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Place, Community Education, Gender and Child Mortality in North-East India

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ABSTRACT

This article examines the relevance of socio-cultural and environmental factors in explaining child mortality in Northeast India, considered to be the most inaccessible region in the country. Using data from the Indian National Family Health Survey, we provide evidence that lack of hygiene in the household and poor women's engagement in physically demanding agriculture based work contributes to higher risk of child mortality. Unlike in other parts of India, female children have an edge over boys in childhood survival and living with paternal grandmother tends to lower the risk of child death in the first five years of life. Community education is found as the dominant factor outside the household to have a significant effect on child mortality.

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INTRODUCTION

The community environment in which a child is born and brought up is like a nutrient influencing childhood survival. Place, because of its social significance, is therefore a key consideration in understanding variations in child mortality. In the Indian context, community level considerations have been undertaken in several recent analyses of child mortality (Krävdal, 2004) and fertility (Moursund *et al*., 2003; and McNay *et al*., 2003). Examples of prominent background or community characteristics that have been considered significant in the study of the determinants of child mortality include women's education (Das Gupta, 1990), women's economic roles (Basu and Basu, 1991), community attitudes to birth spacing and sibling rivalry (Whitworth and Stephenson, 2002), sex of child (Kishore, 1993; Chen *et al*., 1980; Vella *et al*., 1992a, 1992b), nutrition (Chaudhuri, 1984; Briend *et al*., 1988), and birth intervals and breast feeding practices (Palloni *et al*., 1986; Pebley *et al*., 1987; Retherford *et al*., 1989; Forste, 1994).

However, much of what we know about the correlates of child mortality in India may not apply to communities which are inaccessible and isolated from mainstream Indian culture. For example, in North India, Jatrana (2004) noted that infant mortality was affected by the non-utilization of colostrums in breast milk and the presence of refuse and animals in people's courtyards. The northeastern region of India comprising eight small states (namely Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura) is the abode of many tribal peoples who live in their traditional homelands. Many of them have different sociocultural beliefs and practices from mainstream Hindu or Islamic culture. Mountainous terrain and seasonal problems with communication mean that much of northeast India is separated from the rest of the country physically and culturally. Therefore, this paper tries to measure covariates of child mortality that are relevant to the specific circumstances of Northeast India, including especially the effects of the shared environment of upbringing. It is not surprising that child mortality data are often clustered within communities and families since children living in the same community often share community health care and educational facilities. Their health is affected

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by shared services such as access to electricity. In addition, at the household level clustering might be expected not only because of biological factors such as is common from a shared gene pool, but also household level effects such as family income levels that impact on nutrition and other dimensions of child health. Das Gupta (1990) in her study of determinants of child mortality in rural Punjab found a strong tendency for child deaths to cluster within families even after controlling for a number of socio-economic and biological factors.

Rao, Ladusingh and Pritamjit (2004) also found that sociocultural practices had a significant effect on nutrition. This in turn had a bearing on child mortality in isolated communities of Northeast India. Child mortality data, collected from demographic and health surveys are usually based on multistage sampling designs. These may induce dependence in the data structure. Ignoring clustering in child mortality and the dependent nature of data in the analysis of child mortality can yield spurious results. Keeping these factors in view, recent analyses of infant and child mortality have attempted to capture clustering of child deaths while tackling the problem of interdependence in the data structure induced by the sampling design. Examples include Guo and Rodriguez (1992), Sastry (1997), Bolstad and Manda (2001), Whitworth and Stephenson (2002) and Krävdal (2004). Such considerations are also found in Madise, Matthews and Margetts (1999) and Griffiths, Matthews and Hinde (2002).

This paper commences with a review of the literature relating to the role of place-based factors in child mortality. This tries to draw on research from around the globe in order to make it possible to appreciate better those factors that are specific to Northeast India that emerge in the body of the paper. Following a discussion of the background to the authors' survey material the paper then turns to analyzing a range of socio-demographic variables that influence childhood mortality in Northeast India. The results of the main analysis are presented relative to five multilevel logistic models that explore the relative power of place-based explanatory variables.

PLACE MATTERS: A REVIEW

Most of the studies, which investigate determinants of child mortality, look into the association with individual and household variables. However, local effects outside the household matter because socio-cultural and economic influences within the community affect health, especially of the most vulnerable groups in a population. In a study of maternal care and childhood immunization in Guatemala, Pebley *et al*. (1996) found that women living in municipalities with a high concentration of indigenous as opposed to ladino people were less likely to use formal prenatal care and formal assistance with child delivery. This was regardless of family, social and economic characteristics. Sastry (1996) attributes the differential child survival between the Northeast and South/Southeast of Brazil to the poor community water supply and sanitation in the North East and to unevennesses in the quantity and quality of medical facilities. Sastry also found an association between child mortality and community levels of education. This influenced norms and attitudes to childcare and reproductive behaviour. In Malawi, Bolstad and Manda (2001) investigated sociological and biological factors affecting child mortality, a country where infant mortality rates are still one of the highest in the world. They concluded that considerable variations in child mortality were due to family and community effects.

From a study of child mortality in a farming population in Gambia, where women are expected to undertake heavy agricultural labour, Sear *et al*. (2002) found that children living with their maternal grandmothers had significantly lower levels of mortality during their early years as toddlers, but not during infancy or later childhood. They also found striking differences in child mortality among the four villages in their study, even though the villages were only a few kilometers apart. This was mainly due to variations in malaria rates and access to better quality land in some of the villages. Balk *et al*. (2004), in their study of West Africa, argued that variation in child mortality could not be explained exclusively by a traditional set of individual level socio-economic and bio-demographic characteristics. They emphasized the importance of integration of community-levelmacro-environmental and spatial factors with individual level characteristics. In a study of child mortality in ten countries (Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Ghana, Guinea, Mali, Niger, Senegal and Togo) they showed that spatial variations in

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urban proximity, population density, distance to the coast, climatic variations, farming systems and geographical patterns of disease were important influences worthy of research. They also investigated state-level influences, noting infant mortality risks were lower in Ghana than in the nine other countries. The country effects on the relative risk of child mortality largely became insignificant, however, after household and spatial variations were incorporated into the analysis. The differential in child mortality between the ten Western African countries was attributed mainly to spatial variations within these countries. They found rainfall to be weakly significant with infant mortality. Urban residence was found highly beneficial to infant survival. Infant mortality tended to increase with distance from the African coast, and the presence of tree crops were found to be the most advantageous because of their influence on nutrition.

In a study of the association between urban poverty, unmet need for contraception, birth attendance and height for age of children, Montgomery and Hewett (2004) have recently produced some interesting findings. They have demonstrated that in urban localities of developing countries, unlike in the West, poor households often have more affluent neighbours. This generates health and social externalities. Neighbourhood interactions produce key information flows as well as impacting on local service provision. Their study therefore makes the case for recognizing geographical variations in the power of social networks in influencing patterns of child health. Montgomery and Hewett concluded that wherever living standards at cluster level were significant, the cluster effects were of substantive importance. Their work therefore confirmed the importance of neighbourhood effects in the study of urban poverty and child health.

The foregoing discussion has highlighted the importance in the academic literature of factors outside the household in determining differentials in child mortality. The effects are sometimes in addition to household and individual effects and sometimes they are intertwined in complex ways with determinants at other levels. Not only is it therefore important for researchers to remember to look for community and neighbourhood influences, but it is also critical that appropriate modeling tools are used to detect the nature of these effects.

THE ROLE OF COMMUNITY VARIABLES IN CHILD HEALTH IN NORTHEAST INDIA

In isolated communities of tribal people, decision-making at the household and community level rests on the household head. They occupy the highest position in the local social hierarchy. Working with other heads of household they will be responsible for the quality of the local drinking water supply, the development of irrigation cannels, decisions about the nature of local agriculture, the organization of local health facilities, the quality of local infrastructure and the uptake of educational and health care facilities. The educational level of head of households in a community such as this is therefore of vital importance in determining the welfare of the wider community. As such, the importance of measuring aggregate educational attainment of head of households in a study of child mortality can not be overstated.

The role of elderly members of household in particular can have an effect on child mortality. In agriculture-based communities, it is a common practice that household members work together in the fields by day leaving behind children in the care of senior household members. In households where the mother-in-law is present, the daughter-in-law also feels freer to discuss matters relating to childcare and personal hygiene with her, in addition to tapping the physical and moral support provided by the older generation. In view of this evaluation the presence of a maternal grandmother in a household becomes an important issue in the context of Northeast India.

The social status of women in the Northeast India is high relative to that of women in many parts of the country where purdah and caste-based rules restrict their activities. But this greater freedom may also be problematic. Many work as much as men in the fields and farms besides attending to household chores. After returning home late in the evening from agricultural work, women must be ready again for work in the field early in the morning. This physical exertion can reduce their capacity for breast feeding. Basu and Basu (1991) have provided evidence that women's work, in spite of its other benefits has one crucial adverse consequence – a higher level of child mortality than amongst women who do not undertake heavy agricultural work.

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Unlike other parts of India, in the Northeastern region daughters are not considered as liabilities and by and large the dowry system (the payment of a bride price) does not exist. In fact India's only matriarchal states are Meghalaya and Arunachal Pradesh, both located in the Northeast. Marriage is largely on individual choice and parents are only involved in the ceremonialal rites. All these make discriminatory treatment of daughters limited relative to the rest of India.

Child mortality is also affected by household hygiene, as well as standard of living. Most households in the Northeast do not have access to modern toilet facilities particularly communities living in the hills. Lack of modern sanitation is a major public health risk that impacts child health more than other members of the communities. In summary there are several community level factors particular to the context of Northeast India that this paper identifies as especially important in the analysis of patterns of infant and child mortality.

SOURCE OF DATA AND VARIABLES

The two rounds of India's National Family Health Survey (INFHS), 1992–1993 and 1998–1999, provide representative data on child mortality. For the present study we have used the latest INFHS-2 (1998–99) data. The survey collected information on household socio-economic and environmental conditions, complete birth history of women on retrospective basis, women's bio-demographic characteristics and health seeking behaviour. The survey adopted a multi-stage stratified cluster sampling design. The primary sampling unit (PSU) is either a village or portion of a village in rural areas. In urban areas the Urban Frame Survey (UFS) of the National Sample Survey Organisation (NSSO) has been used. For this study child mortality by age in months was measured for single live births born in the five years period preceding the survey. A total of 7774 single live births were recorded in the survey. 489 of these were followed by deaths before the fifth birthday.

The community-level effects introduced above were measured as follows. Community education was considered as an indicator of the preparedness of a community to provide a conducive supporting environment favouring child survival. Community education was measured by the average years of schooling of head of households in the community, which in the study was operationalised at the level of the primary sampling unit. The majority of head of households had completed 3–6 years of schooling. Residential background was also treated as part of community background. The sex of the oldest (index) child was incorporated in the model to examine prevalence of child sex discrimination as found in other parts of India. Previous birth interval was categorized as less than 24 months, 24–36 months, beyond 36 months. First birth was taken as yet another important predictor of child mortality included in the present study. Keeping in view that children born to younger mothers are at greater risk of dying in childhood, maternal age at the delivery of the oldest child was included relative to the age categories below 18 years, 18–24 years and 24 years above. Mother's education and working status are also incorporated in the study. Toilet facilities were taken as a proxy of household hygiene. They were coded as flush, pit and no facility. Use of pit latrines is a common practice in the region and a substantial proportion of households do not have any toilet facility at all.

In view of the role of paternal grandmother in bringing up children in Northeast India, households were dichotomized between those where the grandmother was present and those where she was absent. The ranking of a household standard of living index (SLI) into low, medium and high was based on the total scores assigned to certain consumer durables, housing conditions, ownership of agricultural land and livestock and other items in the household graded numerically in terms of their value or importance. Index scores ranged from 0-4 for low SLI to 15–24 for a medium SLI and 25–67 for a high SLI. Table 1 provides details of variables and coding categories.

Figures 1 through 4, provide box-plot depictions of the age distribution of children born in the five years period preceding the INFHS-2 by survival status and a few background characteristics. The age distribution of living children born in the last 5 years does not reflect much heterogeneity by background characteristics with median age closely clustering around 30 months. However, the age distribution of children who died in the five year period preceding the survey

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Table 1. Distribution of live births and deaths by background categories used in the analysis.

Background characteristics	Live births %	Child deaths %
Sex of child		
Male	4069(52.3)	265(54.2)
Female	3705(47.7)	224(45.8)
Previous birth interval		
<24 months	1630(21.0)	152(31.1)
24–36 months	2069(26.6)	125(25.6)
>36 months	1871(24.1)	75(15.3)
First birth	2204(28.4)	137(28.0)
Maternal age at child birth		
<18 years	526(6.8)	55(11.2)
18–24 years	2970(38.2)	177(36.2)
24+ years	4278(55.0)	257(52.6)
Mother's work status		
Not working	5022(64.6)	294(60.1)
Working	2752(35.4)	195(39.9)
Mother's education		
Illiterate	3228(41.5)	256(52.4)
Lower middle	2393(30.8)	143(29.1)
Middle	1191(15.3)	56(11.5)
High school & above	962(12.4)	34(7.0)
Residence background		
Rural	6231(80.2)	427(87.3)
Urban	1543(19.8)	62(12.7)
Standard of living index		
Low	2675(34.4)	217(44.4)
Medium	3810(49.0)	218(44.6)
High	1289(16.6)	54(11.0)
Household toilet facility		
Flush	1324(17.0)	50(10.2)
Pit	3884(50.0)	245(50.1)
No facility	2566(33.0)	194(39.7)
Grandmother in the household		
No	7214(92.8)	458(93.7)
Yes	560(7.2)	31(6.3)
Aggregate community education		
Less than three years	1954(25.1)	170(34.8)
3–6 years	3729(48.0)	236(48.2)
6+ years	2091(26.9)	83(17.0)
Total	7774	489

Note: Figures in parentheses are percentages of total live births and deaths.
Source: Northeast Region, INFHS-2 (1998–99), International Institute for Population Sciences, Mumbai.

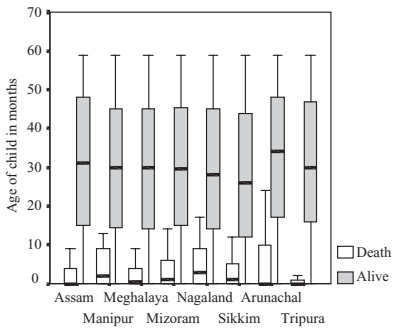

Figure 1. Distribution of children by states and survival status.

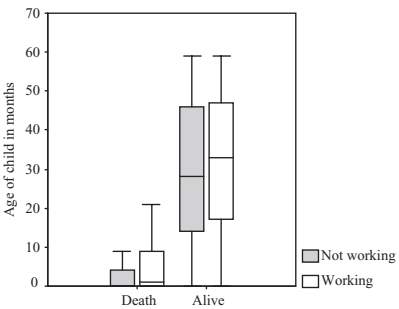

Figure 2. Distribution of children by mother's working status and survival status.

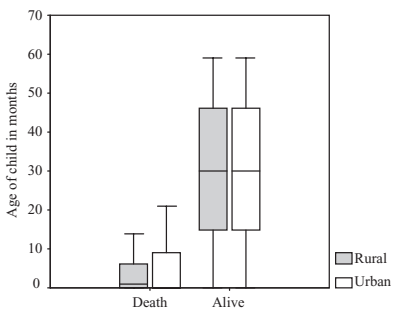

Figure 3. Distribution of children by place of residence and survival status.

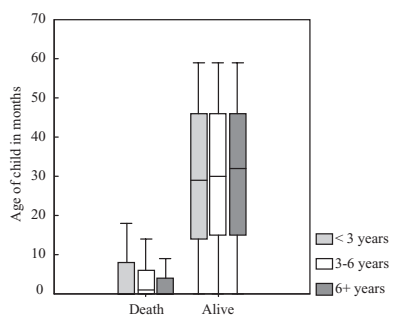

Figure 4. Distribution of children by aggregate educational level of household head and survival status.

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is very skewed and differs by background characteristics. There is clear evidence of clustering of child deaths among working women and in households where the household head had low educational attainment. Deaths happen at the youngest ages in Assam, Meghalaya, Arunachal Pradesh and Tripura.

MULTI-LEVEL ANALYSIS

There is strong evidence from India and elsewhere of clustering of child deaths within families owing to shared community and maternal characteristics (Das Gupta, 1990; Curtis *et al.*, 1993; Curtis and Steele, 1996). Multi-stage stratified cluster sampling adopted in INFHS-2 induced a hierarchical dependent data structure wherein women are located within households which in turn are identified within communities. As such we can no longer apply normal statistical techniques, which assume that child deaths are independent. Multi-level analysis provides scope for modeling clustered data, allowing correction of standard errors and estimation of degrees of freedom in a situation where the outcome varies significantly between higher order units (Goldstein, 1995). A two level discrete hazard model is used for analysis in this study. A multi-level discrete time hazard model is essentially a multi-level logistic model. Let y_{ij} be the binary response for the i^{th} child in the j^{th} community, with $y_{ij} = 1$, if the child dies under five years of age. If $\pi_{ij} = P(y_{ij} = 1)$, then the two level logistic model can be written as

$$y_{ij} = \pi_{ij} + e_{ij} \tag{1}$$

where,

$$\log it(\pi_{ij}) = \beta_{oj} + \beta_{1j}X_{ij} + \sum \beta_{ij}X_{ij} \tag{2}$$

$$\beta_{oj} = \gamma_{oo} + u_{oj}, \quad \beta_{1j} = \gamma_{1o} + u_{1j} \tag{3}$$

The error terms e_{ij} and (u_{oj}, u_{1j}) are uncorrelated. This random intercept and random slope model assumed an average probability of child death and community education varying randomly across communities. Model assessment in terms of variation in child mortality is explained by covariates at the two levels with reference to the empty model:

$$\log it(\pi_{ij}) = \beta_{oj} + e_{ij} \tag{4}$$

Snijders and Bošker (1999) defined the variation explained by variables at level one and level two as

$$R_1^2 = 1 - \frac{(\hat{\sigma}_u^2 + \hat{\sigma}_e^2/n)\ for\ fitted\ model}{(\hat{\sigma}_u^2 + \hat{\sigma}_e^2/n)\ for\ empty\ mode} \tag{5}$$

$$R_2^2 = 1 - \frac{(\hat{\sigma}_u^2 + \hat{\sigma}_e^2/n)\ for\ fitted\ model}{(\hat{\sigma}_u^2 + \hat{\sigma}_e^2/n)\ for\ empty\ model} \tag{6}$$

where $\hat{\sigma}_u^2$, $\hat{\sigma}_e^2$ and n are the estimated errors of level two, level one and average number of children in the communities.

RESULTS

The multi-level logistic model described in the preceding section was applied to the child mortality data of Northeast India incorporating maternal education, community education, household and other individual characteristics in a stepwise manner to discover whether child mortality depends not only on individual and household characteristics but also to a large extent on influences of the community level. Model I is an empty model without any control variables but with a random intercept for communities measuring variation in aggregate risk of child death between communities. In addition to a random intercept, Model II considered mother's educational level to signify the importance of maternal education on enhancement of child survival.

As outlined in the background to this paper, in Northeast India community involvement plays an important role in ensuring overall welfare and development. Household heads as community leaders are responsible for educational and healthcare facilities, the quality of drinking water, electricity connection, providing irrigation facilities and other aspects of infrastructural development. In order to focus on the importance of these dimensions of community support, Model III includes average years of schooling of the head of households at the level of the community. Models II and III were designed to bring to light the relative importance of maternal education and community preparedness in providing a conducive supportive environment for newborn babies and young children.

Model specification including both maternal education and community education is represented by Model IV which includes in addition

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the sex of the index child, previous birth interval, maternal age at delivery of the index child, maternal working status, residence background, presence of grandmother in the household, household toilet facility and household standard of living index (SLI), as controlled variables. To investigate the joint effect of work status of women and SLI, an interaction between these two covariates is included in Model V in addition to other covariates in Model IV.

Table 2 displays the parameter estimates of these models. For each model, parameter estimates (that is, the coefficient of covariates) in the logistic model are provided and the corresponding standard error is shown within parenthesis. The exponentiation of the estimated parameter of a correlate yields odds of child mortality associated with the particular category of the correlate relative to the reference category while the rest of the covariates are controlled. For assessment of model fit a summary statistic is also included in the form of deviance, which measures the extent to which the fitted model deviates from the saturated model. In the case of individual level binary data the likelihood for the saturated model being 1, the deviance is simply the value of minus twice the natural logarithm of the likelihood. The approach followed for assessing model fit is to find the difference in the deviances from alternative models. The difference in deviance follows an exact Chi-square distribution with degrees of freedom equal to the difference in the number of parameter in the competing models.

The significance of the random intercept at $p < 0.05$ in all the models is indicative of the ground reality that in Northeast India there exists considerable variation in child mortality even after controlling for individual, household and community factors. The result of Model II reflects the significance of maternal education as an individual level characteristic accounting for variation in child mortality. The inverse relationship between maternal education and child mortality is evident in studies by Cleland and Sathar (1984); Pebley and Stupp (1987) and Hobcraft *et al*. (1985). These are once again confirmed from the present study. The odds of child mortality of those born to mothers educated up to high school and above is 30 percent less compared to children of uneducated women. This is statistically significant at probability level $p < 0.05$.

Looking at the role of community elders, the supporting environment of the community was measured by community educational attainment. It is not surprising to note from the result of Model III that community education also had an inverse relationship with child mortality and that this association was statistically significant at $p < 0.05$. It is also worth noting that the explained proportion of variation in child mortality was 16 per cent with maternal education as the only controlled individual level factor. The explained proportion of variation in child mortality was 25 per cent due to community education alone. This clearly suggests the importance of both individual and community education in explaining child mortality. In isolated localized communities of Northeast India, the significance of community education in enhancement of child survival comes from the fact that the supporting environment outside the household is moulded to some extent by the literacy level of community elders. Model 3 is clearly more powerful than Model 2 given the deviance statistic, illustrating the importance of considering community as well as individual explanations of child mortality.

It is important to note from the results of Model IV that the odds of a female child experiencing death during childhood is lower than that of a male child, suggesting absence of female sex discrimination in Northeast India unlike in other parts of India. In most of India girls have much poorer life chances on account of sex discrimination in the allocation of scarce health and food resources. The findings here are in agreement with the results of Rao *et al*. (2004) in their study of the nutritional status of children in Northeast India.

To arrive at a meaningful interpretation as regards the relationship between maternal work status and child mortality, it is important to note the nature of the work in which women are engaged and utilization of agricultural production for household consumption. In Northeast India most of the women work in agriculture. Labouring in fields in tough terrain and facing the climatic extremes of the very wet and cold seasons makes this arduous work. It is therefore not surprising that children born to working women are 18 per cent more likely to die during childhood compared to children of non-working women and the differential in child mortality by working status of mother is found to be statisti-

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Table 2. Parameter estimates and standard errors for two-level models of child mortality in Northeast India.

Fixed effect	Model-I	Model-II	Model-III	Model-IV	Model-V
Intercept	–2.736**(0.053)	–2.483**(0.070)	–2.091**(0.112)	–1.592**(0.281)	–1.491**(0.285)
Sex of child					
Male[R]					
Female				–0.070(0.095)	–0.070(0.095)
Previous birth interval					
<24 months[R]					
24–36 months				–0.482**(0.127)	–0.489**(0.127)
>36 months				–0.875**(0.148)	–0.882**(0.148)
First birth				–0.361**(0.137)	–0.368**(0.137)
Maternal age at child birth					
<18 years[R]					
18–24 years				–0.506**(0.173)	–0.509**(0.173)
24+ years				–0.426**(0.183)	–0.423**(0.183)
Mother's education					
Illiterate[R]					
Lower middle		–0.303**(0.110)		–0.221**(0.115)	–0.222(0.145)
Middle		–0.522**(0.154)		–0.249**(0.162)	–0.232(0.167)
High school and above		–0.816**(0.189)		–0.350**(0.215)	–0.337(0.215)
Mother's work status					
Not working[R]					
Working				0.166*(0.101)	0.128(0.150)
Place of residence					
Rural[R]					
Urban				–0.033(0.174)	–0.049(0.174)
Household toilet facility					
Flush[R]					
Pit				0.299*(0.170)	0.268(0.170)
No facility				0.348*(0.182)	0.311*(0.182)
Standard of living index					
Low[R]					
Medium				–0.117(0.112)	–0.265*(0.141)
High				–0.224*(0.180)	–0.169(0.203)
Grandmother in the household					
No[R]					
Yes				–0.170(0.196)	–0.154(0.196)
Interaction					
Work × Medium SLI					0.362(0.207)
Work × High					–0.339(0.382)
Community education					
Aggregate			–0.139**(0.023)	–0.083*(0.030)	–0.084**(0.030)
Deviance	1990.37	1813.48	1748.11	1530.05	1497.28

[R]: Reference category; Figures in parentheses are S.E. of estimates; * $p < 0.10$, ** $p < 0.05$.

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cally significant at $p < 0.10$. Similar results were also revealed from the study of child mortality by Basu and Basu (1991).

Child survival to a large extent also depends on maternal age at the time of delivery. This is due to the fact that younger women are not physiologically as mature. They are exposed to a higher risk of pregnancy and delivery complications subject their children to a higher risk of dying in childhood. Children born when their mothers were in the age range 18–24 years and older than 24 years have less than 40 per cent and 35 per cent odds respectively of dying in childhood compared to children born to young mothers below 18 years of age. These differentials in odds of childhood mortality by age at delivery are significant at $p < 0.05$.

The household toilet facility was considered as a proxy for household hygiene for the simple reason that in households with no toilet facility it is quite likely that children will be exposed to a less unhygienic environment. This is why the odds of child mortality in households which use pit latrines as a toilet facility is 34 per cent more than that of children in households which use flush toilets, and the odds become much more pronounced for households with no toilet facility at all. The differential in child mortality due to hygiene is statistically significant at $p < 0.10$.

The standard of living index (SLI) is an indicator of the overall material well being of households and it makes sense to take households with high SLI as belonging to a more affluent category. Therefore, it is consistent that the odds-ratio of child mortality decreases with increasing SLI. For high SLI households the odds-ratio of child mortality relative to low SLI households is lower by 20 per cent and this is significant at $p < 0.10$.

Elderly women, particularly the mother-in-law, look after children when other family members are away in the field during the daytime. They are also a source of guidance and physical and emotional support to younger women during pregnancy, delivery and after delivery. It was found, however, that odds-ratio of risk of child mortality was only lower by 16 per cent for households with a grandmother present compared to other households and this was not a statistically significant effect.

Even after controlling for many other variables, it is interesting to note that maternal education and community education remain significant in explaining child mortality (sex of child, previous birth interval, age at delivery, working status, residence background, toilet facility, standard of living index and paternal grandmother presence in the household). The magnitude of the child mortality differential explained by individual and community level covariates included in Model IV are 2.6 per cent and 30 per cent respectively. An interaction between working status and the household standard of living index is incorporated in Model V to examine whether the effect of working status on child mortality varies across households with different levels of wellbeing. The addition of this interaction effect alters the results of Model IV. The influence of maternal education on child mortality loses its statistical significance though the nature of relationship still holds good. The introduction of interaction between working status and SLI facilitates comparative assessment of risk of child mortality by working status at each level of household SLI. For women in low SLI households the risk of child mortality among working women in terms of the odds ratio relative to non-working women is higher by 13 per cent. In the case of women from medium SLI households, the odds of child mortality is 63 per cent more for working women compared to non-working women and the odds are 19 per cent less for children born to working women belonging to high SLI relative to their non-working counterparts. The differential in child mortality between working and non-working women of medium and high SLI are found to be significant at $p < 0.05$. However, the importance of community education remains unchallenged both in its magnitude and direction of influence. The explained proportion of variation in child mortality by individual and community level factors by Model V remains more or less the same at 2.7 and 30 per cent respectively, as in Model IV. The test of difference in deviance statistics indicates that Model V is preferable to Model IV. At the community level, community education remains the most dominant factor, and it should be noted it remains significant while that of another community level indicator, urban residence, is not significant. Household hygiene and household wellbeing affect child mortality in the expected directions. Some of the prominent individual characteristics, such as, previous birth interval and maternal age at

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delivery are found to have persistent effects on child mortality.

DISCUSSION

In studies of infant and child mortality, local effects outside the household matter because of socio-cultural and economic influences of the community. These effects are most important for the most vulnerable groups in a population – the children. Theorising the effects of community is therefore important in mortality research. It has too frequently been ignored by demographers, social statisticians and population geographers. In this paper we have shown the importance of community education and community hygiene in reducing the risk of child deaths under 5 years of age, in isolated tribal communities in Northeast India.

The significant inverse relationship between aggregate level of community education and child mortality in the first 5 years of life is a reflection of the socio-cultural practices of the region where community elders are responsible for arranging educational and healthcare facilities, providing drinking water supply, arranging the development of irrigation canals and leading the community in a range of welfare activities. The key message from this is that educational enhancement of community elders is a key element in capacity building in agriculturally-based traditional societies. Empirical verification of this is evident, for example, in the fact that communities with on average a minimum of 6 years schooling amongst household heads had an average 58 per cent of households using piped water. By contrast in communities with less than 3 years of schooling for household heads, 69 per cent used water from ponds and rivers. One mechanism to tackle this issue would be to invest more in adult literacy programmes. This strategy would recognize that educational investment in community leaders benefits not only them, but the wider community, including children and infants. The paper has also investigated the implication of household hygiene on child mortality. The incidence of child mortality was also found to be directly related to having no modern toilet facility. An intervention strategy of introducing low cost community toilet facilities could pave a way to improving child survival chances.

It should not be surprising to notice the positive association between the working status of women and child mortality. This is so because women in Northeast India are mostly engaged in heavy agriculture-based work, which demands a lot of physical labour. This impacts not only on breast feeding, but also on child care. The study also found that the working status of women varied with household wellbeing. The influence on child mortality tended to diminish for women of medium SLI and for richer households. Such associations cannot be solely attributed to poverty, as agriculture is the main source of resource for poor and rich. A plausible reason is that richer households are able to use agricultural production for their own consumption while poorer households may suffer from malnutrition despite women working as landless labour at harvest time. A more efficient distribution system (PDS), which could provide grains, pulses and other essential commodities at subsidized prices to poorer households could help to counter malnutrition but it would not, of course, produce a fundamental distribution of wealth or tackle the underlying causes of poverty.

The lack of a significant association between the sex of the child and the risk of a child dying, shows that in Northeast India there is no significant sex discrimination against female children. Daughters are not considered liabilities as they are in many other parts of India. This too can be considered a 'place' effect on childhood mortality, although because of the nature of the data set presented in this paper, the effect is not illustrated in a statistical fashion relative to the rest of India. Nevertheless, it is significant that the only matriarchal states in India are in the Northeast, and that as a consequence it would appear that sex is not a key discriminator in childhood mortality.

In conclusion, Northeast India is an interesting location to have studied the inter-relations of place, community education, gender and child mortality. The research has shown that while individual level explanations are important, community-level practices and characteristics are critical in determining patterns of child survival.

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