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RICH–POOR GAP IN MATERNAL CARE
The case of Northeast India

Laishram Ladusingh and **Chungkham Holendro Singh**

This paper examines the rich–poor gap in antenatal and delivery care in Northeast India on the basis of household economic well-being index constructed from household amenities, housing quality, consumer durables owned and assets. The study uses data on frequency of antenatal checks, iron folic supplementation, receiving two doses of tetanus toxoid injection and skill of delivery attendant from the Indian National Family Health Survey-II (1998–99). The finding reveals an unimaginably low level of maternal care in the region. Besides, there is evidence of concentration of women without adequate maternal care amongst the poorest economic strata. The need for region specific equitable maternal care services is suggested for the inaccessible northeastern region of India.

KEYWORDS: maternal care; concentration curves; inequality

Introduction

Maternal care is a major concern in most parts of Northeast India. There is a general consensus that maternal care plays a vital role in the improvement of women's reproductive health in developing countries (Becker *et al*. 1993; Bhatia & Cleland 1995; Magadi *et al*. 2000). Antenatal and delivery care is crucial to save women from complications relating to pregnancy and childbirth. Antenatal care comprises routine health check-ups by a doctor, consumption of iron supplements and injection of tetanus toxoid vaccines during pregnancy. Delivery conducted by health professionals (doctors, nurses and auxiliary nurses or midwives) ensures safety of the mother and child.

In the case of preventive healthcare, such as maternal care, the availability of health facilities do not necessarily mean creation of demand and utilization (Basu 1990; Obermeyer 1993). Economic accessibility is an important factor in availing maternal care. Women from affluent households are more likely to avail themselves of adequate maternal care than women from poor households. They also utilize public and private health facilities. A number of studies (Elo 1992; Pebley *et al*. 1996; Raghupathy 1996; Navaneetham & Dharmalingam 2002) have highlighted the significance of maternal education in explaining variation in maternal care. Paradoxically, there is scant literature exploring the role of economic well-being in explaining maternal care inequality at least in the Indian context. The main reason for this is the lack of household income or consumption information in most of the demographic health surveys (DHS).

Conventionally in demographic literature, maternal care adequacy is assessed in terms of proportion of women who had complete antenatal care and whose delivery was

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conducted by health professionals. However, such an approach suffers from loss of information since some of the cross sample variation is lost as a result of dichotomization and arbitrary choice of cut-off points (Wagstaff & van Doorslaer 1994). As such, it is necessary to quantify maternal care through measurement methods which overcome this limitation. The evidence describing the level of maternal care at the extremes of economic well-being status in the Indian context in general and more so for the northeastern states of the country hardly seems to be conclusive. Moreover, the available studies on the aggregate level of maternal care are also not free from issues of measurement from dichotomized scale.

The present study reports maternal care in terms of predicted probabilities of complete antenatal care and safe delivery in Northeast India. The focus of this paper is to examine the rich–poor gap in maternal care using a statistically sensible well-being index. The study hopes to unfold the success or otherwise of government commitment to provide universal access to safe and affordable reproductive health services after the ICPD 1994 at Cairo.

Background of Northeast India

Northeast India comprises eight small states of Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. The region has international borders with Bangladesh, Bhutan, China and Myanmar. Topographically, it is characterized by mountainous terrain and all-weather communication means are limited. Most of the states in the region are landlocked and are cut off from the rest of the country during the wet and cold seasons. As a consequence, advancement in healthcare elsewhere in the mainland is not uniformly shared with the people of Northeast India despite the untiring effort of the Republic of India to promote the region through special financial and development packages. Health is a state subject in the Indian context, and the health infrastructure of the region remains inadequate and poor as most of the states do not have sufficient resources for investment in the health sector.

Northeast India is mostly inhabited by aboriginal tribes with distinct socio-cultural beliefs and practices. Healthcare, particularly maternal care, relies to a great extent on risky traditional practices. Inadequate health and communication infrastructure along with prevalence of traditional healthcare practices act as detrimental factors depriving women of proper antenatal and delivery care.

Northeast India on the whole, however, is socially and demographically more advanced than many other states in the country. Female literacy and life expectancy are on the rise to levels comparable to that of Kerala. The dowry system of paying bride price for marriage is not practised in the region. Sex discrimination at work and during decision-making is virtually non-existent. Exploitation and dominance on a caste basis found in other parts of India do not characterize the Northeastern region. In such a social and demographic scenario conducive for health equity, household economic well-being is expected to play an important role in proper maternal care.

This paper examines the magnitude and direction of association between household economic well-being and maternal care in the context of Northeast India. The objective of the present study is to bridge the gap between conceptual rationale and on-the-ground reality. The rest of the paper is organized as follows: the Data and

Methods section explains the method adopted for construction of an economic well-being index followed by a description of data sources for this study; the subsequent section is devoted to presentation of results of descriptive, multivariate and inequality analysis; and the main discussion and conclusions are presented thereafter.

Data and Methods

Measuring Household Economic Well-Being

Income and consumption based measures of household economic well-being cannot be used in this study because neither income nor consumption data is collected in Demographic and Health Surveys (DHS) of many countries including India. In the absence of such data, household standard of living indices are often constructed using three sets of information, namely, access to potable water and toilet facility with flush, quality of housing materials and ownership of selected consumer durables (Montgomery *et al.* 2000). There are three approaches in the construction of standard of living indices, differing in the manner in which different household amenities, quality of housing materials and assets are weighted. In a study of contraceptive use in Bangladesh, Degraff (1991) included ownership of boat and land, access to potable water and type of materials for housing wall. A similar approach is also found in Adair *et al*. (1993), Standiford *et al*. (1995) and Devin and Erickson (1996). Madhuri (1996), in his study of child mortality, constructed a household economic status indicator based on whether the household possessed one of five consumer durables or received remittances. Studies which construct economic status indices using total score of equally weighted durables and assets are found in Jensen (1996), in his analysis of fertility in Indonesia, Guilkey and Jayne (1997), in their study of use of contraceptives in Zimbabwe, and Desai (1992), in a study of the role of family structure on children at risk. In contrast, Dargent-Molina *et al*. (1994) have taken the sum of the values of all goods owned by the household. More recently, Bollen *et al*. (2002) have examined the validity of these ranges of economic status indicators to determine how the estimated impact of economic status on fertility varies with the choice of indicator using micro-survey data from Peru and Ghana. They found that the impact of economic status on fertility can differ depending on the choice of indicator but has a minor influence on the predicted effects of the control variables. The review of these approaches reveals some elements of arbitrariness and lack of principle to motivate the appropriateness of the weights used in construction of household standard of living index.

Filmer and Pritchett (2001) estimated statistically sensible weights using principal components analysis. These weights captured common information from the list of household amenities, quality of housing materials and ownership of consumer durables such that the linear combination of each of the variables explained the largest proportion of total variation among all the variables included. They made an extensive reliability and validity test of suggested wealth score in the Indian context. The well-being index (WBI) used as a proxy for household economic well-being in this study is based on their method. Dharmalingam and Morgan (2004) also adopted a similar approach in the Indian context.

Data and Methods

Data for the present study is from the latest round of India's National Family Health Survey-II (1998–1999). This is a countrywide survey of ever married women and the sample size is representative at state and regional levels. The survey adopted a multistage stratified cluster sampling design. From each state, primary sampling units (PSU) are drawn, employing probability proportional to size (PPS) systematic sampling and households are further drawn from the PSU following circular systematic sampling. The PSU is either a village or portion of a village in rural areas. In urban areas, PSU is taken as the urban frame survey (UFS) block of the National Sample Survey Organisation (NSSO). The NFHS-II used a household questionnaire to collect sex, marital status, occupation of household members, housing materials, amenities, source of drinking water and possession of consumer durables. Women's bio-demographic particulars, retrospective birth history, timing and type of antenatal checks, place of delivery, delivery attendant and children's immunization were collected using a separate women's questionnaire. The present analysis is restricted to a currently married women sample of Northeast India and uses information on antenatal care and delivery related to the last two children born to women in the three years preceding the survey.

In the Indian system of maternal care, antenatal care comprises a check-up of the abdomen, weight, blood pressure and internal examination, giving two doses of tetanus toxoid injection and iron folic acid (IFA) tablets to women for three months. Women having at least three antenatal checks during pregnancy are considered to have completed all required care. In the present analysis, women who had had at least three antenatal check-ups, had received two doses of tetanus toxoid injection and had consumed IFA tablets or syrup for three months are considered as having received complete antenatal care (ANC). A dichotomous variable satisfying these conditions of full ANC or otherwise is coded as 1 or 0, and is considered an outcome variable for antenatal care. Women whose deliveries were conducted by a doctor, a nurse or other trained professionals are considered to have availed themselves of safe delivery care, irrespective of whether the delivery took place at the health institution or at home. A dichotomous variable which conforms to the above criterion, or otherwise coded as 1 or 0, is considered an outcome variable for safe delivery. Thus, we have two dichotomous variables describing outcomes of antenatal and delivery care.

Residence background, women's education, age at delivery and household economic well-being index (WBI) are the explanatory variables considered for the present analysis. Urban residence is coded as 1 and rural residence as 0. Women's education is considered in terms of completed years of schooling. The WBI, categorized as low, medium and high on equal interval length scale, is included to differentiate the effect of household economic well-being on maternal care.

Method of Analysis

The present study adopts a descriptive analysis of maternal care outcomes, that is, full antenatal care and safe delivery care. Descriptive analysis is supplemented with multivariate analysis that highlights the effect of household economic well-being, controlling for residence background, schooling and age at delivery on antenatal and delivery care. For this we used biprobit analysis to generate predicted joint probabilities of outcome variables representing antenatal and delivery care.

In the final analysis, we use the concentration curve and concentration index (C) to examine inequality in predicted probabilities of no maternal care for women belonging to different levels of economic comfort. The concentration curve is drawn by plotting cumulative proportion of births ranked by WBI beginning with the poorest along the *x*-axis and cumulative proportion of predicted probabilities of no maternal care along the *y*-axis. The departures of the concentration curve from the line of equality which bisects the coordinate axes depict the extent of inequality in predicted probabilities of no maternal care. The concentration index quantifies the magnitude of inequality and is defined as twice the area between the concentration curve and line of equality.

Methods of biprobit analysis and concentration analysis are explained in the Appendix. Biprobit regression analysis and other computations were carried out using STATA 8.0 version, and concentration curves were drawn using Microsoft Excel.

Results

Descriptive Analysis

The prevailing levels of full ANC and safe delivery with other control variables—residence background, years of schooling, age at delivery and strata of economic well-being—are shown in Table 1 for all eight northeastern states. The level of full ANC is very low for all the states, the highest being just 27.9 per cent for women in Sikkim and the lowest being 14.4 per cent in Nagaland. Nagaland is the most underdeveloped state in the region and its infrastructure facility is probably the poorest of all states. Nagaland was never under any administration before the British Empire. The erstwhile kingdom of Sikkim joined the Indian Union in 1975. During British rule, the state and its adjoining areas were developed as a place for education of their wards. It is a tourist destination and has a sustainable economy. Delivery care in Northeast India is much more adequate than prenatal care, as 69.3 per cent of women's last two deliveries in Mizoram and 53.5 per cent in the state of Manipur were attended by a doctor, a nurse or a trained professional. However, most of the women's deliveries in Meghalaya were attended by unqualified persons with a figure of just 21.0 per cent for safe delivery. This scenario of prenatal care and safe delivery is bound to expose women of Northeast India to the risk of complications related to pregnancy and childbirth, and this is a major cause of maternal mortality.

Maternal age at the time of delivery can be considered as a proxy for measuring the physiological maturity of women for childbearing. Pregnancy and delivery by young and elderly women can lead to maternal and child risk. On the other hand, relatively younger women are expected to have knowledge of the necessity of prenatal and delivery care as compared to women of older cohorts. On this count, women in Northeast India are found to have an edge as the average age at the time of delivery ranges from mid- to late twenties.

The relationship between maternal care and women's completed years of schooling is evident, as prenatal care and delivery in the states of Mizoram and Manipur with higher educational attainment on the whole tend to dominate maternal care performance of women in other states of the region. Columns 6 to 8 of Table 1 show the distribution of the two most recent births in the three year period preceding the survey by economic well-being strata. Invariably, among the states in Northeast India, at least 50 per cent of

TABLE 1
Description of dependent and control variables.

States in Northeast India	Proportion of births under			Mean years of schooling (4)	Mean age at delivery (5)	Economic well-being strata (%)			Number of births
	Full ANC (1)	Safe Delivery (2)	Urban resident (3)			Poorest (6)	Middle (7)	Richest (8)	
Arunachal Pradesh	0.239	0.309	0.100	3.4	24.8	55.9	26.2	17.9	431
Assam	0.250	0.265	0.169	3.9	24.3	60.5	25.5	14.0	1069
Manipur	0.217	0.535	0.277	5.8	27.5	53.3	28.0	18.7	669
Meghalaya	0.195	0.210	0.139	3.4	26.6	58.0	25.0	17.0	620
Mizoram	0.242	0.693	0.523	6.6	25.9	50.0	30.5	19.5	495
Nagaland	0.144	0.322	0.163	4.6	26.4	50.8	29.2	20.0	459
Sikkim	0.279	0.343	0.094	3.4	25.5	51.0	29.5	19.5	458
Tripura	0.263	0.464	0.115	4.6	23.9	54.9	25.7	19.4	304
Northeast total	0.229	0.376	0.201	4.4	25.6	54.8	27.1	18.1	4505

Note: ANC: Antenatal care.
Source: Computed from Indian National Family Health Survey–II (1998–99).

the recent births were born to women belonging to the poorest households and less than 20 per cent to the richest households, while the percentage of births to middle class households varies from 25 per cent in Meghalaya to 30 per cent in Nagaland. Detailed discussion on the linkage between maternal care and household level of economic well-being is deferred to the next stage of analysis. At this stage, however, it is clear that most of the households in Northeast India are poor. In other states of India, the percentage of women who received all recommended types of antenatal care are 65 per cent in Kerala, 51 per cent in Tamil Nadu, 42 per cent in Karnataka and 36 per cent in Andhra Pradesh. These southern states are much more progressive than other states including Northeast India. Delivery assisted by health professionals at an all India level is 42 per cent (IIPS & ORC Macro 2000).

Multivariate Analysis

To explore the association between maternal care and household economic well-being, we have applied multivariate analysis based on the biprobit model described in the Appendix. Multivariate analysis shall substantiate results of descriptive analysis controlling for confounding effects of socio-demographic factors. The results of the biprobit analysis are shown in Table 2 in terms of estimated coefficients of observed covariates and level of significance.

TABLE 2
Estimated coefficients of observed covariates from biprobit model.

States in Northeast India	Residence	Maternal education	Age at delivery	Economic well-being strata	
				Middle	Richest
Full ANC					
Arunachal Pradesh	0.582*	0.095**	−0.009	0.609**	0.957**
Assam	0.712**	0.103**	−0.005	0.360**	0.586**
Manipur	0.168	0.048**	−0.027*	0.283*	0.787**
Meghalaya	0.773**	0.026	0.002	0.508**	0.706**
Mizoram	0.372**	0.056**	−0.030	0.299*	0.025
Nagaland	0.624**	0.053*	0.011	0.173	0.619**
Sikkim	0.445*	0.069**	−0.018	0.267	0.505*
Tripura	0.299	0.077**	−0.034*	0.032	0.472*
Northeast total	0.362**	0.068**	−0.018**	0.230**	0.501**
Safe delivery					
Arunachal Pradesh	0.221	0.087**	−0.022	0.494**	0.822**
Assam	0.774**	0.109**	0.005	0.280*	0.849**
Manipur	0.286*	0.043**	−0.002	0.639**	1.327**
Meghalaya	1.680**	0.084**	0.010	0.587**	0.668**
Mizoram	0.772**	0.144**	0.021	−0.052	0.412
Nagaland	0.339*	0.099**	−0.018	0.069	0.639**
Sikkim	0.201	0.096**	−0.017	0.512**	0.685**
Tripura	0.854**	0.153**	−0.036*	0.255	0.718**
Northeast total	0.717**	0.096**	−0.001	0.502**	0.847**

Note: Significant at *$p < .05$ and **$p < .01$.

The first panel of the estimated coefficients is that of full antenatal care (ANC). The results show that women residing in urban areas are more likely to access complete antenatal care than their rural counterparts. The rural–urban difference in antenatal care is statistically significant for most of the states in Northeast India. This is indicative of the importance of availability and greater accessibility of health facilities in urban areas. Controlling for residence, household economic status and age at delivery, women's education measured in completed years of schooling emerges as a determining factor for prenatal healthcare enhancement in the case of Northeast India. The positive association between women's education and antenatal care has valid statistical significance except for the state of Nagaland, no doubt because education keeps women informed of the necessity and the importance of prenatal and health care. The results so far indicate the importance of self-knowledge through education and availability of health facilities for enhancement of prenatal care in these remote states. Age at delivery is included in the analysis to differentiate maternal care between younger and older women. Though there is no statistically visible difference in antenatal care uptake of younger and older women, it is evident that older women are less likely to opt for antenatal care and safe delivery.

A household economic well-being index (WBI) based on principal factor analysis of household amenities, housing quality and possession of consumer durables was constructed following Filmer and Pritchett (2001). To assess the detrimental effect of low household economic well-being, the WBI range is divided into three strata on equal interval scale and is coded as poorest, middle and richest classes using dummy coding. Undoubtedly, the rise in household economic well-being makes for significant improvement in uptake of complete antenatal care. The positive association between maternal care and the highest hierarchy of household economic strata is statistically pronounced. The second panel of the coefficients of observed covariates and its significance shown in Table 2 relates to safe delivery. As in the case of antenatal care, educated women residing in urban areas and belonging to the highest strata of economic well-being are more likely to avail safe delivery attended by a doctor, a nurse or a trained health professional than less educated women living in rural areas and belonging to the lower economic strata.

The multivariate analysis has shown that residence background, maternal education and household economic well-being of women are dominant factors determining maternal care in Northeast India.

Inequality Analysis

It is necessary to analyse the differential in maternal care resulting from differences in household well-being as better-off households can afford healthcare expenditure. To examine the magnitude of variation in maternal care, we have generated joint probability (P^{11}) of receiving both complete antenatal care and availing safe delivery from the biprobit model which adjusts for residence background, women's education, age at delivery and household economic status.

Within the states of Northeast India, maternal care varies by household economic well-being. Table 3 shows the magnitude of maternal care in terms of predicted joint probabilities of availing both complete prenatal care and safe delivery by three strata of economic well-being as measured by WBI.

The magnitude of maternal care in terms of predicted joint probability of complete prenatal care and availing safe delivery stands at 15 per cent for Northeast India as a

TABLE 3
Estimated probabilities of complete antenatal care and safe delivery (P^{11}) by economic well-being strata in the states of Northeast India.

States in Northeast India	Economic well-being strata			Aggregate	Sample size
	Poorest	Middle	Richest		
Arunachal Pradesh	0.03(0.04)	0.18(0.12)	0.40(0.20)	0.14(0.18)	431
Assam	0.04(0.05)	0.19(0.16)	0.55(0.24)	0.15(0.22)	1069
Manipur	0.07(0.04)	0.19(0.08)	0.44(0.09)	0.18(0.15)	669
Meghalaya	0.02(0.04)	0.15(0.15)	0.35(0.23)	0.11(0.17)	620
Mizoram	0.15(0.09)	0.26(0.12)	0.29(0.09)	0.21(0.12)	495
Nagaland	0.03(0.03)	0.07(0.06)	0.26(0.16)	0.09(0.12)	459
Sikkim	0.06(0.05)	0.19(0.09)	0.39(0.16)	0.16(0.16)	458
Tripura	0.08(0.08)	0.19(0.12)	0.43(0.15)	0.18(0.17)	304
Northeast total	0.05(0.05)	0.18(0.12)	0.40(0.16)	0.15(0.16)	4505

Note: Figures in parentheses are standard errors.

whole, ranging from a low of nine per cent in Nagaland to a high of 21 per cent in Mizoram. This is indicative of poor maternal healthcare in all the states of this region because of inadequate health facilities and poor infrastructure. What is more alarming is that women with virtually no maternal care are concentrated among poor households. This is evident from the fact that hardly three per cent of women in poor households of Nagaland and Meghalaya received maternal care, and the highest proportion reached by women in the lowest strata of economic status is just 15 per cent in Mizoram.

The chances of availing complete antenatal care and safe delivery increases with household economic well-being. The level of maternal care is more respectable though far from satisfactory among women belonging to the richest households. There is a 40 per cent chance that a woman from the richest group in Northeast India shall avail herself of both complete antenatal care and safe delivery. For women of the highest economic strata, the possibility of getting maternal care ranges between 55 per cent in Assam and 26 per cent in Nagaland. A distinctive feature of maternal care in Mizoram is that it not only has the highest overall aggregate level among the states in Northeast India but also exhibits the least variation among women of different economic strata. In the other states, the chances of getting maternal care vary drastically across different economic strata. Delivery care is related to a great extent to preceding antenatal care. Women who had complete antenatal care are likely to take more care to ensure safe delivery. Once such an association is established, programme officials can devise social marketing strategies for rigorous and meaningful campaigns for antenatal care. To establish the association between antenatal care and safe delivery practices, we analyse the predicted conditional probabilities of getting safe delivery once women have had proper prenatal care. This is shown in Table 4. The chance that women who have had complete antenatal care would have institutional delivery or delivery conducted by skilled professionals is more pronounced with an aggregate level of 51 per cent for the whole region of Northeast India (ranging between 82 per cent in Mizoram and 72 per cent in Manipur, down to 35 per cent in Meghalaya). This clearly shows that efforts to promote antenatal care through adequate education and extension of health facilities will contribute in no small degree in increasing safe delivery practices for women in the states of Northeast India.

TABLE 4
Estimated probabilities of safe delivery conditional on prior availability of full ANC in the states of Northeast India.

States in Northeast India	Min.	Max.	Mean
Arunachal Pradesh	0.15	0.90	0.42(0.19)
Assam	0.17	0.99	0.39(0.23)
Manipur	0.50	0.98	0.72(0.16)
Maghalaya	0.12	0.99	0.35(0.26)
Mizoram	0.35	1.00	0.82(0.16)
Nagaland	0.15	0.95	0.46(0.19)
Sikkim	0.19	0.94	0.48(0.20)
Tripura	0.11	0.99	0.54(0.26)
Northeast total	0.23	0.99	0.51(0.24)

Note: Figures in parentheses are standard errors.

The preceding results have brought into focus poor maternal care in Northeast India in terms of a very low level of availing complete antenatal care and safe delivery. It is a matter of serious concern that women without adequate maternal care belong to the poorest strata of the society. The concentration curve and concentration index of predicted probabilities of receiving neither complete antenatal care nor safe delivery gives a clear idea of inequality in maternal care by level of household economic well-being.

Complete antenatal care comprises at least three antenatal checks, two doses of tetanus toxoid injection and consumption of IFA tablets or syrup for three months during pregnancy. Otherwise, it is not treated as a case of proper antenatal care. Non-institutional delivery and delivery not attended by a trained professional is not recognized as safe delivery. The concentration curves of predicted probabilities that women received neither complete antenatal care nor safe delivery for the states in Northeast India are shown in Figure 1. The graphs are the deviations of concentration curves for predicted probabilities of neither availing complete antenatal care nor safe delivery from the 45° line.

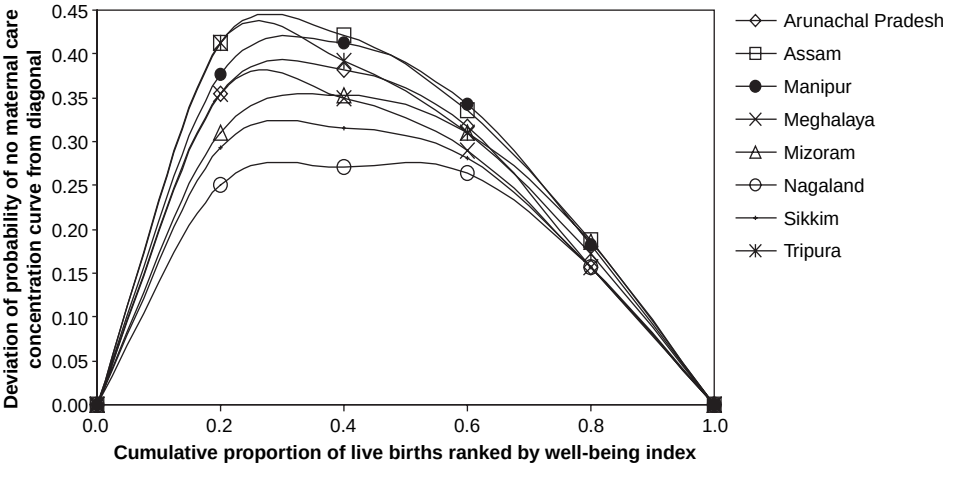

FIGURE 1
Concentration curve deviations for probability of no maternal care.

TABLE 5
Concentration indices of predicted probabilities of receiving no maternal care in the states of Northeast India.

States in Northeast India	Concentration index (C)	Variance
Arunachal Pradesh	−0.194	0.169
Assam	−0.259	0.047
Manipur	−0.241	0.131
Meghalaya	−0.188	0.185
Mizoram	−0.186	0.158
Nagaland	−0.138	0.169
Sikkim	−0.144	0.177
Tripura	−0.244	0.163

For all the states in Northeast India, the concentration curves are above the line of equality, confirming that inequalities in no maternal care are higher amongst the economically poor women than amongst the better off. The concentration of women without maternal care amongst the poorest households is a clear indication that maternal care in Northeast India is pro-rich. The concentration curve for Nagaland is closest to the line of equality signalling lesser concentration of women deprived of maternal care in poorer households compared to other states and maximum concentration is found in the state of Assam, closely followed by Manipur. The concentration index which quantifies the inequality reflected by the concentration curve is shown in Table 5 for each state in Northeast India.

The concentration index provides a means of comparing levels of inequality with non-intersecting concentration curves as well as acting as a tie-breaker in cases where the curves intersect (Wagstaff 2000). From the concentration curves and concentration indices, it is evident that Nagaland dominates over Sikkim, which in turn dominates the states of Mizoram, Meghalaya and Arunachal Pradesh. These states further dominate the concentration of Assam, Manipur and Tripura. This hierarchy of inequalities in no maternal care is summarized by a Hasse diagram (Skiena 1990) in Figure 2. The dominance criteria put Nagaland in the category of least concentration of women without maternal care within poorest households followed by Sikkim, and the greatest concentration in poor households in the states of Assam, Manipur and Tripura. The results of the present study reveal that the northeastern region of India has a long way to go in providing equitable maternal healthcare.

Discussion and Conclusion

This paper examined the completeness of antenatal care and safety of delivery practices in Northeast India, which is considered to be the most economically underdeveloped region in India. The focus of the study was to examine the universally acknowledged association between maternal care and household economic well-being in the context of physically and culturally least accessible areas. The Republic of India has a special North Eastern Council (NEC) to dispense various Central-Government-assisted development programmes for the overall upliftment of the region. Though the emphasis of this study was to trace wealth-induced inequality in complete antenatal care and safe

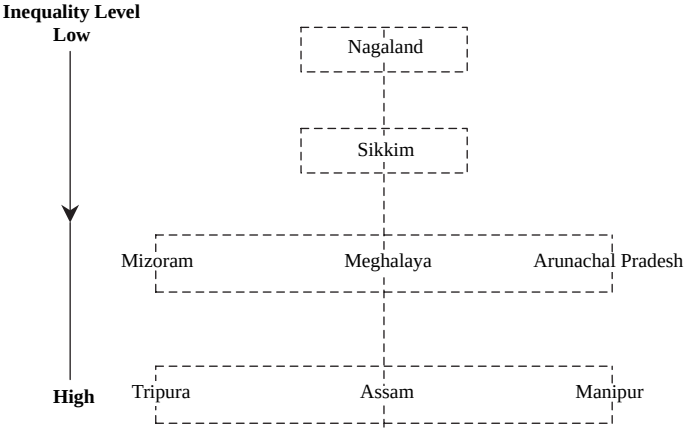

FIGURE 2
Hasse diagram for predicted probabilities of no maternal care based on concentration curve dominance.

delivery, the study also attempted to explain how the main determining factors operate on maternal care.

The results of this study are based on predicted probabilities controlling for residence, maternal education, age at delivery and statistically sensible well-being index and not on reported dichotomous measures. Complete antenatal care and safe delivery information are from factual accounts. The assessment of wealth-induced inequality in maternal care discussed in this paper is free from subjectivity in assessment, which otherwise could vary across economic well-being status (Wagstaff & van Doorslaer 1994). The states of Northeast India are more or less uniform in terms of income and expenditure pattern. This ensured that the maternal care inequalities are amongst states with similar absolute living standards.

The results of our analysis reveal that maternal education is the dominating factor which encourages maternal healthcare during pregnancy and delivery. This is in agreement with other contemporary studies elsewhere (Bhatia & Cleland 1995; Celick & Hotchkiss 2000; Navaneetham & Dharmalingam 2002). Education also accelerates the knowledge of modern healthcare and promotes the demand for modern health services (Jejeebhoy 1995). The significant bonding of maternal education with maternal care is a consequence of relatively high female literacy rates in the region of Northeast India ranging from 44 per cent in Arunachal Pradesh to 86 per cent in Mizoram.

The main obstacles in accessing complete antenatal care and safe delivery in the remote areas of the states in Northeast India are the mountainous topography and limited health infrastructure. This is evident from the higher odds of availing both complete antenatal care and safe delivery for women in urban areas relative to that of rural areas. In the present study, urban residence is considered a proxy variable for assessing the availability of health infrastructure. Though the data source has information on health facilities in the primary sampling units, this cannot substitute for maternal healthcare infrastructure because health facilities at the village level do not have adequate infrastructure and trained doctors for reproductive health services. The significance of maternal education and urban residence implies that for remote areas of Northeast India,

it is knowledge imparted through education and accessibility of maternal care health facilities that are crucial for antenatal and delivery care uptake.

Poor households hardly have resources for healthcare expenses as their priority is to meet their basic daily needs such as a square meal a day, whereas households in the higher strata of income well-being can afford to spend a higher proportion of their household earnings on healthcare. The rich–poor gap in maternal care is reflected in the results of our analysis as well. The odds of availing proper prenatal care and safe delivery are substantially higher for better-off women than for women in the lowest income strata. The concentration of women without any maternal care amongst the poorest households shows the urgent need to improve maternal care facilities for poor households through mobilization of resources, strengthening of healthcare infrastructure and implementation of area specific health packages.

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Appendix

The general form of biprobit model according to Ashford and Sowden (1970) can be expressed in terms of joint probability distribution of full antenatal care (y_1) and safe delivery (y_2) as

$$P_{ij}^{11}(\tilde{x}) = F[Z_i(\tilde{x}), Z_j(\tilde{x})] \tag{1}$$

where, $P_{ij}^{11}(\tilde{x})$ is the joint probability that a randomly selected woman with measured covariates $\tilde{x} = (x_1, x_2, \ldots\ldots\ldots\ldots, x_m)$ manifests two-dimensional responses $Z_i(\tilde{x})$ and $Z_j(\tilde{x})$ representing full antenatal care and safe delivery. The function $F(z_i, z_j)$ denotes the volume under standard bivariate normal distribution corresponding to joint response (z_i, z_j).

The probability that the measured covariates manifest one dimensional marginal response $Z_i(\tilde{x})$ for full ANC is

$$P_{ij}^{10}(\tilde{x}) = P_i^1(\tilde{x}) - P_{ij}^{11}(\tilde{x}) \tag{2}$$

where, $P_i^1(\tilde{x}) = \Phi[Z_i(\tilde{x})]$ and $\Phi(\bullet)$ is the cumulative area of univariate standard normal distribution. Similarly, we have

$$P_{ij}^{01}(\tilde{x}) = P_j^1(\tilde{x}) - P_{ij}^{11}(\tilde{x}) \tag{3}$$

denoting one dimensional marginal response $Z_j(\tilde{x})$ for safe delivery.

The probability that randomly selected women with observed covariates $\tilde{x}$ manifest neither full ANC nor safe delivery is

$$P_{ij}^{00}(\tilde{x}) = 1 - P_{ij}^{10}(\tilde{x}) - P_{ij}^{01}(\tilde{x}) - P_{ij}^{11}(\tilde{x}) \tag{4}$$

The concentration index and its variance according to Kakwani *et al.* (1997) are calculated as

$$C = \frac{2}{\mu} \sum_{t=1}^{T} f_t \mu_t R_t - 1 \tag{5}$$

and

$$Var(C) = \frac{1}{n}\left[\sum_{t=1}^{T} f_t a_t^2 - (1+C)^2\right] + \frac{1}{n\mu^2} \sum_{t=1}^{T} f_t \sigma_t^2 (2R_t - 1 - C)^2 \tag{6}$$

where n denotes the sample size, T the number of economic well-being strata, f_t the proportion of sample, μ_t is the mean of health variable in the tth economic stratum, σ_t^2 is

the variance of μ_t and μ is the overall mean of health variable based on n. R_t and a_t are further defined as

$$R_t = \sum_{i=1}^{t-1} f_i + \frac{f_t}{2}$$

$$a_t = \frac{\mu_t}{\mu}(2R_t - 1 - C) + 2 - q_{t-1} - q_t$$

where $q_t = \frac{1}{\mu}\sum_{i=1}^{t} \mu_i f_i$.