Studying the Contextual Effects of Women's Education on Child Immunization in India

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ABSTRACT

Numerous studies have highlighted the strong correlation, often assumed to be causality, between maternal education and child health. This study extends previous research by examining both the individual and contextual effect of women's education on complete and timely immunization of their children against six dangerous, but preventable, diseases in India. Multi-level analysis of data from the 1994 Human Development Profile Index (HDPI) and the 1991 district-level Indian Census data reveals a positive and significant relationship between the adult female literacy rate in a district and child immunization within that district even after controlling for mother's own education and district-level socioeconomic development. The paper concludes by discussing the limitations of the study, relevant policy implications, and future avenues of research.

Dear Dr. Sastry,

Greetings!

This analysis is far from complete. Some changes that I intend to make are as follows:

1) **Model the micro-level mother's education coefficient**
2) **Add an index of health care development (concentration of doctors and nurses in the district) at the district level.**

Warm regards,

Sangeeta

INTRODUCTION

In developing countries, children face an elevated risk of illness and death due to incomplete immunization, with severe implications for their growth potential and the risk of morbidity and mortality in later years. For example, despite extensive immunization programs, more than a million children die from measles every year, 430,000 from neonatal tetanus, and close to 400,000 from whooping cough (UNICEF, 1990). Consequently, because the care of infants remains an almost exclusive domain of women in most societies, policy-makers and researchers unanimously support maternal education as an appropriate tool for improving the overall health and survival of their infants as well as influencing the timing and shape of demographic processes (Caldwell, 1994; World Bank, 1993). Their argument is that a woman's education raises her skills and overall self-confidence, increases her exposure to information, and allows her to interact effectively with, and feel control over, modern healthcare institutions (Cleland, 1990),

However, significant gaps in the literature on maternal education and child health remain theoretically and empirically unaddressed. For example, because of inadequate socioeconomic control variables at the household and community level, several scholars are critical of extant theories that underscore the *causality* between individual-level maternal schooling and child survival (Desai and Alva, 1998; Kishor, 2000). Thus, the need for explicitly measuring *contextual effects* in order to disentangle correlation from causality is highlighted, which is based on the assumption that since education and socioeconomic development are strongly correlated, high aggregate levels of women's education may increase other women's access to health facilities within that community, thereby improving the *overall* health of children of *both* educated and uneducated mothers (Desai and Alva,

1998). However, the unavailability of appropriate data as well as a suitable analytical strategy have resulted in indirect, as opposed to direct testing of this argument.

Using individual- and district-level data within multilevel models, this study attempts to address that existing gap *directly* by testing the hypothesis that in India, mother's own education and also the proportion of female literacy in the district affect children's complete immunization status. At the heart of this paper is the question: are children residing in areas with high female literacy rates more likely to be fully immunized than those residing in areas with low female literacy rates, controlling for their own mother's education as well as the wealth of the district, and if so, then why? After a brief literature review addressing the various nuances of the relationship between maternal education and child health, I present evidence to support my hypothesis, and then conclude the paper by discussing policy issues and future avenues of research.

MATERNAL EDUCATION AND CHILD IMMUNIZATION: PAST RESEARCH

Widespread awareness that mother's education is important for their children's health is commonplace in sociological research. For example, cross-national comparisons using large data sets such as the World Fertility Survey and the Demographic and Health Surveys as well as several micro level quantitative and qualitative research studies have consistently suggested that education, in general, and female education, in particular, wields a strong influence in reducing child morbidity and mortality (Lloyd, 1991; Hobcraft, McDonald, and Rutstein, 1984). Such causal interpretations are supported by the reasoning that education endows women with "instrumentality," or the ability to accumulate and assimilate information (pertaining to ORS, immunization, and nutritional needs), access relevant

healthcare services, feel control over the world, and interact effectively with important institutions (Cleland, 1990). Thus, "a large number of studies have shown, almost as convincingly as anything can in the social sciences, that a mother's education has an independent, strong, and positive impact on the survival of her children" (Caldwell, 1994).

Causality between the above-mentioned variables is based on the argument that all women possess similar innate abilities and that education acts exogenously to improve those abilities (Mosley and Chen, 1984). Some possible links and pathways that result in greater utilization of modern health services are as follows: (1) an educated woman's non-fatalistic attitude allows her to break away from tradition and make independent decisions regarding direct utilization of modern health facilities, negotiate with medical personnel, and ensure means of safeguarding her own health and that of her children (Cleland 1990), (2) through her superior skills and self-confidence, an educated woman are better able to utilize community resources to her advantage and increase her direct child-health knowledge (Caldwell, 1994), (3) potential health benefits from delayed and lower fertility among an educated woman enables greater investment in the child (Caldwell and Caldwell, 1993), and (4) an educated woman's views are taken more seriously by her husband and others family members (Das Gupta, 1990). Finally, education endows a mother with increased autonomy or agency during her peak childbearing years when she wields least authority (Das Gupta, 1990).

However, without necessarily disputing the general statistical association between female education and child health, an emerging body of literature asserts that the association at the individual-level is neither universal nor well established. In fact, the process through which female education directly influences health—if such a causal link exists at all—remains unclear. For example, while a few scholars such as Hobcraft (1996) are uneasy about

concluding causality from, what could possibly be a correlation, Das Gupta (1987) argues that in a strongly gender inequitable *cultural context*, maternal education can actually reduce the survival chances for higher order daughters. Finally, why is the effect of maternal education greater in rural areas than in urban areas where better quality health services are located (Schultz, 1984)? Thus, the evidence concerning the influence of maternal education on child health and immunization is mixed, making us speculate whether the frequently observed and ratified relationship is better explained through a contextual analysis of the research problem? Given the well-known importance of social effects, should we expand our lens and replace individual-level analyses with more appropriate, more realistic, multilevel methodologies that incorporate and analyze various levels of data simultaneously?

While the importance of context has long been recognized, few studies have examined the contextual effects of maternal schooling on child survival because of an emphasis on other macro-level variables such as region or presence of healthcare facilities (Sastry, 1996). However, the importance of contextuality is increasingly evident in recent studies of child health. For example, in an analysis of child mortality in Colombia, Rosenzweig and Schultz (1982) revealed an important substitutive relationship between public health facilities and maternal education in urban areas. They reported that *controlling* for average education levels in the municipality reduced the positive effect of municipality health services on child survival. Building on this research, Sastry (1996) explained large regional variations in child mortality in Brazil by incorporating community level variables into a hazard model to show that the availability of health facilities in an area served *as a substitute* for maternal education in its influence on child survival.

In a significant departure from existing contextual analyses, Desai and Alva (1998), through community-level fixed effects models, demonstrate that maternal education may be a proxy for the socioeconomic status of the household as well as the community—data and characteristics that are not accurately captured by traditional single-level analyses. Since educated mothers come from socio-economically well-off households that reside in economically developed areas with good school and medical facilities, the observed *causality* between maternal education and immunization may, in fact, be spurious (Desai and Alva, 1998: 71; Palloni, 1981). On the other hand, the strong *correlation* may be due to a *contextual* or unintended *spillover* effect: the immunization status of children of *both* educated *and* uneducated mothers is likely to be high in communities with high levels of aggregate female education, and by extension, better access to health facilities, because of social interactions, institutional support, and norms. Thus, as the proportion of literate women increases in an area, so does the overall level children's immunization in that area. However, such studies face problems of aggregation bias or even selecting the appropriate unit or level of analysis, and tend to be silent about the nested character of the effect of one's woman's education on the decisions of other women.

In conclusion, while a multi-level analysis helps to capture the above-mentioned social dimension of the effect of female education on child health, household-level analysis, on the other hand, would miss the effect of a woman's education on the immunization decisions of other women. In this paper, I expect to find that an increase in education levels fosters the spread of information pertaining to child immunization not only among educated women themselves, but also among uneducated women. Thus, recognizing the nested (or hierarchical) nature of this observation—i.e. geographical areas as aggregates of households

and children, and households as the aggregates of the children and processes within them—is essential for a better understanding (and prediction) of social issues.

THE RELEVANCE OF CONTEXTUALITY: DISENTANGLING THE LINKS

Contextual studies are motivated by the belief that individual behavior and attitudes are modified and constrained by shared membership of social contexts, such as the family, the neighborhood, etc. However, in this paper, the *specific links* between district-level female literacy rates and the immunization status of children of uneducated and educated mothers residing in that district are difficult to disentangle due to lack of relevant data. Nonetheless, several factors that possibly explain a contextual effect include: 1) institutional support through mass media and adequate medical facilities, 2) diffusion of information through social networks and interaction between women of different educational backgrounds, and 3) negotiating power of educated women.

Children's immunization status is, in part, an indicator of the quality (and quantity) of the healthcare facilities available to their mothers. Being an important cornerstone of the National Health Policy in India, major institutional channels such as the mass media (e.g. the radio, television, and newspaper) and government departments (e.g. the Health and Family Welfare Ministry) are instrumental in disseminating relevant information through advertisements, or organizing free health camps, or improving extant infrastructure.[1] The expectation is that both uneducated and educated mothers are influenced by the messages generated and legitimized by these institutions. Specifically, because educated mothers tend to reside in economically developed areas, they are likely to respond to public health

[1] The Expanded Program on Immunization (EPI) was introduced in 1978 with the objective of providing free immunization services to all eligible children and expectant mothers (WHO 1986). The Universal Immunization Program (UIP) was later introduced in 1985–86 and is implemented through the existing network of the primary health-care system, including Primary Health Centers (PHCs), sub-centers, and Community Health Centers.

interventions pertaining to child immunization and take the appropriate measures (Desai and Alva, 1998). More importantly, in a "spillover" effect, children of uneducated mothers residing in the same area are more likely to have better health and higher survival probability because of their advantageous environment, such as better infrastructure, high levels of hygiene, and low prevalence of infectious diseases; they may also be influenced by their observations of the social structures and messages surrounding them.

Additionally, since social networks tend to be gender-specific due to women's and men's socially ascribed roles in the private and public spheres, women interact extensively and effectively with each other to exchange information and resolve problems related to child health (Tripathi, 2000). Thus, educated mothers may transfer information regarding child immunization to uneducated mothers through diverse social structures, networks, and frequent interactions. Although membership in community organizations is not directly correlated with increased immunization, one could argue that women's frequent participation could initiate ideational and health-seeking behavioral change due to significantly greater odds of having related discussions. For example, infant immunization requires a considerable amount of commitment on the part of the parents, particularly the mother, in knowing and remembering when to have the child immunized and in being sufficiently convinced of the benefits of modern health care to put up with the distressing side-effects (fever with DPT, an unpleasant boil with BCG) of inoculation, for the sake of the less tangible benefits of preventive health care (Das Gupta, 1990). Women who are ambivalent about immunization may often supplement healthcare providers' instructions with the experiences and knowledge of more educated women, and thus immunize their child. In any case, as the proportion of

female literacy in an area increases, so will the odds that both educated and uneducated women will interact with other educated women regarding child immunization.

Finally, through influential positions such as doctors, NGO health workers, teachers, or even employers of informal economy workers (domestic helpers, sweepers, nannies, etc.) educated women may manipulate extant social institutions to better serve the needs of themselves and other women. By mobilizing community resources and public services, by improving access to information, skills, services, and technologies, and by increasing women's political participation and visibility, they may negotiate for the accessibility to *and* continual support for adequate health services and responsive medical personnel. Such actions are likely to improve the immunization status of their own, and as an unintended consequence, the immunization status of other uneducated women's children.

Thus, emphasizing the social and institutional contexts in which individuals are embedded imparts a degree of realism that is often absent from single-level models. In this analysis, I examine the contextual effects of average female literacy on the immunization status of children residing in geographically defined districts of India. I hypothesize that:

- A significant and positive relationship exists between female literacy rates (for women above age 15) in a district and children's immunization status in that district.
- The contextual effect of female literacy on children's immunization status is likely to persist and be significant even after controlling for individual-level characteristics such as maternal education and macro-level characteristics such as wealth.
- The contextual association of female literacy rates in a district will be evident for both educated mothers and mothers with no education.

INSERT FIGURE 1 HERE

In an attempt to distinguish between contextual and compositional effects, relevant child- and district-level predictors and controls are also included in the analysis.

DATA AND METHODS

Data

Two levels of data are utilized for this analysis. The individual-level data is from the cross-sectional HDPI (Human Development Profile Index) collected by the National Center for Applied Economic Research, India. The HDPI interviewed 194,473 individuals from 63,852 households, residing in rural areas of 16 Indian states. In addition to a wealth of household-level information, extensive health (anthropometric and immunization) details of 32, 459 children were also gathered. However, since the analysis is restricted to children between the ages of 12-23 months, the current sample size is 4023 eligible children.

The second- or district-level data is extracted from the 1991 Indian Census collected by the Government of India, and provides information regarding employment, literacy rates, wealth, level of urbanization, specific demographic events, etc. for 412 rural and urban districts. A district is the basic unit of administration in India for which spatially disaggregated information on female literacy is available. Hence, it is a useful unit of analysis because of the social dimensions of child health which tend to be interdependent due to the influence of social norms and of diffusion effects. 195 rural districts are included in the study sample because the individual-level HDPI collected data from only selected rural areas. Unique state-district identifier codes were created to merge the individual and district-level

data so that children are "nested" within districts. Finally, relevant descriptive statistics of all the dependent and independent variables at both levels are encapsulated in Table 1 and 2.

INSERT TABLE 1 AND TABLE 2 HERE

Individual-level dependent variable

The dependent variable, *infant immunization*, which measures whether a woman's last living child born 12 to 23 months ago has received eight immunizations: 1 BCG (against tuberculosis) at birth, 3 doses of DPT (diphtheria, pertussis, tetanus) and 3 doses of oral polio at 6, 10, and 14 weeks after birth, and 1 measles at 9 months after birth, is from in the individual-level file. The reason for restricting the sample by age (12-23 moths) is because guidelines issued by the World Health Organization require that infants receive all eight injections *in the first year of life*. The issues of concern in the study of infant immunizations are more than just that a child should be immunized; *completeness* and *timeliness* of immunizations are also critical aspects of healthcare provision.

The dependent variable is binary with "0" = if the child did not receive *all* eight immunizations and "1" = if the child received *all* eight immunizations. Because of the restricted age group, i.e. children between the ages of 12-23 months, the individual-level sample is limited to a total of 4,023 children, with only one child per household. Frequency distributions reveal that timely immunization of infants is far from complete. By the end of their second year of life, only 35.5% of all living children are fully immunized, while 29% have not received any immunization, making them vulnerable to six potentially fatal, though preventable, diseases. Given the binary nature of the outcome variable, logistic regressions

were used to explore the individual-level model (results not included). Cases with missing values were dropped from the analysis.

Independent variables

Individual level: The main explanatory variable at the individual level is *maternal education*, and being categorical in nature, was recoded into four dummy variables: (1) no education, (2) complete primary school, (3) completed secondary school, and (4) completed matriculation and above. While 75% of the mothers had no education, only 7% had completed their matriculation. Low levels of female education in rural districts of India further underscore the necessity of studying the contextual effects of education on child health as well as emphasizing education as an appropriate developmental tool.

Several individual-level control variables that, quite independently of maternal education, are known to affect child immunization, are also included in the analysis. While most variables are mainly categorical, three are continuous in nature. I included the following as compositional controls in the analysis: (1) *social background*: religion (Hindu, Muslim, Others) and caste/tribe (SC, ST, other), (2) *socioeconomic*: an index (ranging from 0-8) of unproductive consumption possessions (such as bicycle, radio, television, etc), basic facilities (flush toilets and piped water) and overall housing condition, (3) *bio-demographic*: child's age (a continuous measure in months), sex of child (male, female), birth order of child (one, two or three, four or higher), and (4) *access to knowledge about immunization*: weekly exposure to mass media such as radio, television, and newspapers (ranging from 0-3) and freedom to move outside the home (no permission needed, not allowed to go outside).

District-level: The main contextual or district level variable in this study is the proportion of adult females (15 years and older) residing in rural districts who are literate.

The reason for creating this variable is threefold: (1) the HDPI only samples households/children in rural areas, (2) the typical age for childbearing (and marriage) in India is around 15-49, if not earlier, and (3) by age 15, the educational fate (in school or not and educational attainment) of most rural women is decided. Additionally, I did not use age-specific educational attainment rates because literacy rates in different age groups tend to be highly correlated across districts that the precise choice of reference group is unlikely to matter. Furthermore, given the importance of interpersonal effects in child health, the correct choice of age group is far from obvious (Dreze and Murthi, 2001). I expect to find a strong, positive association between female literacy in a district and child immunization status, with children residing in districts with high aggregate literacy more likely to be fully immunized compared to those residing in districts with low overall female literacy. On an average, only 16% of rural women above the age of 15 in the sample are literate, and the distribution of education across various districts is highly skewed. While the lowest level of education in a district is 2%, the highest is 70%, thus further reinforcing the necessity of studying and incorporating contextual effects.

District-level control variables in the analysis include: (1) *social background*: the proportion of Muslims and people belonging to scheduled castes and tribes as indicators of the social composition of different districts, (2) *socioeconomic*: the overall wealth index, and (3) *developmental*: urbanization as the share of the population residing in urban areas. The wealth index serves as a proxy for the overall socioeconomic status of the district and is created through a factor analysis of seven variables measuring housing environment (the condition of the roof, floor, and wall), the type of fuel used by the household, and the toilet (flush/others) and water (piped water/others). Cronbach's alpha for the wealth index is 0.67,

indicating its overall good fit. It is assumed that children's immunization status is positively associated with a district's wealth and proximity to urban centers and negatively related to the proportion of minority groups residing in the district, since they typically are disadvantaged on a variety of socioeconomic measures as well as access to healthcare facilities, hygiene, and basic infrastructure (Jeffery and Basu, 1996). Missing values for all the covariates were imputed through series means imputation.

Analytical Strategy

A majority of sociological studies pertaining to maternal education and child health continue to focus on micro-level predictors and studiously ignore higher-level effects such as the neighborhood, community, or even district. This is primarily due to problems in transporting these higher effects into individual-level examination as well as choosing the appropriate units *and* levels of analysis (Lee and Bryk, 1989). However, even when such effects are included in single-level equations, the results can be misleading due to aggregation bias, misestimated standard errors, and heterogeneity of regression (Bryk and Raudenbusch, 1992). Such methodological problems are corrected by hierarchical linear modeling (HLM), which permits simultaneous estimation of full individual-level and district-level models.
In light of the multilevel nature of the research question posed in this study, i.e. the effect of aggregate female literacy on children's complete immunization status, I will use HLM to explain various contextual and compositional effects of child immunization. HLM, which employs maximum likelihood statistical estimation, provides relevant tools for modeling within and between social phenomena, thus allowing for the direct representation of the influence of district-level factors on structural relations within districts through a set of

regression coefficients. The method adjusts for the correlated errors among individuals within the same districts and uses the appropriate degrees of freedom for district-level hypotheses.

Because analysis in HLM cannot proceed with missing data in the dependent or level 2 variables, the macro and micro-level datasets were first read into STATA 7.0. Basic data analysis steps such as imputing missing values through series means or dropping cases, checking frequencies, running descriptive analysis, distribution, and correlations of included variables were performed. Finally, STATA datasets were converted into SPSS through Stat Transfer 6.0, which were then read into HLM to create an SSM and to run several multi-level models (Bryk and Raudenbusch, 1992).

A two-level model with several predictors of child's immunization status at both child- and district-level is used in this study. In the analysis of average district differences, the level-1/individual-level model is:

[1.1] $$Yij = \beta_{0j} + \Sigma\beta kj(Xijk - X..\ k) + e_{ij}$$

where

- Y_{ij} = log odds of being IMMUNIZED for child i in district j.
- β_{j0} = the intercept or the overall log odds of immunization of child i in district j.
- βkj = the slopes for k individual-level control variables Xijk (fixed across districts)
- (Xijk-X.. k) = individual-level variables that are grand mean centered.
- e_{ij} = the individual-level error term

The level 2/district-level model is:

[1.2] $$\beta_{0j} = \gamma_{00} + \gamma_{01}*(\text{Proportion of literate females above age 15}) + \Sigma\gamma_{0m}Z_{jm} + u_{0j}$$

[1.3] $$\beta kj = \gamma_{k0}$$

where:

- γ_{00} = intercept for the district-level model of the log odds of a respondent's immunization ($\beta 0j$) across the population of j districts
- γ_{01} = log odds of being immunization associated with the effect of proportion female literates above age 15.
- u_{0j} = the error term for the district-level random effect on the intercept
- γ_{0m} = district-level coefficients for m district-level control variables Zjm
- γ_{k0} = constant coefficients βkj across all districts

To summarize the equations presented above, Y_{ij} represents the log odds of being immunized for a child *i* residing in district *j* as a function of various individual-level (child, mother, and household) background characteristics X_{ijk} and the random error e_{ij}. All independent variables included in level-1 of the model lead to level-2 equations where each coefficient at level-1 becomes an outcome variable at the second level. A variable that is kept random allows for variance between districts for that particular parameter; fixing, on the other hand, does not allow for variation between districts. In my models, all the effects of the individual variables are fixed, while no slope has been modeled. The intercept is predicted by several variables at the district level with individual-level variables acting as controls. Finally, in the models, individual-level control variables and all variables at the district-level are centered at their grand means, so that the intercept is interpreted as the immunization status in children with average individual-level characteristics in a district with average district characteristics.

RESULTS AND DISCUSSION

To reiterate, through hierarchical linear modeling, this study examines 1) whether the correlation between immunization status and the proportion of literate females in a district is statistically significant, 2) if the relationship can be explained by compositional effects of the mother' own educational attainment, rather than contextual effects, and 3) how the proportion of literate females in a district affects children of both educated and uneducated mothers.

Table 3 reports the stepwise results of the multi-level analysis. Model 1 estimates the effect of district-level average literacy for women above age 15 on the individual-level dependent variable: child immunization. In Model 2, district-level controls are introduced to investigate if the relationship observed in Model 1 remains consistent and robust. Model 3

includes all the variables at the individual as well as district-level in order to evaluate: (1) the robustness of the contextual effect (by controlling for individual-level factors), and (2) the extent to which the compositional effect at the individual-level explains the effect, if any, of the observed relationship between aggregate female literacy rate and child immunization.

INSERT TABLE 3 HERE

Model 1 highlights the positive and significant relationship between the proportion of female literates in a district and a child's immunization status against six potentially fatal, but preventable, diseases. Without any control variables, the log odds of children being completely immunized are three times higher ($\gamma_{01} = 3.24$) if they reside in an area where, on an average, a higher number of adult females 15 years and older are literate as opposed to those children living in a district with low female literacy.

Model 2 adds five district-level controls: the wealth index, proportion of urban population, and the proportion of the population belonging to SC, ST, and Muslim groups. Despite a decline in the main coefficient, the significant relationship between children's immunization status and average literacy levels in a district persists ($\gamma_{01} = 2.4552$), lending support to my first hypothesis that a significant positive relationship exists between female literacy rates in an area and the immunization status of children residing in that area. An interesting issue that also emerges from Model 2 is the significant negative association between the proportion of Muslims in a district and immunization status ($\gamma_{04} = -1.8489$), implying that the log odds of children being inoculated are almost twice reduced if they reside in a predominantly Muslim district as opposed to a districts with populations of other social

backgrounds. Thus, the various socioeconomic disadvantages (higher poverty rates, lower incomes, and lack of healthcare facilities and infrastructure in minority areas) experienced by Indian Muslims and their children, is empirically highlighted (Jeffery and Basu, 1996).

One could support the observations in Model 2 by arguing that districts with high average female literacy have a large number of fully immunized children simply because of the presence of a large number of educated mothers, whose children, by extension, tend to be in better health. And, the fact that maternal education, household socioeconomic status, and the area of residence tend to be highly correlated suggests that well-educated mothers, on an average, live in more-economically developed areas with better medical facilities as well as high levels of hygiene and infrastructure (Desai and Alva, 1998; Palloni, 1981). So, the presence of large number of such individuals in a district will, by extension, increase overall levels of children's immunization status in that district. On the other hand, another way to justify these results would be to maintain that districts with high female literacy rates (and socioeconomic status) have a higher proportion of immunized children because even those mothers who are *not* educated may be getting their children immunized because of a variety of contextual factors such as knowledgeable social networks and effective healthcare systems and norms. These facilities are available to these mothers because of the educated mothers around them (the networks) as well as the higher socioeconomic status of the area (the institutions).

Finally, in order to test the robustness of the contextual effects as well as the proportion of the variance that is explained by the compositional factors, controls for the individual mother's education (at the micro-level) are introduced in Model 3. Results for the effect of district-level aggregate adult female literacy on a child's immunization status remain

consistent: i.e. significant and robust (γ_{01} = 1.6746) even after accounting for a wide range of individual-level variables. Thus, the log odds of being fully immunized, *regardless of the mother's own education status*, are higher for children residing in districts with a higher proportion of female literates above age 15 than those residing in districts with low female literacy. A comparison of the female literacy coefficient in Model 2 (γ_{01} = 2.4552) with the female literacy coefficient in Model 3 (γ_{01} = 1.6746) indicates that almost 68% of the district effect is contextual in nature while 32% is compositional. This ratifies my second hypothesis that the contextual effect of female literacy on child immunization status is likely to persist and be significant even after controlling for individual-level characteristics such as maternal education and other macro-level characteristics such as wealth and level of urbanization. Finally, the significant constant coefficient for all 3 models indicates that overall differences in children's immunization status do exist between various districts.

Consistent with Model 2, the effect of the proportion of Muslims residing in a district on children's immunization status still remains significant and negative (γ_{04} = -1.8026); i.e. the log odds of children not being fully immunized in predominantly Muslim districts is still high, even after controlling the individual-level characteristics (such as socioeconomic status and social background) of the child. What this implies is that even if a child has an educated mother, or comes from a household with high socioeconomic status, or is not a Muslim, just the fact that he/she resides in a Muslim area (that tend to be more impoverished than areas with other minority/majority groups) increases the child's risk of contacting six potentially fatal diseases. In fact, it is disturbing to note that almost 97% of the effect is contextual, rather than compositional.

Although studies argue that the gender gap in child health is closing due to extensive preventative programs that prioritize immunization, individual-level models (not included here) indicate that gender differentials in immunization still persist (United Nations 1998). In separate analyses not included, the slope for gender was modeled, and the significant constant coefficient for the 3 stepwise models suggested that irrespective of the characteristics of the district, boys are more likely to be immunized than girls. In the present analysis, children whose mother's have completed their matriculation as well as children from households with high socioeconomic status (as indicated by the household possession index) are more likely to be immunized completely. Although this finding is not surprising since both variables are highly correlated, it does bear testament to the fact that aggregate female literacy in a district *does not* negate the effects of individual maternal education on a child's immunization status (Desai and Alva, 1998). On the other hand, compared to other social castes and tribes, children belonging to scheduled tribes have a lower probability of being immunized.

Changes in the significance of individual-level logistic regression coefficients (not reported here), when introduced into Model 3 of the stepwise models, further substantiates my story that a child's immunization status is affected by more than just individual-level characteristics: it is also affected by the *larger context* in which the child resides. Although level-1 coefficients (in the individual-level analyses) are almost identical to those reported in Model 3 (with the macro-level variables), some surprising changes do occur. Specifically, the individual-level coefficient for Muslims, women with primary school education, a woman's exposure to the mass media (newspapers, radio, and television), as well as belonging to scheduled caste, which were highly significant in the individual-level model, lose significance

when introduced into Model 3, implying that these effects are washed out by district-level contextual characteristics. Further research is needed in this area.

CONCLUSIONS

Departing from previous studies, this research shifts the emphasis from an exploration of the relationship between maternal education and child health at the individual level alone to the effect of the larger contextual characteristics of a child's environment on the child's health. Such an inquiry also highlights the richness of social interactions and networks. I find that districts with high female literacy rates have a higher proportion of immunized children because even those mothers who are *not* educated may be getting their children immunized because of a variety of contextual factors such as knowledgeable social networks and effective (and responsive) healthcare system. Thus, as the proportion of literate women increases in an area, so does the overall level children's immunization in that area, even after controlling for mother's education at the individual-level.

Certain limitations regarding the use of specific variables in this analysis need to be addressed. First, while this study documents the relationship between proportion literate women in an area and child immunization, it does not clarify *how* this relationship is maintained due to lack of data. Second, the district-level explanatory variable, "adult female literacy," which includes all literate rural women above the age of 15, fails to account for *the quality* as well as *consistency of education* among the literates between states. Does literacy refer to specific skills and knowledge provided by formal education, or is it the ability to write one's name and recognize the alphabets, which is the conventional definition of literacy in certain Indian states? Yet, as demonstrated in this paper, even this crude indicator of

educational levels performs well in predicting the inter-district variations in child immunization. Finessing the variable to make it more meaningful is a future project.

Finally, although the intent was to observe possible diffusion effects of urbanization, the variable, "proportion of urban population," presents a challenge. While this analysis is restricted to rural districts of India due to the constraints imposed by the individual-level HDPI dataset, an urgent need to study child immunization in the context of urban poverty exists since we cannot assume that urban poverty is less acute or affects fewer people than rural poverty. The reality is that due to increasing urbanization and migration, urban and rural development are not separate entities which can be understood and supported independently from each other, but are linked in multiple complex ways. Again, inclusion of this variable widens avenues for future research projects, although it would also be meaningful to observe *other* indicators of child health such as stunting or wasting that are more responsive to context and environment, as opposed to child immunization, which is affected by women's agency.

A surprising non-finding in this study pertains to the effect of the wealth index since one would expect, from previous research, to find the socioeconomic status of the district to be positively related to children's immunization status. Maybe it could be due to the crude housing and standard of living indicator created, and more thought needs to be given to alternate measures. The same applies to the non-finding related to the proportion of scheduled castes and tribes residing in the district. Finally, although the significant coefficient for gender indicates that irrespective of the area under consideration, boys are more likely to be immunized than girls, modeling the slope to demonstrate gender *equity* yielded non-significant results (analyses not included).

The present analysis strongly supports the view that increasing women's education is an effective way of increasing child immunization because, one could argue, education raises women's health-seeking consciousness, enables them to mobilize community resources and public services, improves their ability to access information, skills, services, and technologies, and increases their political participation (Caldwell, 1994). Putting that within a context, I argue that raising the abilities of the population as a whole would also influence those with poorer abilities. Thus, policy interventions should aim to enable people to deal more effectively with their own health care through formal education, by disseminating information on health care through a wide variety of sources such as the mass media, as well as by encouraging and initiating the creation of social associations, clubs, and networks. Also, since cutbacks in government spending on improvements in health, education, and nutrition have resulted in widespread poverty and negative health outcomes, particularly among women and their children, it is vital that government allocate more resources and capital towards gender-sensitive social developmental (Kabeer, 1994).

Ensuring the well being of children, the next generation of citizens, is of critical concern for both parents and states (Hobcraft, 1996). Consequently, broader socioeconomic and contextual changes are necessary to conscientize women and improve child health and survival since this arena of inquiry has exposed the damaging consequences of women's powerlessness in and on society. Only then can women be agents of their own, as well as their children's, health-seeking negotiations. Deceptively simple yet overwhelmingly important, issues pertaining to child health are not just the basis of sociological inquiry, but of human existence itself.

FIGURE 1. CONCEPTUAL MODEL OF STUDY

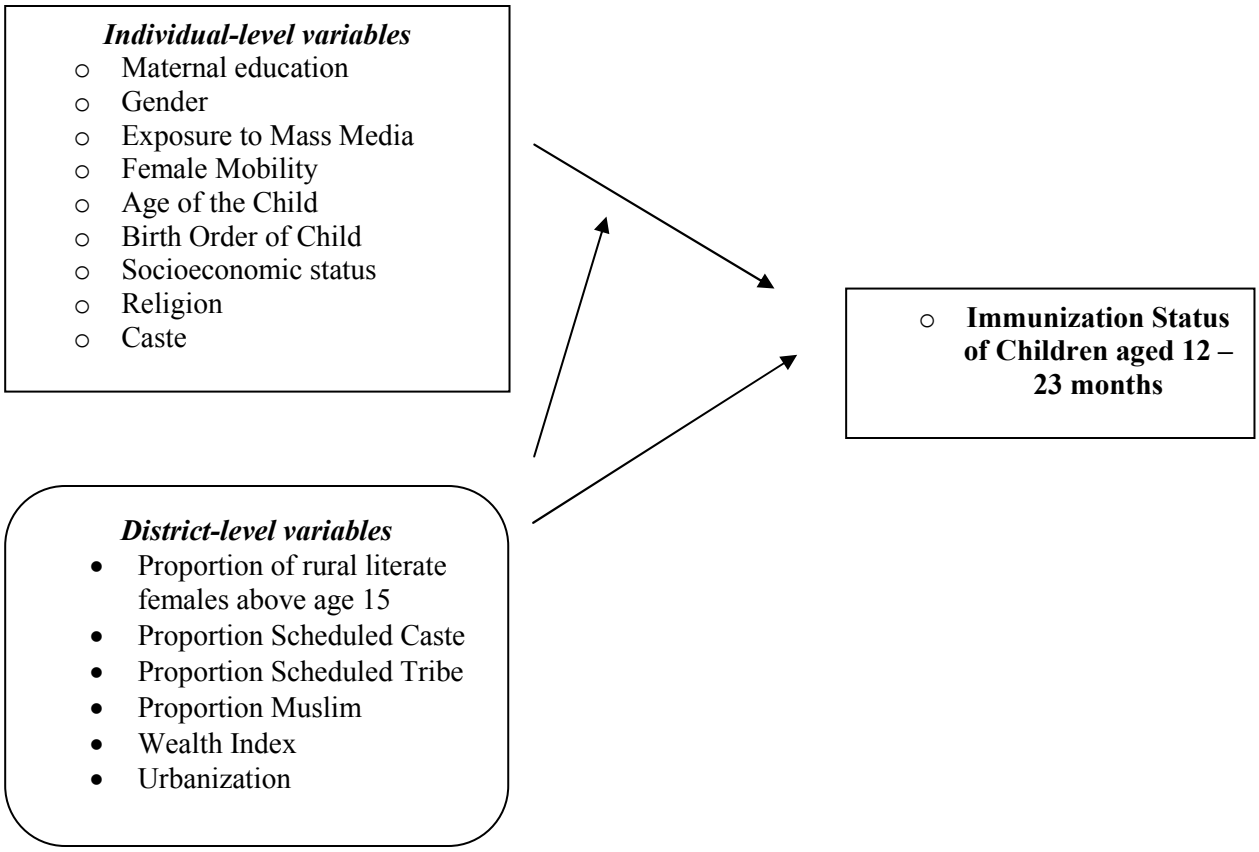

Table 1. INDIVIDUAL-LEVEL DESCRIPTIVE STATISTICS

Variable	Mean	Standard Deviation	Minimum	Maximum
Immunization Status	0.53	0.50	0.00	1.00
No education	0.75	0.43	0.00	1.00
Primary Ed	0.09	0.29	0.00	1.00
Secondary Ed.	0.08	0.28	0.00	1.00
Matriculation	0.07	0.26	0.00	1.00
Male	0.53	0.50	0.00	1.00
Assets	5.11	1.82	1.67	11.86
Exposure to Mass Media	1.86	1.07	1.00	5.00
Mobility of household women	0.40	0.49	0.00	1.00
First order birth	0.24	0.43	0.00	1.00
Second/Third order	0.43	0.49	0.00	1.00
Fourth and above birth order	0.33	0.47	0.00	1.00
Scheduled caste	0.23	0.42	0.00	1.00
Scheduled tribe	0.25	0.36	0.00	1.00
Non-scheduled caste/tribe	0.61	0.49	0.00	1.00
Hindu	0.81	0.39	0.00	1.00
Muslim	0.13	0.34	0.00	1.00
Other religions	0.06	0.23	0.00	1.00
N = 4023 children between age 12 – 23 months				

Source: Human Development Profile Index, India

Table 2. DISTRICT-LEVEL DESCRIPTIVE STATISTICS,

Variable	Mean	Standard Deviation	Minimum	Maximum
Proportion of literate females	0.16	0.13	0.02	0.70
Proportion of Muslims	0.10	0.12	0.00	0.70
Proportion of scheduled castes	0.17	0.07	0.00	0.37
Proportion of scheduled tribe	0.10	0.16	0.00	0.88
Proportion of urban population	0.21	0.11	0.03	0.75
Wealth Index	30.52	12.58	6.60	68.12
N = 195 districts				

Source: Census of India, 1991

Table 3. HIERARCHICAL LINEAR MODEL RESULTS FOR INDIVIDUAL AND DISTRICT EFFECTS ON AN INFANT'S IMMUNIZATION STATUS

	Model 1	**Model 2**	**Model 3**
District-level variables			
Intercept (Immunization Status) γ_{00}	0.2798***	0.2897***	0.2096***
Average female literacy rate γ_{01}	3.2379***	2.4552**	1.6746*
Proportion of Scheduled Caste γ_{02}		-1.8263	-1.6628
Proportion of Scheduled Tribe γ_{03}		-0.9695	-0.7223
Proportion of Muslims γ_{04}		-1.8489**	-1.8026**
Proportion of Urban Population γ_{05}		0.5771	0.8600
Wealth Index γ_{06}		0.0081	0.0029
Individual-level variables			
Educational Attainment			
No education (Ref category)			
Primary γ_{20}			0.2067
Middle school γ_{30}			0.1797
Matriculation and above γ_{40}			0.4070**
Sex of the child γ_{10}			0.1234*
Assets of the household γ_{50}			0.0888***
Exposure to mass media γ_{60}			0.0880
Physical mobility γ_{70}			0.1136
Social Background			
Non sch. caste/tribe (Ref category)			
Scheduled Caste γ_{80}			-1595
Scheduled Tribe γ_{90}			-0.2989**
Religion			
Hindus (Ref category)			
Muslims γ_{100}			-0.1321
Others γ_{110}			-0.0284
Birth order of child			
First (Ref category)			
Second or third γ_{120}			0.0890
Fourth and above γ_{130}			-0.0462

$^{+}$ significant at $p < 0.10$ * significant at $p < 0.05$ ** significant at $p < .01$ *** significant at $p < .001$

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