and include health as an exogenous variable in the model.

Such models are considered 'naïve' as their results tend to be biased. Once the 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 (Alderman et.al, 2001).

When determining the characteristics of child health, studies include not only child characteristics, but also household and community-level variables (Mosley and Chen (1984), Handa (1999), Thomas et.al. (1991), Alderman and Garcia (1994)). Even if a study is examining the impact of a particular factor (such as 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 geographic boundaries, studies on health must successfully identify important indigenous variables.

The proximate determinants framework establishes the influence of all socio-economic factors on child survival through five major categories. These categories consist of variables which increase the threat of morbidity and mortality in young children (Mosley and Chen, 1984). The first and most obvious category is of maternal factors such as age, parity[2] and birth interval. The health of the mother can directly impact the wellbeing of the fetus as well as infant survival after birth. Environmental contamination comes next, it takes into account different mediums through which diseases and infections are most likely to be transmitted to children. These mainly include air, water, contact (mostly through fingers), food and insect vectors (Mosley and Chen, 1984).

[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 and Varner, 2010)

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 (Mosley and Chen, 1984). Injury, whether accidental or intentional, may be considered as a random event, however, repeated patterns for particular regions could represent environmental hazards that are spatially indigenous. The last factor is of personal illness control, consisting of preventive as well as curative measures taken by individuals to avoid and fight diseases. These can be drawn from traditional practices that taboo certain types of behavior or modern forms of immunizations, prenatal and postnatal measures (Mosley and Chen, 1984).

In addition to the above mentioned factors, geography can also play a significant role in the social development of societies through the availability of essential minerals. A study done by Field, Robles and Torero (2008) examines the impact of iodine deficiency on the children's cognitive development. Iodine is a mineral that is produced in the ocean and consequently deposited in the soil. People in African countries like Tanzania suffer from iodine deficient disorders (IDD) due to the low mineral content in the soils (Field, Robles & Torero, 2008). The authors' study the impact of an Iodized Oil Capsule distribution program across Tanzania and 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 the pregnancy attained 0.36 to 0.51 years more of education compared to children with iodine deficiency. Furthermore, it is also highlighted that micronutrient deficiencies have a greater impact on the cognitive development of females as compared to that of males, since the female fetus is more sensitive to maternal thyroid deprivation (Field, Robles & Torero, 2008).

The role of income in the wellbeing of children has also been the focus of several studies (Case and Paxson (2010), Currie and Stabile (2003), Case et.al. (2002), Curtis et.al. (2001), Currie (1998), Behrman and Deolalikar (1987)). Case et. al. (2002) emphasize the existence of a gradient in health status which implies that wealthier people enjoy better health and longevity across the entire income distribution. The paper presents a strong positive relationship between family income and health status for children up to the age of 17 years. This correlation tends to get stronger as children grow older. Even though parental educational attainment dampens some impact of income, when education is controlled for, doubling income can increase the probability of a child having excellent health by 4 percentage points (Case et. al. 2003). Among children with any given chronic condition such as asthma, epilepsy, heart condition etcetera, children with chronic conditions belonging to wealthier backgrounds have better health than those from lower-income households. The authors' also establishes that, "…the buffering effect of income is cumulative (over years)…" (Case et. al. 2003, p1319). The study however, does not adequately reflect on the role of genetic transfer of diseases across generations. Additionally, Currie and Stabile (2003) stipulate that children belonging to low socio-economic status (SES) experience deteriorating health with age not because of lack of resources but mostly because of the greater frequency of adverse health shocks such as accidents and nutrition-related disorders like diabetes.

The intergenerational transmission of economic wellbeing on health is evident from the low stock of health endowment in children from lower income families (Currie, 2008). Some studies consider health stock at the time of birth as exogenous and genetically determined. However, recent studies indicate that fetal health is dependent on adult risk of disease. Low SES children are born with low health stocks due to the surrounding conditions at the time of birth instead of poor genetic endowment. This statement highlights the need for protecting 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 (1989) in their paper "Heterogeneity, Intrafamily Distribution, and Child Health" delve into possible unobserved sources of heterogeneity at the household level. They identify two sources of heterogeneity emerging from unobserved factors when determining the impact of parental behavior on child health. The first source of heterogeneity arises from differences in endowments at the household level in which behavioral decisions on resource allocations are made. These can be a result of different health conditions, for example mosquito infestation, parent's health endowments or sanitary conditions in the residential area. Taking into account such family or community fixed effects in the analysis can help overcome this problem (Rosenzweig and Wolpin, 1989). To control for heterogeneity, this study will follow the methodology of Alderman and Garcia (1994) and implement community averages as instruments for potentially endogenous variables. This approach intends to capture the effect of variables at the community level (which influence household decisions) that may be correlated to other exogenous variables and/or the error term and therefore curtail heterogeneity problems.

The second source of heterogeneity is attributed to the disparity in children's inherent endowments such as health or intelligence (Rosenzweig and Wolpin, 1989). Parents can be expected to invest in their children based on such factors. Studies often fail to capture such factors in their investigation (Rosenzweig and Wolpin, 1989). The authors explain this point by giving an example: it is established that breastmilk is crucial for an infant's health,

however, the amount of milk intake depends on the infants ability to suckle. Due to this, ill or immature infants may receive insufficient levels of breastmilk. If such factors are not taken into account, estimating the impact of breastfeeding on children's nutritional status can be biased upwards. Taking into consideration inter- as well as intra-household heterogeneity is therefore crucial for a sophisticated empirical analysis (Rosenzweig and Wolpin, 1989).

For Pakistan, health and nutritional status of children has been the examined to some extent (Iram and Butt (2006), Shafqat Shahzad (2006), Arif (2004), Alderman et.al. (2001), Mahmood and Kiani (1994), Alderman and Garcia (1994)). Most studies have conducted an analysis by adopting the simple Ordinary Least Squares (OLS) technique to determine the major factors affecting child health. Arif (2004) in his paper "Health and Poverty in Pakistan" implements an extensive selection of variables stemming from family, household and community-level characteristics to determine their impact child morbidity and malnutrition. Mahmood and Kiani (1994) conduct a similar regression estimation to isolate the effect of health care factors such as immunization, breastfeeding, sanitation, etcetera on child survival in Pakistan. A major shortcoming of studies on Pakistan (except Alderman (2001 and 1994), Iram and Butt (2006)) is that the possibility of endogeniety and omitted variables is not taken into account. From the above discussion of literature, it can be established that a simple regression analysis of a complex subject such as health cannot produce accurate results.

This research will contribute to the existing literature on health for Pakistan by conducting a more sophisticated analysis as compared to most of the more recent Pakistan-focused studies. It will implement an instrumental variables technique to identify the key determinants of health and the nutritional status of children in Punjab. This technique will assist in isolating the impact of endogenous factors such as income, health knowledge, food intake and

community-levels of illness on child health. Furthermore, it will use the latest household level dataset of MICS 2007-08 for estimation, which to the best of our knowledge, has not been applied by other studies on child health.

Theoretical Framework

Gary Becker is responsible for putting 'family' on the map of academic research in economics in 1960s. The simplicity and applicability of his models demonstrate the practicality of research at the household level (Pollak, (2002), Grossman (2001), Gronau (1997)). Most researches study health and nutrition by employing the Beckerian model of household utility where utility is derived from both, purchased and home-produced goods (Chen and Li (2006), Arif (2004), Kovsted et. al. (2002), Handa (1999), Glewwe (1999), Alderman and Garcia (1994), Thomas, Struass and Henriques (1991)).

According to theory, households purchase goods and combine them with time in a household production function to produce commodities. The purpose of purchased goods and time is to serve as inputs in acquiring commodities. Commodities in turn, enter the household's utility function. For example, if the 'quality of children' is a commodity, then the inputs can be food, vaccinations, schooling and parental time. Another example of a commodity can be 'sleeping' which is dependent on a bed, house and time (Pollak and Wachter, 1975). In order to estimate the parameters of the production function, information of inputs is essential. However, often inputs and outputs can be jointly determined. For example, unobserved (to researchers) sickly individuals are more prone to using health-related inputs. This can cause the estimated results of health inputs to be biased downwards. (Behrman and Deolalikar, 1988). The simultaneity bias caused by joint input-output demands can be removed by implementing instruments (Thomas, Strauss and Henriques, 1991).

Behrman and Deolalikar (1988) consider different cases of the household production model in their study. The first case is 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. Lack of uncertainty is also assumed in the model. As per the simple neoclassical household model, people are risk averse and tend to recoil from choices with uncertain consequences. Although 'uncertainty' about decisions on health and nutrition may be a realistic argument, but due to estimation complexities, studies often do not incorporate it into their models.

Behrman and Deolalikar (1988) next consider a one-period household-firm model with constrained maximization of a joint utility function (p 639).

The household's preference function is:

$$U = U(H^i, C^p, C^i, T^i_L, E^{i/c}, S, \xi), \quad i = 1, 2, 3 \ldots I \qquad (1)$$

Where H^i is the health of the household member i, C^i is the consumption of household member i, with superscript p referring to the pure public goods, T^i_l is the leisure time of the household member i, $E^{i/c}$ is the education of household child i, S is the number of surviving children, ξ are 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 briefly touched upon. The constraint set of production functions can be subdivided into three categories. These categories are: production functions which produce health and nutrition,

functions where health and nutrition affect other outcomes, and lastly functions in which health and nutrition do not enter. We are interested in the first category.

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

$$H^i = H\,(N^i, C^i, C^p, I, E^i, E^m, T^i_l, T^i_H, T^m_H, \Pi^i, \Omega) \qquad (2)$$

where N^i is the nutrient intake of the ith individual, E^i is the education of the ith individual and the superscript m refers to the mother or caregiver's education. T^i_H is the time devoted to health-related procedures (the superscript m refers to mother/caregiver)[3]. Π^i refers to the individual's endowment (e.g. genetic make-up, age, initial health) and Ω is the endowment of the household (general environment). All these variables are considered important in the determination of health. (Behrman and Delalikar, 1988).

When evaluating estimated results based on the production equation, there are some considerations that need to be accounted for. As already mentioned earlier, the possibility of simultaneity bias due to joint demand of inputs and outputs must be taken into account. The system of instrumental equations can be useful in removing this endogeniety. The issue of omitted variables also needs to be noted since there can be a number of variables which are not observed. If these variables are correlated with the included variables, it can result in biased estimates (Behrman and Deolalikar, 1988). Another cause of concern is that the distribution of resources across households may not be uniform, so estimates based on household averages may be misleading. Lastly, although the production functions represent a

[3] Information on the nature of occupation is missing, and it can affect health depending on the use of energy, so the use of time can be useful here. Also, the amount of time spent on leisure and health-related activities can directly impact health (Behrman and Deolalikar, 1988).

one-period framework for the purpose of simplicity, some inputs in the function can have lagged outcomes and so the estimated results may understate the impact of those variables (Behrman and Deolalikar, 1988).

The second set of constraints refers to the income and time constraints (full-income constraints) at the household level. The constraint equates income earned from all sources to the total expenditures of the household by incorporating prices for all variables (Behrman and Delalikar, 1988). Constrained maximization of preferences is often followed by reduced-form demand functions. Endogenous variables in the household model are the 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 fitted values of endogenous factors which can be entered in the production functions.

According to Alderman and Garcia (1994), unobserved heterogeneity at the household level can cause the observed variables to be correlated to the error term of the health production function. To curtail the issue of heterogeneity, production functions and input demand functions should be estimated simultaneously (Alderman and Garcia (1994), Behrman and Deolalikar (1988)). By modeling community variables, the effects of unobserved factors that influence household decisions can be captured. In the presence of heterogeneity, the error structure of the health production and input demand functions is assumed to be the following (Alderman and Garcia, 1994):

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

and

$$Y_{vi} = X_{vi}\delta + Z_{v}\tau + \omega_{Yv} + \mu_{Yvi} \qquad (4)$$

Where Hi is the health of household member i and subscript v denotes the village or community. Y_{vi} is any input that goes in to the production of health. Unobservable community characteristics affecting health production and input demand are represented by ω. These unobservable community factors may be different for both functions, therefore different subscripts are used. μ reflects individual specific health endowments that are exogenous to both the functions. Household specific variables are represented by X, and Z denotes community characteristics including prices.

Since the community variables are mostly constant at the village level, studies can adopt the community fixed effects model. In the fixed effects model, deviations from the village means are formulated and since community effects across communities are fixed, so 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, as compared to vector X (Alderman and Garcia, 1994). Alderman and Garcia (1994), adopt a slightly different approach. They include a cluster mean value[4] 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 assist in capturing the effect of the unobserved factors. According to the authors, cluster means are potent instruments in themselves. Although the cluster means 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[5]. Furthermore, in order to capture the effect of unobservable community-specific factors, district dummies are also included in the production functions (Alderman and Garcia, 1994).

[4] This cluster mean value is exclusive of the household being estimated, therefore it is also known as non-self cluster mean.
[5] Community averages will be discussed in more detail later in the paper.

Variable Description

Dependent Variables:

Strauss and Thomas (1995), in four simple words, explain why health is a complex area of research, "Health status is multi-dimensional" (p1908). Studying the health of human beings entails the consideration of all the dimensions of physical wellbeing. Child health is measured by the level of nutritional status and morbidity prevalent in the sample population. Nutrition level of children is standardized by weight and height according to the World Health Organization's international reference standards (Arif, 2004). It is established that food intake and absence of disease are crucial for growth and they interact in a complex manner (Alderman and Garcia, 1994). To gauge the status of health, four variables will serve as dependent variables in the estimation of our model.

According to Thomas et. al. (1991) weight of children 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 health for a longer time horizon. Also, height captures the welfare effect on health (Thomas et.al., 1994). Hence, the level of nutrition (or lack of malnutrition) among children is captured by:

-height for age

-weight for age

Most studies focus on the level of nutrition to determine health status. Height and weight are good indicators of health, however, morbidity or prevalence of disease can also serve as an indicator of physical wellbeing. Malnutrition coupled with disease can lead to higher mortality rates. Variables that can represent morbidity amongst children are:

-if the child has been ill with cough during the past two weeks

-if the child has had diarrhea in the past two weeks

Explanatory Variables:

Based on the choice of variables in the literature, this paper aims to conduct a detailed analysis, such that all the major categories of variables are employed in the estimation and the possibility of omitted variable bias is minimized. The categories are:

-Household Characteristics

-Housing Characteristics

-Prenatal, Delivery, Early Childhood Care

-Health Environment and Community-level Infrastructure

-Health Knowledge and Access to Information

Household Characteristics:

Consist of a set of variables that influence child health at the household level. Choices made within the domain of a household reflect household and individual characteristics. These variables tend to have a distinct yet significant impact on children's health and overall wellbeing. Sex of the child has been used as an explanatory variable in several studies. Based on the sex, it can be determined whether boys and girls are treated differently in a family unit (Kovsted et.al., 2002). Assuming that parental behavior affects the health of children with a lag, the age of the child becomes an important factor in determining health (Kovsted et.al., 2002). Furthermore, according to Alderman and Garcia (1994), age and its quadratic term are imperative in determining a child's susceptibility towards malnutrition as well as disease. As children grow older, they are able to break away from the threshold of malnutrition since they are able to feed and fend for themselves to some extent. We will include sex, age and age-squared in our regressions.

The importance of mother's education has been discussed and established in the literature review. Parental education has a positive and significant impact on children (Thomas et. al., 1991). Educated mothers are better caregivers and are able to benefit more from the public and community-level positive externalities (Chakrabarti, 2003). In some studies, father's education does not come out as significant; however, the presence of a father in the house can be expected to have a positive impact on child height (Handa, 1999). MICS has information on education for mothers and household heads.

The effect of mother's age on the health of her children can go either way. It is assumed that due to biological factors, increasing age at the time of delivery can result in decreased birth weight or other physical defects in children born. Alternately, with age, mothers tend to gain experience in child care and can therefore increase the survival of their offspring (Kovsted et. al., 2002). Parents' heights have been estimated in some studies to address the genetic impact of tall parents on their children's height. Glewwe (1999), states that health endowments vary across children and can be correlated to observed variables resulting in biased estimation of parameters. So, to factor-in the effect of health endowments, Glewwe (1999) includes parental heights in his estimations and concludes that parent's heights are positively correlated to the height of their children. Unfortunately, this paper cannot include parent's height and age variables due to data limitation.

Having a large number of siblings can negatively affect a child's health, as each child receives a smaller share of resources in terms of parent's time and money (Chen and Li, 2006). Birth order of children may also be important. If mother's learn from their experience and become better caregivers as they have more children, then, the first born may be worse off than its younger siblings. On the contrary, children born in the end order of large families

may suffer from poor health and malnutrition due to a strain on the household resources (Arif, 2004). Similarly, a large household size reflects congestion at the household level (Alderman and Garcia, 1994). However, if there are a larger number of adults in the household, it could result in greater pooled resources (as more members contribute to the household income) and caregivers per child. Number of persons per room is also an indicator of congestion in a house; it is expected to adversely affect the health of children. For our regressions, we have information on the number of children, household size and number of rooms for sleeping in the household.

Variables such as calories and proteins per capita directly affect health as they are reflective of food intake and contribute to the nutritional status of children and adults alike. Since measuring food intake directly can be challenging, nutrient availability can be proxied by including prices of food items such as wheat, rice, beef and eggs. The increase in food prices are expected to negatively affect calorie and protein intake (Alderman and Garcia, 1994). MICS 2007-08 dataset for not contain information on food intake nor on food prices. However, since our main measures of child health (height and weight) are cumulative indicators of health, the effect of food prices at a particular point in time can be expected to be negligible and are therefore ignored. Information on income, consumption, and expenditures per capita serves the purpose of estimating how financial wellbeing can influence physical wellbeing. Nonetheless, it should be noted that these variables are often misreported or missing from household surveys. In this study, we will include household income per month to control for financial inputs.

Table1A- Household Characteristics

Exogenous variable	Reference	MICS 2007-08
Sex of child	Chen and Li (2006), Kovsted, Portner & Tarp (2002), Alderman and Garcia (1994), Handa (1999)	✓
Age of child (in months)	Kovsted, Portner & Tarp (2002), Alderman and Garcia (1994), Handa (1999)	✓
Age squared	Chen and Li (2006), Handa (1999)	✓
Mother's education	Chen and Li (2006), Kovsted, Portner & Tarp (2002)	✓
Highest grade completed (primary and above)	Handa (1999)	✓
	Alderman and Garcia (1994)	
Father's education	Chen and Li (2006), Kovsted, Portner & Tarp (2002)	Household head's education
Highest grade completed (primary and above)	Handa (1999)	
	Alderman and Garcia (1994)	
Mother's age	Kovsted, Portner & Tarp (2002)	×
Mother's height	Glewwe (1999), (Alderman and Garcia (1994)	×
Father's Height	Glewwe (1999)	×
Number of siblings	Chen and Li (2006)	×
Birth order of the child	Arif (2004)	×
Household Size	Alderman and Garcia (1994)	✓
Persons per room	Arif (2004)	Rooms per HH
Calories per capita	Alderman and Garcia (1994)	×
Protein per capita		
Expenditures/capita	Handa (1999)	×
Expenditures/capita/per year	Alderman and Garcia (1994)	×
Log of Expenditure/capita	Handa (1999)	×
Per capita income	Chen and Li (2006)	Monthly Income at the HH level
Log of per capita income	Chen and Li (2006)	

Housing Characteristics:

These characteristics are incorporated to take into account the influence exogenous household factors on the health of children. Kitchen facilities can affect children's wellbeing when better hygiene and cooking amenities are included in the analysis. Ownership of a refrigerator reflects not only financial welfare of the house, but also the ability to store food in the summers. Electricity connection and the physical structure of a house (whether it is made of bricks and concrete or mud walls) represent financial wellbeing (Arif, 2004). According to the MICS 2007-07 over 90 percent of the households have access to electricity, which is why it may not be a variable of interest to this study. This study will include type of fuel used for cooking, house structure and type of dwelling to control for housing characteristics.

Table 1B- Housing Characteristics

Exogenous variable	Reference	MICS 2007-08
Exclusive Kitchen Share Kitchen No kitchen	Handa (1999)	✗ What type of fuel is used in the kitchen
Refrigerator	Handa (1999)	✓
Electricity	Arif (2004)	✓
Type of Housing (Pakka)	Arif (2004)	✓

Prenatal, Delivery, Early Childhood Care:

These variables are known to affect an infant at the time of birth and during early childhood years. Children who are breastfed are expected to be healthier and less prone to diseases as compared to children who are not. Similarly, children born in hospitals are expected to be delivered in better and safer conditions. It is common knowledge that vaccinations to diseases are necessary to increase resistance against infections and fatal illnesses. Furthermore,

according to the World Health Organization, Vitamin A is essential for the development of the immune system and healthy growth of children.[6] Alderman and Garcia (1994) use Vitamin A as a proxy for nutrient availability and food intake. MICS 2007-08 has information on all four of these variables.

Table 1C- Prenatal, Delivery, Early Childhood Care

Exogenous variable	Reference	MICS 2007-08
If child has been breast fed exclusively	Alderman and Garcia (1994)	✓
If child was born in a hospital	Alderman and Garcia (1994)	✓
Vitamin A (retinol equivalent) per capita	Alderman and Garcia (1994)	✓
If child has been vaccinated	Alderman and Garcia (1994)	✓

Health Environment and Community-level infrastructure:

This category captures the effect of the surrounding environment on the wellbeing of a child. Distance to the nearest private or public health clinic reflects the cost of seeking healthcare. Child health status is expected to fall as the travel time to health facilities increases (Handa, 1999). Thomas et. al. (1991), include health establishments with and without specialists in their estimation equation. It is expected that facilities with specialists will have a positive effect on children's health whereas the opposite should hold for facilities without specialists. In the MICS 2007-08, we have information on distance to clinics, but there is no data on the availability of health specialists.

[6] WHO website: Immunization, Vaccines and Biologicals

The importance of hygiene at the community level can be determined by estimating the significance of access to water and waste disposal facilities in the household. It is expected that households with inside access to water and flushing toilet facilities will have a positive impact on the welfare of children as they reduce exposure to pathogens (Chen and Li, 2006). Our dataset has detailed information about water and sanitation at the household level. Variables which will be implemented are household access to piped water, flushing toilet, underground drain and waste management.

Table 1 D- Health Environment and Community-level infrastructure

Exogenous Variable	Reference:	MICS 2007-08
Distance to private doctor (min.) Distance to govt. clinic (min.)	Alderman and Garcia (1994)	Closest health facility: public or private
Health establishments- Without specialists: # per 1000 pop beds/facility With specialists: # per 1000 pop beds/facility	Thomas, Strauss & Henriques (1991)	 × ×
Dummy for HH with running water	Chen and Li (2006)	✓
Dummy for HH with its own water source	Chen and Li (2006), Handa (1999), Alderman and Garcia (1994)	✓
Dummy for HH with flushing toilet Toilet linked to sewage or not	Chen and Li (2006), Alderman and Garcia (1994) Handa (1999)	✓ ✓

Health Knowledge and Access to Information:

The importance of health knowledge has often been undetermined in the literature. Few studies have incorporated mother's knowledge about health issues as a determinant of child health. Kovsted et. al. (2002) in their study include a variable 'if the mother knows reason for malaria' as a proxy for knowledge about health issues. Since the region they studied is in Africa where malaria is endemic, the question is deemed relevant. Another interesting variable is the existence of close relatives who could be a source of health knowledge

(Glewwe, 1999). Exposure to mass media is a major source of information for all kinds of issues. (Glewwe (1999), Handa (1999)). Ownership of television or radio therefore, is considered to positively affect children's health by augmenting the parents' knowledge on healthy practices, advanced medical facilities, new diseases and preventive measures and much more. In the MICS 2007-08, malaria knowledge is not available, however it does contain information on HIV/AIDS knowledge, use of iodized salt, safety measures of water, hygiene habits and TV and radio ownership.

Table 1E- Health Knowledge/Access to Information

Exogenous variable	Reference	MICS 2007-08
If mother knows reason for malaria	Kovsted, Portner & Tarp (2002)	MICS has information on AIDS/HIV knowledge
Existence of close relatives	Glewwe (1999)	×
Own Television	Handa (1999)	✓
Own Radio	Handa (1999)	✓

Possible Endogenous Variables:

Like all cross-sectional studies, this study also has to cater to the possibility of endogenous variables and biased estimation results. Based on literature, some variables have been identified as being endogenous to children's health status. To begin with, income can directly affect the health of children, however, ill children may negatively affect the labor supply and income of parents (Chen and Li, 2006). To remove this endogeniety or potential reverse causality, Kovsted et.al. (2002) use education of father and ownership of land as proxies for permanent income. Handa (1999) implements a set of instrumental variables such as ownership of durables, income from property, telephone, type of dwelling and material of

walls. Alderman and Garcia (1994) also follow a similar approach. They estimate predicated annual expenditures per capita in order to determine long-run income. The instruments used to predict expenditures are total dry and irrigated land holdings, land in tree crops, value of vehicles, livestock and physical capital, education of parents, and household size. MICS 2007-08 has information on income at the household level, and also, it provides us with several potential instrumental variables for income such as: ownership of house, land, livestock and durables and type of dwelling.

Following the Alderman and Garcia (1994) framework, the nutrition production function of children consists of five endogenous variables for which community averages have been included as instrumental variables along with other exogenous variables. These five factors are: number of days the child is ill with diarrhea in the past two weeks, number of days the child has another illness in the past two weeks, whether the child was breastfed exclusively, if the child has been vaccinated and whether the child was born in a hospital. The incidence of these variables at the community level will affect the individual household's likelihood. For example, if a large number of children in the community have diarrhea, the possibility of diarrhea being passed around increases. Similarly, if the incidence of breastfeeding is high in a locality, it can positively influence other mother's to breastfeed their children, 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 decisions on healthcare measures. MICS 2007-08 has information on all five variables, however, information on breastfeeding and hospital birth is available for children under 2 years only, and including these variables reduces the number of observations drastically.

As already mentioned in the literature review, parent's knowledge about health is treated as endogenous because of the likelihood of reverse causality with the dependent variable. The variables implemented to gauge health knowledge have also been discussed in the preceding category of variables. MICS 2007-08 survey consists of questions about HIV, use of iodized salt, if water is made safe for drinking, if hands are washed before meals and after the use of toilet and how solid waste is disposed off. All these variables can serve the purpose of proxies for quantifying peoples' awareness about health issues.

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 the fact that children are measured at an early age and may still face the danger of mortality after being measured (Kovsted, el.al., 2002). Similarly, fertility selection bias refers to the fact that children born are not a random sample of the potential number of births to a family since parents do not treat all health outcomes of their children equally (Kovsted et.al., 2002). Nevertheless, due to data limitations, not much can be done beyond acknowledging the existence of this problem (Kovsted et. al., 2002).

Table 1F- Possible Endogenous Variables

Variable	Instrumental Variable or Proxy	MICS 2007-08 (Instrumental Variable or proxy)
Income/Expenditure	Father's education or ownership of land instrumented for permanent income (Kovsted et. al., 2002). Type of dwelling and material of outside walls, income from property, durables (Handa, 1999). Total dry and irrigated land holdings, land in tree crops, value of vehicles, livestock & other physical capital, education of parents, HH composition (Alderman and Garcia, 1994)	Instrument: Ownership of house, size of land holdings, ownership of durables, type of dwelling, livestock Proxy: material of walls and roofs, ownership of durables, income transfers
Diarrhea in past two week Illness in past two weeks Vaccination Exclusively breastfed Birth in a hospital	Community Averages (excluding self), predicted expenditures, tap water, distance to private doctor and govt. clinic (Alderman and Garcia, 1992, 1994)	Instrument: Community averages (excluding self)
Health knowledge	If mother knows reason for malaria (Kovsted et. al., 2002). Existence of close relatives, mother's Education, exposure to mass media (Glewwe, 1999)	Proxy: Knowledge about HIV, Wash hands, iodized salt, safe drinking water, TV, Radio
Mortality selection in surveys	Many of the children are measured at such an early age that a significant proportion of the deaths occur after they are being measured (Kovsted et. al., 2002)	Not Available
Fertility selection	Not much can be done here due to data limitations (Kovsted et. al., 2002)	Not Available

Data Description and Summary Statistics

The MICS 2007-08 is a household level dataset comprising of 91,075 households and over 592,843 listed members. There are about 71,507 children under 5 years and 70,266 child questionnaires have been answered in the survey. The MICS data has been collected from all 35 districts of Punjab and covers households from major cities, urban and rural areas. The data is representative at the Tehsil level, and from the sample domains, enumeration areas were selected from which random samples were collected at the cluster level of 12 to 16 households. More detail about the sample design can be obtained from the appendix of MICS 2007-08 report.

For Punjab, from table 2A we can see that the mean z-score for height-for-age[7] (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 of the reference population. About 26 percent of the children in the sample are severely stunted (below -3 standard deviation of the reference)[8] 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 of the reference population. However, the percentage of children severely underweight is much smaller than HAZ and stands at 11 percent of the under 5 population[9].

[7] The z-score values of height-for-age and weight-for-age will be implemented. Heights and weights of children are standardized according to the following formula: $Z = (x - \mu) / \sigma$ where x is the raw score, μ and σ are the mean and standard deviation obtained from the World Health Organization (WHO) international reference standard for children of same age and sex.

[8] WHO & NHS website

[9] According to the WHO z-scores technique, the z-scores that fall in the 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.

Table 2A
Nutritional Status of Children in Punjab (0-59 months)

	Observations	Mean	Standard Deviation	Moderate (-2 to -2.99 SD)	Severe (less than -3 SD)
Height for age	63695	-1.83	1.87	19.9%	26.2%
Weight for age	67395	-1.38	1.39	18.3%	11.6%

According to the survey, about 17 percent of children under five have had episodes of diarrhea or cough in the past two weeks. Over 12 percent children were reported to have cough for 0.12 days on average in a 2 week period, and about 7.6 percent of the children suffered from diarrhea for 0.08 days in a 2 week period (table 2B).

According to MICS 2007-08, majority (over 90 percent) of the children under 2 years were breastfed and similarly over 80 percent of the children under 5 have received Vitamin A at least once in their lifetime and also had BCG vaccination scars. An average household in Punjab consists of eight people, which in indicative of congestion. A vast majority of housing structures are made of concrete wall and roof structures and the most common sources of water at the household level are hand and donkey pumps (borehole). The means and SD of the variables used in the analysis are given below.

Table 2B: Descriptive Statistics

Variable	Mean	SD	Observations
height-for-age	-1.83	1.87	63695
weight-for-age	-1.38	1.39	67395
Child ill with cough in last 2 weeks*	0.12	-	69569
Child had diarrhea in last 2 weeks*	0.08	-	69515
Household Characteristics			
Sex: Female: 0, Male:1*	0.51	-	71510
Age in months	29.34	17.52	70658
Log of total HH income	8.84	1.48	71510
Number of HH members	8.23	3.75	71510
Sex of household head: Female: 0, Male:1*	0.97	-	71510
Number of rooms for sleeping	2.19	1.24	71405

Radio/tape recorder*	0.37	-	71261
Television*	0.59	-	71442
Refrigerator/freezer*	0.37	-	71407
Bicycle*	0.50	-	71314
Motorcycle or scooter*	0.26	-	71333
Car or truck*	0.09	-	71292
Animal-driven cart*	0.07	-	71232
Mother Primary Educated*	0.15	-	71440
Mother Middle level Educated*	0.07	-	71440
Mother Secondary level Educated*	0.10	-	71440
Mother Higher level Educated*	0.08	-	71440
HH head Primary Educated*	0.15	-	71387
HH head Middle level Educated*	0.12	-	71387
HH head Secondary level Educated*	0.17	-	71387
HH head Higher level Educated*	0.09	-	71387
Housing Characteristics			
HH with Pakka roof*	0.82	-	71463
HH with Pakka walls*	0.74	-	71447
HH with no or straw walls*	0.02	-	71447
Cooking fuel-wood/shrubs/coal/kerosene/char/dung/crop residue*	0.76	-	71466
Electricity*	0.92	-	71465
Prenatal, Delivery & Early Childhood Care			
Child ever breastfed*	0.96	-	27522
Child ever received Vitamin A*	0.83	-	69727
Child has a BCG scar*	0.86	-	68898
Child born in a hospital*	0.36	-	47296
Number of dead children	0.38	0.85	69778
Number of Stillbirths	0.08	-	68255
Any LHW visit in last month*	0.58	-	68052
Health Environment & Community-level Infrastructure			
HH with Piped Water*	0.18	-	71370
HH with Well dug inside or outside*	0.04	-	71370
HH with spring, tanker, surface & other water*	0.03	-	71370
HH using bottled water*	0.02	-	71370
HH with flush facility*	0.54	-	71322
HH with Pit latrine*	0.13	-	71322
Type of nearest health facility : private=0, public=1*	0.59	-	71195
Solid waste disposed by Municipal Institution*	0.07	-	71360
Solid waste disposed by Waste Management Dept.*	0.01	-	71360
Solid waste collected by Pvt. Company Vehicle from home*	0.03	-	71360
Distance to nearest health facility- within 29 min*	0.74	-	71119
Health Knowledge/Access to information			
Ever heard of HIV or AIDS*	0.29	-	70254
Know about the iodized salt*	0.55	-	71407

Ever used a contraceptive method*	0.38	-	69021
Make water safe for drinking?*	0.05	-	71329
After toilet- Some people wash hands with soap*	0.36	-	71359
After toilet- Everyone washes without soap*	0.10	-	71359
After toilet- No one washes hands*	0.06	-	71356
*Dummy Variable: the mean represents the proportions for this variable			

Estimation Strategy

The estimation strategy for this study is based on the household production model. The selection of explanatory variables given in Table 2B is drawn from the choice of variables in the literature and the availability of those factors in the MICS 2007-08.

Four regression equations will be estimated. The potentially endogenous variables identified in table 1F will be instrumented by the factors available in MICS 2007-08 by applying the methodology of Alderman and Garcia (1994). The two-stage least squares (2SLS) approach will be applied. The 2SLS approach essentially consists of two stages, in the first stage the endogenous explanatory variable is regressed on one or more suitable instruments (which are correlated to the endogenous variable and uncorrelated to the error term of the main equation). In the second stage, the fitted values of the endogenous variable from the first estimation are employed to estimate the main equation.

The focus of the paper will be primarily on the first two equations (5 and 6) which determine the nutritional status of children. The equation to be estimated for height for age z-score (long-term nutritional status) is:

$$Y_i = \alpha + \beta H_i + \gamma K_i + \mu P_i + \Pi E_i + \theta A_i + \varepsilon_i \qquad (5)$$

where Y_i is the for height for age (HAZ) of child i in the household. Children under 5 years will be considered for the entire analysis. H_i is a vector for household characteristics, K_i represents the housing characteristics, P_i is prenatal, delivery, and early childhood care, E_i

comprises of health, environment and community-level infrastructure, A_i is health knowledge and access to information and finally ε_i is the error term.

The equation of weight for age (measuring short-term nutritional status) is:

$$W_i = \alpha + \beta H_i + \gamma K_i + \mu P_i + \Pi E_i + \theta A_i + \varepsilon_i \quad (6)$$

W_i is weight-for-age (WAZ) for child i in the household.

Equations 7 and 8 measure the current health status of children. The dependent variable for both the functions is qualitative i.e. a dummy variable, and can take the values of 0 or 1. The objective is to find the probability of the dependent variable taking the value of 1, given the exogenous variables. The probit model will be implemented for the following estimation equations:

$$C_i = \alpha + \beta H_i + \gamma K_i + \mu P_i + \Pi E_i + \theta A_i + \varepsilon_i \quad (7)$$

$$D_i = \alpha + \beta H_i + \gamma K_i + \mu P_i + \Pi E_i + \theta A_i + \varepsilon_i \quad (8)$$

where $C_i = 1$ indicates if child i has been ill with cough during the past two weeks, and $D_i = 1$ indicates if child i has had diarrhea in the past two weeks. The rest of the categories are the same as for equations 5 and 6.

Results and Empirical Findings

Simple ordinary least square (OLS) estimations have been adopted for the first stage of the estimation strategy. Of all the possible endogenous variables three variables namely income, diarrhea and vitamin A supplements fail the exogeniety tests and are therefore instrumented. The Durbin-Wu-Hausman (DWH) test and overidentification tests are standard tests for

instrumental variable estimations[10] and have been implemented to test the necessity and validity of the instruments. The first stage regression results for the three endogenous variables and their instruments are given in Table 1 in the appendix.

The instruments used for income are the ownership and size of agricultural land, type of dwelling, ownership of house 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 (of the endogenous covariates) are much greater than 10 which implies that these instruments are highly relevant.

Following the Alderman and Garcia (1994) methodology, non-self community average for diarrhea, and the interactive dummy variables of mothers' education and community prevalence of diarrhea are used as instruments for diarrhea. However, the signs for instruments are not in line with theoretical reasoning. Higher levels of diarrhea prevalence in the community should increase the likelihood of diarrhea infection of a child, similarly, children with more educated mothers should be less likely to have diarrhea. The incorrect signs can be attributed to the quality of data for diarrhea. For the MICS dataset morbidity had to be recalled for the past 2 weeks for every child in the household and recall error can drastically affect the quality of the data, also if the respondent is not the mother of the child, then illness recall can be even more unreliable. Furthermore, the definition of illness may vary across households from different socioeconomic backgrounds. The positive correlation between maternal education interaction dummy and children diarrhea could be because

[10] The DWH test determines the endogeniety of the suspected variable and therefore establishes if an instrumental variable analysis is necessary or not. The Hansen J test of overidentification is relevant whenever the endogenous variable is overidentified, i.e. the number instruments are greater than the number of endogenous variables. The J-test determines if the instruments are correlated to the structural equation's residuals, in that case, the instruments become invalid (Wooldridge, 2002)

educated mothers are better able to recall their children's illnesses as compared to illiterate mothers.

The estimation results for the first and second stage of the structural equations for cough and diarrhea largely have incorrect signs and go against theoretical explanations. Due to the poor quality of the morbidity data, the second stage results for these two variables are not reported. All estimations have been controlled for heteroskedasticity of unknown form by implementing the robust standard errors at the cluster level. Also district dummies are included for all regressions to control for factors affecting at the district level. Urban district dummies are created by interacting district dummies with urban-rural dummy variable, these are included as control variables. In the second stage estimation, the predicted values from the first stage regressions are employed as exogenous indicators along with other explanatory variables. The regression results for the z-score of child weight for age and height for age are reported in table 3.

The signs of majority of the variables in the estimated equations are in line with the literature on child health. Column 1 and 2 give the estimation results for child HAZ and WAZ. From the results, a one percent increase in household's predicted income results in an increase of 0.21 and 0.23 standard deviations in children's height and weight. Similarly, a percentage increase in income transfers (remittances, pensions and government transfers) also has a significant and positive effect on children's physical wellbeing. As expected, parental education has a positive effect on both short term and long term nutrition of children. The effect of mothers' education on child health is significant and positive. The income effect of mother's education is being captured by the household income variable and the direct impact of mother's education is being transmitted through efficient child rearing practices and

information acquisition. Children whose mothers are educated at the primary level are taller by 0.07 standard deviations compare to children with illiterate mothers. Since primary level education is not sufficient to open up a job market for women, this level of education can mostly influence child rearing through better maternal practices. As the education level of the mothers rises, the HAZ scores of children also increase progressively. This indicates that over the years, educated mothers are better able to nurture their children as compared to uneducated women. The current health status of children is significantly improved when mothers are educated at the middle[11] and higher level and the weight z-scores increase by 0.08 and 0.18 SDs respectively. Since father's education is not available, household head's education has been used, and the heads education at the primary and middle level increases a child's weight by 0.03 and 0.05 SDs. Income at the household level may perhaps be capturing part of the household head's education impact on child health, which is why the head's education does not come out very strong in the estimations.

Sickness variables of cough and diarrhea are also included as explanatory variables. Cough does not come out as a significant explanatory variable for child health. Diarrhea infection has a strong negative effect on weight, however, predicted values of diarrhea infection are implemented for HAZ, and the coefficient has an incorrect sign. When unpredicted values of diarrhea are implemented in the HAZ estimation, diarrhea dummy becomes insignificant with a negative coefficient. The incorrect result of predicted diarrhea dummy is perhaps a consequence of poor quality data.

2

Child height for age varies considerably with child age (in months) which is consistent with other studies on Pakistan as well as other countries (Chen and Li (2006), Glewwe (1999),

[11] Primary level: Grade 1-5, Middle level: Grade 6-8, Secondary: Grade 9-10, High: Grade 11-12, Tertiary: above grade 12.

Handa (1999), Aldeman and Garcia (1994). This is because malnutrition rises with age for children in the first two years of life as their main source of nutrition is mother's 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, to the contrary male children are more likely to be undernourished. This may be due 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 coefficient of household size for HAZ and WAZ are negative (-0.03, -0.03) showing a strong adverse effect of large households on the health of children. As already mentioned, this can be attributed to congestion and distribution of scarce resources amongst more family members, children being the most vulnerable group tend to suffer the most. A male household head has a strong negative effect on child height and weight z-scores, this is in conflict to economic literature where it is assumed that female headed households are poorer and children should therefore be weaker. However, this contradiction can be explained by examining the data, according to MICS 2008-07, over 96 percent of the households are male-headed and since there is not enough variation in the dataset this variable has limited explanatory power.

Among household durables, ownership of a refrigerator is positively affecting children's growth and weight as it allows households proper storage of food and therefore better quality of food intake. Although television does not directly affect children's physical wellbeing, but its presence in the house increases children's height and weight by 0.06 and 0.03 SDs, this can be due to two reasons; first owning a television implies financial wellbeing, even if it is very nominal, secondly television can be a source of health knowledge for some parents and can therefore have a positive spillover for children's health.

A wealth index comprising of housing conditions and household assets[12] has been created using the principal component analysis. A one percent increase in the wealth index increases a child's height by 0.06 SDs. The wealth index has a positive effect on WAZ, however the result is not statistically significant. In another set of estimations, variables employed in the wealth index were included as independent exogenous variables and ownership of motorcycle reflected a strong positive effect on the long-term and short-term health status of children. This could be because owning a motorcycle is not only indicative of financial wellbeing, but for children it also means that incase of illness they can easily be transported to a health facility.

Vitamin A intake and BCG vaccination have no significant effect on the children's z-scores. As already mentioned, this could be because majority of the children in the sample have received vitamin supplements and have been vaccinated, so the indicators do not show enough variation across the observations. As expected, the number of children who have died in the past to a mother have a significant and negative effect on the WAZ and HAZ of her living children. Although the reason of death of these children is not available in the data, however it could be assumed that if death occurred due to inherited conditions, household environment or poor parenting owing to lack of knowledge or concern for children, these factors continue to adversely affect the surviving children in the household.

The z-score for height and weight improve by 0.12 and 0.09 SDs in households with flushing toilets (connected to a sewer or a septic tank). The strong effect of a toilet facility on children's wellbeing highlights the importance of sanitation at the household level. Having a pit latrine in the house also improves children's WAZ as compared to children without proper

[12] Wealth index comprises of the following variables: Number of rooms for sleeping, ownership of bicycle, motorcycle/scooter, car/truck, animal driven cart, households with finished roofs, walls and type of cooking fuel

toilet facilities. Effective waste management is also important, and from the results we can see that households where waste is collected by the Municipal Institutions, Waste Management Department or Private Vehicles have children with higher z-scores for height and weight as compared to households where waste is dumped in open streets and fields. Interestingly, having a public health facility nearby instead of a private health facility reduces a child's weight z-score by 0.05 SDs. This result suggests that public health facilities offer poorer services when compared to private facilities and therefore have a very strong negative impact on the short-term health status of children. Living close to the city or urban areas displays negative effects on the health of children. The area dummy has a negative coefficient for height as well as weight z-scores, however the results are significant for the HAZ and translate into 0.19 SDs decline in the z-scores.

Parent's awareness about general health is being gauged by questions such as use of iodized salt and if they have heard about HIV/AIDS virus. These questions about health knowledge have a very strong and positive effect on the short and long term health status of children in our sample. Use of iodized salt and HIV/AIDS dummy are significant at 1 percent level for both HAZ and WAZ indicating that parents with greater health awareness also raise healthier children. The usage of contraceptives has positive effect on child WAZ and results in an increase of 0.04 SDs. Households where some or no members wash their hands with soap after using the toilet have weaker children (lower WAZ) compared to households where everyone washes their hands with soap. So the daily sanitary habits in a household which can cause simple illnesses have a significant effect on the short-term status of children, however, the effect of sanitary habits may not have a long term impact children's wellbeing.

A parsimonious model comprising of fewer variables of interest has been estimated and reported in Table 2 of the appendix. Maternal and household head's education has already been established as important for children's wellbeing, however, estimated coefficients of these variables increase in size and significance in the parsimonious model. Similarly, the wealth index which was not previously significant for WAZ is now significant at 1 percent level for both, HAZ and WAZ. This may be because the wealth index is now capturing the effect of excluded household level variables such as durables and community infrastructure and environment. Households predicted income has a significant yet smaller effect on the height and weight z-scores compared to the main estimation model. The estimated coefficient for the type of health facility closest to a household has not changed much for height and weight equations, and it remains significant for WAZ only.

Table 3- Child Health Determinants: Second Stage Results

	Height for Age (z-score)		Weight for Age (z-score)	
Independent Variable	Coefficient	t-statistic	Coefficient	t-statistic
Household Characteristics				
HH Income[p]	0.207	3.22***	0.232	4.70***
Income Transfers	0.014	3.44***	0.016	5.27***
Diarrhea[a]	0.535	2.95***	-0.145	-5.96***
Cough	0.013	0.51	-0.015	-0.73
Age in months	-0.086	-5.57***	-0.025	-2.18**
Age squared	0.001	5.94***	0.0003	1.92*
Sex	-0.086	-5.60***	-0.110	-9.85***
Number of HH members	-0.033	-4.53***	-0.033	-5.87***
Sex of Household Head (Male=1, Female=0)	-0.663	-3.75***	-0.633	-4.70***
Wealth Index	0.058	1.75*	0.014	0.57
Radio/tape recorder	-0.008	-0.42	-0.022	-1.51
Television	0.061	2.90***	0.029	1.84*
Refrigerator/freezer	0.089	3.23***	0.063	3.11***
Mother Primary Educated	0.073	2.75***	0.014	0.75
Mother Middle level Educated	0.101	2.84***	0.082	3.07***
Mother Secondary level Educated	0.175	4.41***	0.051	1.70*
Mother Higher level Educated	0.271	4.62***	0.181	4.11***
HH head Primary Educated	0.024	0.96	0.031	1.66*
HH head Middle level Educated	0.007	0.26	0.052	2.52**
HH head Secondary level Educated	0.032	1.18	0.026	1.28
HH head Higher level Educated	0.057	1.41	-0.007	0.24

Prenatal, Delivery & Early Childhood Care				
Vitamin A[P]	0.032	0.09	0.275	1.06
BCG scar	0.028	1.13	0.020	1.05
Number of Stillbirths	0.011	0.46	0.015	0.85
Dead children	-0.037	-3.80***	-0.013	-1.70*
LHW visit	-0.031	-1.27	-0.046	-1.45
Health Environment & Community-level Infrastructure				
HH with piped water	-0.011	-0.43	-0.017	-0.90
HH with well dug inside or outside	0.011	0.24	0.013	0.38
HH with spring, tanker, surface	-0.013	-0.24	-0.066	-1.67*
HH using bottled water	-0.044	-0.57	-0.043	-0.71
HH with flush facility	0.123	4.67***	0.088	4.52***
HH with pit latrine	0.014	0.43	0.047	1.98**
Solid waste disposed- Municipal Institution	0.119	2.67***	0.098	3.15***
Solid waste disposed- Waste Management Dept.	0.218	2.62***	0.099	1.48
Solid waste collected- Pvt. Company Vehicle	-0.107	1.52	0.110	2.23**
Dist. to nearest health facility- within 29 min	0.026	1.08	0.020	1.15
Type of nearest health facility (Public=1, Private=0)	-.015	-0.59	-0.053	-2.87***
Health facility * Urban Dummy	0.012	0.27	-0.145	-0.44
Area (Urban=1, Rural=0)	-0.185	-1.69*	-0.093	-1.31
Health Knowledge/Access to information				
Make water safe for drinking?	0.011	0.25	0.024	0.75
After toilet- Some people wash hands with soap	-0.001	-0.03	-0.031	-1.93*
After toilet- Everyone washes without soap	-0.017	-0.50	-0.047	-1.81*
After toilet- No one washes hands	-0.038	-1.03	-0.089	-3.04***
Ever used a contraceptive method	0.015	0.62	0.039	2.91***
Ever heard of HIV or AIDS	0.098	3.95***	0.083	4.45***
Know about the iodized salt	0.073	3.66***	0.061	4.07***
R^2	*0.111*		R^2	*0.0708*
F(114,6169)	*39.62*		*F(114,6184)*	*28.20*
N	*55135*		*N*	*58074*

*Significant at 10% level
**Significant at 5% level
***Significant at 1% level
[P] Predicted value for HAZ and WAZ
[a] Predicted value for HAZ

Conclusions and Policy Recommendations

This paper has examined the determinants of child health in Punjab by implementing the instrumental variables approach. The results show that income, be it in the form of money generated by household members or transfer payments has a direct effect on the wellbeing of children. This may not be a novel finding however, it reiterates the drastic effects of poverty on the health of children. In the estimations, housing characteristics is the richest category in terms of number of indicators, as well their significance on the 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 domains of their homes, household dynamics such as number of members in the household, durables such as television and refrigerator, the education level of mothers, all prove to significantly affect the health of the children in the household.

The effect of the surrounding environment and community-level infrastructure in the estimated results is transmitted mainly through the sanitary disposal of waste. Proper waste disposal can be extremely effective in curtailing the spread of communicable diseases which can be life threatening for children. Moreover, personal hygiene of the household members which is being gauged by the practice of washing hands with soap after using a toilet facility also has a real impact on the current health status of children. Prenatal to early childhood care variables do not surface as significant variables in the estimated results, except for the number of deceased children to a mother. These results however cannot undermine the importance of prenatal/antenatal care for children. As most of the prenatal and antenatal care questions in the MICS 2007-08 survey cover children under the age of two years, these variables have not been included in this study owing to sample attrition.

Based on the discussion of the empirical results some interesting conclusions can be drawn. The impact of mother's education on the wellbeing children in Punjab reaffirms the findings of other papers on the topic. Educated mothers have healthier children and this positive impact has a long term effect on the health of children. The impact of maternal education is being transferred through better nurturing and domestic practices. This result has an important implication in policy making as it suggests that female education and child health are interrelated goals as education of women today has a causal effect on the health of the next generation.

Parents knowledge on health and its impact on their children's wellbeing is an untapped yet emerging area of research, especially in Pakistan's context. Some basic questions asked in MICS 2007-08 on the use of iodized salt and knowledge about HIV/AIDS virus have significant results, which entails that parents who are more aware about health issues have healthier children. It is true that a more detailed survey on health knowledge of parents could support this argument better, however the results in this study have a very strong implication: access to information can translate into better child rearing practices. By creating mass 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 are accessible in the most backward communities of Punjab, and Pakistan at large. These can serve as efficient and economical instruments of information dissemination and reach out to rural and remote communities.

Although the general presumption about South Asian countries is that female children are generally discriminated against male children at the household level, our results reject any gender discrimination. This indicates that parents across Punjab nourish their male and female children alike. On the healthcare front, even though the results for BCG vaccination and Vitamin A intake are not significant nonetheless, the fact that majority of the children in Punjab are now being immunized and vaccinated is commendable.

Appliance ownership has surged in Punjab 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 (MICS 2003-04 & 2007-08). This may be due to increased access to credit which has allowed households to purchase durables on installments. The presence of a motorcycle or scooter in the house also improves children's wellbeing. Although such durables are not direct inputs

for nutrition, but their ownership has positive spillovers on the health of children, therefore complimentary policies such as micro-financing or easy installments schemes can prove to be beneficial.

Apart from the above the recommendations, this paper has highlighted the importance of overall social development on child health, and it has identified further parameters of research which are still untapped in the context of Pakistan.

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Appendix

Table 1: Child Health Determinants: First Stage Instrument Equations

Independent Variables	log of Income	Diarrhea	Vitamin A
Ownership of agricultural land	0.211		
	(10.0)***		
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)***		
Non-self community average		-0.049	0.194
		(-2.19)**	(13.5)***
Community prevalence of diarrhea x mothers education (primary)		0.066	
		(16.30)***	
Community prevalence of diarrhea x mothers education (middle)		0.069	
		(12.26)***	
Community prevalence of diarrhea x mothers education (secondary)		0.078	
		(16.81)***	
Community prevalence of diarrhea x mothers education (high)		0.072	
		(12.40)***	
	F(80,6255)=118.5	*F(80,6200)=48.8*	*F(79,6197)=309.75*

Note: Figures in parenthesis are t-values
*Significant at 10% level
**Significant at 5% level
***Significant at 1% level

Table 2: Parsimonious Model
Child Health Determinants: Second Stage Results

	Height for Age (z-score)		Weight for Age (z-score)	
Independent Variable	Coefficient	t-statistic	Coefficient	t-statistic
HH Income[P]	0.077	1.88*	0.086	2.68***
Wealth Index	0.150	4.08***	0.102	3.59***
Mother Primary Educated	0.201	8.19***	0.118	6.65***
Mother Middle level Educated	0.296	9.11***	0.235	9.93***
Mother Secondary level Educated	0.425	12.89***	0.261	10.73***
Mother Higher level Educated	0.622	14.38***	0.475	14.84***
HH head Primary Educated	0.039	1.66*	0.049	2.78***
HH head Middle level Educated	0.039	1.42	0.077	3.9***
HH head Secondary level Educated	0.097	3.77***	0.096	5***
HH head Higher level Educated	0.154	4.13***	0.125	4.64***
Type of nearest health facility	-0.014	-0.7	-0.048	-3.3***
Area (Urban=1, Rural=0)	-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	*62338*		*N*	*65925*

*Significant at 10% level
**Significant at 5% level
***Significant at 1% level
[P] Predicted value

Table 3- Parsimonious Model
Child Health Determinants: First Stage Instrument Equations

Independent Variables	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)**
Livestock	0.207
	(9.82)***
	F(83,6356)=81.74

Note: Figures in parenthesis are t-values
*Significant at 10% level
**Significant at 5% level
***Significant at 1% level

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