Nutritional Status of Children in North-East India

Contrary to the findings in other parts of India, in the north-eastern region, female children have a nutritional edge over male children.

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Undernutrition in children is the consequence of a range of factors which are often related to insufficient food intake, poor food quality, and severe and repeated infectious diseases. The inadequacy is relative to the food and nutrients needed to maintain good health, provide for growth and allow a level of physical activity (National Nutrition Policy, Government of India, 1993). Widespread poverty resulting in chronic and persistent hunger is the biggest scourge of the developing world today. Poverty, in turn, is closely linked to the overall standard of living and whether a population can meet its basic needs, such as access to food, housing, health care and education. This intersectoral and interrelated cause of undernutrition

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operates at many levels from the community at large to the household and children within households. Undernutrition is often cited as an important factor contributing to high morbidity and mortality among children in developing countries (Sommer and Loewenstein, 1975; Chen, Chowdury and Huffman, 1980; Vella and others, 1992a, 1992b). Undernutrition during childhood can also affect growth potential and risk of morbidity and mortality in later years of life.

The National Nutrition Monitoring Bureau (NNMB) surveys of 1977 to 1996, showed very little improvement in the nutritional status of children; 45 to 50 per cent of children were classified as moderate to severely malnourished (Gopalan and Shiva, 2000). Income, food security and women's available time seem to affect the nutritional status of children of disadvantaged population. Based on a study of three states – Maharashtra, Tamil Nadu and Uttar Pradesh – using data from NFHS-I (1992-1993), Griffiths, Mathews and Hinde (2002) came to the conclusion that the undernutrition of children tended to concentrate and cluster around households in which one of the children suffers from undernutrition. The clustering percentages are 33 per cent in Uttar Pradesh and Maharashtra and 29 per cent in Tamil Nadu. In mid-1995, the Government of India launched a new centrally-sponsored scheme, the national programme of Nutritional Support to Primary Education. Under this programme, cooked mid-day meals were to be introduced in all government and government-aided primary schools within two years. The coverage of the mid-day meals programme has steadily expanded during the last two years and cooked lunches are becoming part of the daily school routine across the country. In a study of three states, Chhattisgarh, Rajasthan and Karnataka, Dreze and Goyal (2003) found that the mid-day meal scheme helps in the enhancement of child nutrition, school attendance and social equity.

Chen, Hug and D'Souza (1981), using data from the demographic surveillance system organized by the International Centre for Diarrhoeal Disease Research, Bangladesh, found girls' mortality risks to be as much as 60 per cent higher than those for boys after the neonatal period. The study also revealed that girls were fed less and suffered more from malnutrition. Infection rates were similar, but boys recovered faster than girls. Utilizing data from Demographic and Health Surveys (DHS) for Ghana, Malawi, Nigeria, Tanzania, Zambia and Zimbabwe; Madise, Matthews and Margetts (1999) studied the heterogeneity of child nutritional status in those six Sub-Saharan African countries. Their findings unfolded to reveal that the percentage of children who were undernourished in terms of being underweight ranged from 16 in Zimbabwe to 36 in Nigeria. A clustering effect at the household level was found in all six countries, ranging from 24 per cent in Tanzania and Zimbabwe to 40 per cent in Malawi. There was also a

significant, but smaller clustering effect at the community level for Malawi, Nigeria, Tanzania and Zambia.

The outcomes of those studies support the World Health Organization (1994) report that over half of the underweight children in the world are living in Asia and Africa, including children in India, Bangladesh, Sub-Saharan African countries and other countries of those two regions of the globe. It is also evident that the nutritional status of children varies across countries in the developing world and that there are wide variations within countries. Though poverty is the main reason for the prevalence of undernourished children, many of the countries in the developing world do not have enough resources to implement wide-scale poverty alleviation programmes. As such when looking for means to reduce and minimize undernutrition among children, one needs to create cost-effective intervention programmes which can be implemented at the community level to develop child-raring and child-feeding practices. For a meaningful investigation into the feasibility of developing cost-effective community-level intervention programmes which can be implemented through the existing social support system, there is an urgent need to study the determinants of undernutrition among children, by using appropriate measures of the nutritional status of children. Keeping the foregoing emphasis on strengthening community-level intervention programmes, this paper makes an attempt to identify child, parental and household background determinants which have either a favourable or unfavourable bearing on the nutritional status of children.

Anthropometric indices

There are various means of measuring the nutritional status of children and anthropometric indices, but weight-for-height, height-for-age and weight-for-age are the most effective measures of undernutrition of children in terms of growth status. Each of these indices provides somewhat different information about the nutritional status of children. The World Health Organization's (1995) interpretation of those indices is as follows:

The height-for-age index measures stunting, owing to linear growth retardation as a result of suboptimal and/or nutritional conditions, primarily reflect chronic undernutrition. The weight-for-height index by contrast measures wasting or thinness, which indicates in most cases a recent and severe process of weight loss often associated with acute starvation and/or severe disease. This index is a relative measure of body mass and body weight, primarily reflecting chronic undernutrition. Weight-for-age reflects body mass relative to chronological age. It is influenced by both the height of the child and his/her weight. This index is often

taken as a composite index integrating the first two anthropometric indices, as it reflects both chronic and acute malnutrition.

Background of study area

The study area is comprised of seven states, namely Arunachal Pradesh, Manipur, Meghalya, Mizoram, Nagaland, Sikkim and Tripura, located in the north-eastern part of India. The region has international boundaries with China, Bhutan, Myanmar and Bangladesh. This area of India is the most interior and inaccessible part of the country as a result of mountanous terrain and poor communication means. It is believed that a sizeable population of the region originated from Thailand, China and other neighbouring countries, that the region is inhabited mostly by the Mongoloid race, has different sociocultural beliefs and practices and is rich in biodiversity. Those states together constitute 5.6 per cent of the country's total land area and 1.2 per cent of India's total population (Census of India, 2001). The states of Mizoram, Nagaland and Meghalya are predominantly Christian, whereas Tripura has a predominantly Hindu population. Mixed

Table 1. State profiles and demographic characteristics

	Arunachal Pradesh	Manipur	Meghalaya	Mizoram	Nagaland	Sikkim	Tripura
Population (in millions)	1.09	2.39	2.31	0.89	1.99	0.54	3.19
Percentage to national population	0.1	0.2	0.2	0.1	0.2	0.1	0.3
0-6 years population (in millions)	2.0	3.12	4.57	1.41	2.80	7.71	4.27
Percentage to state population	18.3	13.1	19.8	15.9	14.1	14.3	13.4
Total land area (km2)	83,743	22,327	22,429	21,081	16,579	7,096	10,486
Population density	13	107	103	42	120	76	304
Sex ratio (females per 1,000 males)	901	978	975	938	909	875	950
Growth rate (%) per decade	2.6	3.0	3.0	2.9	6.4	3.3	1.6
Female literacy rate (%)	44.2	59.7	60.4	86.1	61.9	61.5	56.6
Infant mortality rate (per 1,000 live births)	44.0	23.0	58.0	21.0	23.0*	21.8	16.5
Female singulate mean age at marriage (years)	21.6	25.4	23.0	24.1	23.0	21.9	22.0
Median age at first marriage (25-49)	20.3	23.1	20.4	22.8	21.2	19.8	20.1
Median birth interval (months)	29.9	31.8	28.5	28.4	27.5	32.6	37.1
Total fertility rate (per woman)	2.52	3.04	4.57	2.89	3.77	2.75	1.87

Source: Census of India, 2001 and North Eeastern Sates, NHFS-II (1998-1999), International Institute for Population Sciences.

* Urban only

populations of Hindus, Christians, Buddhists and other local religions are found in the states of Arunachal Pradesh, Manipur and Sikkim. Figures in table 1 depict the profiles of those seven north-eastern states.

According to 2001 census figure, all of those states except Tripura have a growth rate higher than the national average. Nagaland reports the highest growth rate of 6.4 per cent, Meghalya has the highest 0-6 years population proportion to the states population with figure of 19.8 per cent, while Manipur has the lowest with 13.1 per cent. The entire region, with the exception of Arunachal Pradesh, has female literacy rates higher than the national average. Infant mortality rates (IMR), in the three-year period preceding the survey were found to be lower than the country's figure of 68 deaths per 1,000 live births in all the seven states.

NFHS-II survey reports revealed that those states have high fertility rates in comparison to other states in India with Meghalaya reporting the highest total fertility rate in the country of 4.57 and Tripura with 1.87 has the lowest fertility in India. The female singulate mean age at marriage in the region is between 20 – 26 years of age while their median birth interval ranges from 27 to 38 months.

Data source

Anthropometric measures assessing of the nutritional status of children are often not available. However, the two rounds of National Family Health Surveys (NFHS) during 1992-1993 and 1998-1999 have provided nationally representative anthropometric indices in the case of India. This has made it possible to examine the nutritional status of children in the north-eastern region of India, in relation to a range of demographic, socio-economic and household backgrounds. This present study is based on the recent data from NFHS-II and thus facilitates international comparisons. This exercise can illuminate future policy direction in the north-eastern region of India. In addition, it is possible to analyse the new data to understand the influences on the nutritional status of children under three years of age by socio-economic and demographic background factors operating at individual, household and community levels.

In NFHS-II survey, 1,419, 1,689 and 1,373 households were covered in the states of Arunachal Pradesh, Manipur and Mizoram, while the corresponding figures are 1,240; 1,133; 1,299 and 1,290 in Meghalaya, Nagaland, Sikkim and Tripura out of the target number of 1,500 households. From those completed households, over 1,000 ever married women in the reproductive age group 15-49 years were interviewed except in Meghalaya and Nagaland where only 945 and 818 ever married women were interviewed. In all the states, this survey collected the weight and height of the two youngest children below the age of 36 months

born to the interviewed women. NFHS-II also collected data on socio-economic characteristics of the household, health care and food consumption of mother and child, breastfeeding patterns as well as the morbidity of children. The data for the present study of covariates of nutritional status of children in north-eastern India is taken from NFHS-II (1998-1999) and pertains to 2,649 children of age between 1-35 months. The NFHS-II collected information on both the height and weight of each child, making it possible to compute anthropometric indices height-for-age, weight-for-age and weight-for-height.

Methods

In the present study z-scores for the three anthropometric indices height-for-age, weight-for-age, and weight-for-height are used to assess the nutritional status of children. The computation of z-scores involves comparison with an international reference population as recommended by the World Health Organization (Dibley and others, 1987a; Dibley and others, 1987b). The Nutrition Foundation of India concluded that the WHO standard is applicable to Indian children (Agarwal and others, 1991). Devations of z-scores less than – 2SD (standard deviation) from the international reference population were used to classify children as moderately low weight-for-age, low height-for-age and low weight-for-height, Deviation of Z-scores less than – 3SD put children in the severe undernutrition category. The preliminary analysis of identifying the quantum of under nutrition among children under 36 months was based on this categorization and this procedure was followed universally across regions and countries.

Additionally, it required relating the z-scores of the anthropometric indices with demographic, socio-economic and household background to identify crucial correlates of child nutrition in order to draw relevant and effective intervention programmes. To deal with this aspect of linkage, a multilevel regression analysis (Goldstein, 1995) was used. This statistical technique explains changes in the z-scores in response to unit changes or categorical shifts in the demographic, socio-economic and household characteristics of children. The tendency of children with poor families and within villages without proper sanitation, drinking water and health facilities to be similar in terms of nutritional status could be captured by the multilevel regression analysis.

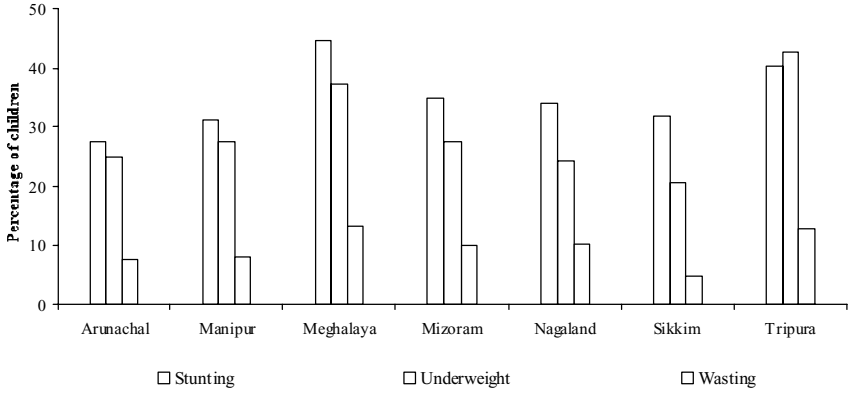
A strong case for using weight-for-age was made by Vella and others (1992a) who found, using data from Uganda that, of the three indices weight-for-age was a better predictor of children at high risk of death than height-for-age or weight-for-height, though other researchers have argued that for cross-sectional data, weight-for-height is the best indicator of current malnutrition

(McMurray, 1996). However, the proportion of children who are wasted is often too small for most studies of determinants of undernutrition. Noting the need to study more elaborately covariates of the nutritional status of children, authors restricted the study to weight-for-age z-scores and adopted a multilevel analysis incorporating the hierarchical data structure of multistage sampling designs.

Preliminary results

The analysis based on the cut-off point of z-score values for the three anthropometric indices height-for-age, weight-for-age and weight-for-height revealed that 34.5 per cent, 28.6 per cent and 9.4 per cent of the total 2,649 children included in the NFHS-II (1998-1999) survey were found to be stunted, underweight and wasted, respectively. The ranges of stunting, underweight and wasting in the north-eastern states of Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Sikkim and Tripura as shown in figure 1.

Figure 1. Percentage of children ages 1-35 months who are stunted, underweight and wasted in the seven north-eastern states of India



In these north-eastern states of India, more than a quarter of all the children aged 1-35 months were stunted and more than one fifth were underweight. Arunachal Pradesh had the lowest number at 27.6 per cent, while Meghalaya had the highest with 44.6 per cent of stunted children. Sikkim had the least with 20.5 per cent and Tripura the highest with 42.4 per cent of underweight children. Wasting among children was found to be at least at 5 per cent in Sikkim and at 14 per cent, the highest number, in Meghalaya.

Figure 2. Nutritional status of children aged 1-35 months in north-east India, 1998-1999

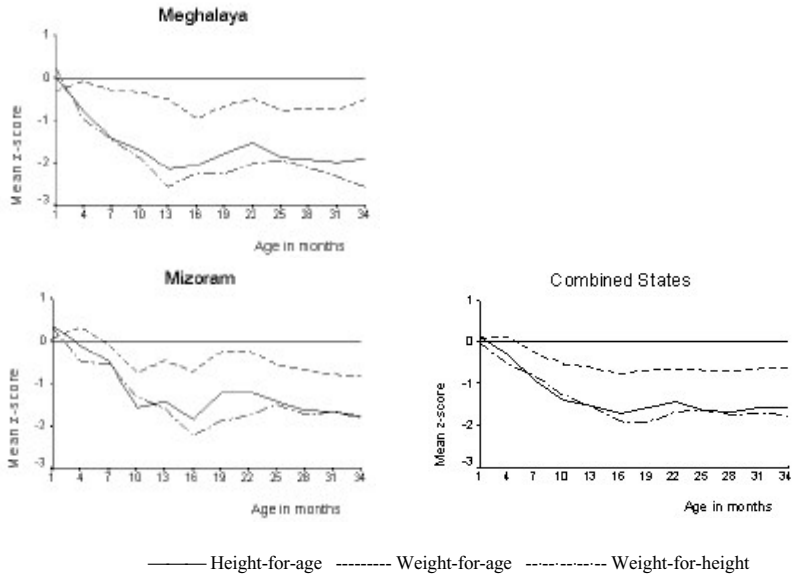


Table 2. Percentage distribution of children aged 1-35 months by background and family characteristics for seven north-eastern states in India

Variables	Percentage	Variables	Percentage
Individual characteristics			
Sex-Female	49.0	Smokes	7.5
Small size at birth	25.6	Illiterate (rc)	69.6
Home delivery	66.4	Educated up to middle school	16.3
Currently breastfeeding 12+	51.5	Educated up to high-school and above	14.1
Fed from bottle	17.8	Not working (rc)	58.7
Breastfeeding up to 6 months	20.4	Non-manual work	8.6
Illness two weeks before survey		Manual work	32.7
Diarrhoea	21.4	**Father's education**	
Fever	37.3	Illiterate (rc)	53.7
Cough	46.9	Educated up to middle school	21.0
Immunization		Educated up to high-school & above	25.3
3 DPT	43.4	**Father's occupation**	
4 Polio	45.6	Not working (rc)	2.9
BCG	62.9	Non-manual work	29.0
Measles	33.9	Manual work	68.1
Vit-A	27.6	**Household characteristics**	
Preceding birth interval		Drinks piped water	46.1
24 + months (rc)	53.1	Uses pit toilet	75.9
Below 24 months	18.2	Separate room for kitchen	63.9
First birth	28.8	Rural place of residence	78.5
Heamoglobin level- Anaemic child	45.9	3+ children below 5 years	21.3
Maternal characteristics		Any death siblings	16.9
Anaemic	26.0	5+ persons per room	10.4
BMI below 18.5 kg/m2	19.7	**Type of house**	
Read newspaper once a week	30.1	Pucca (rc)	15.1
Watches tv every week	44.4	Semi Pucca	24.7
Kachha	60.2	Kachha	60.2
Listen to radio every week	51.2	**Religion**	
Antenatal care during for pregnancy	70.6	Hindu (rc)	32.6
Received iron/folic acid during pregnancy	56.4	Muslim	4.7
Chew tobacco	34.1	Christian	47.2
Drink alcohol	11.6	Others	15.3

Source : North-eastern States, NFHS-II (1998-1999), rc – reference category.

The level of stunting, underweight and wasting by age (in months) of children is shown in figure 2. It is clear that in terms of the three anthropometric indices, the nutritional status of children deteriorated rapidly after birth and stabilized after 18 months of age in all the states and in the region as a whole. In Arunachal Pradesh, Sikkim and Tripura, the mean height-for-age z-scores for children aged one month were negative; indicating that stunting may have been present even in newborn babies in those states. However, except for Arunachal Pradesh and Tripura, the mean weight-for-age and weight-for-height z-scores for children aged one month were positive, indicating that on average, baring these two states, the children were born with adequate weight for their ages and heights. For the north-eastern region of India as a whole, children had a normal nutritional status at birth, as was evident form the fact that mean values of z-scores of all three anthropometric indices were positive and close to zero. This finding also supported the fact that only a quarter of babies were reported to be of small size at the time of birth by their mothers.

Table 2 shows the percentage distribution of 2,649 children by selected child-mother level characteristics and household characteristics included in the multilevel analysis of determinants of weight-for-age anthropometric measure. However, it is to be noted that only the background characteristics, which come under the subset of best predictors, was included in the final multilevel modeling. To assess the size of the baby, the information reported by the mothers, about whether the baby was small or large at birth was recorded in NFHS-II. The striking background of the 2,649 children included in the present study revealed that 66.4 per cent were delivered at home, 69.6 per cent of the mothers were illiterate, 78.5 per cent of them lived in rural areas, 68.1 per cent were engaged in manual work, 60.2 per cent lived in Kachha houses, 34.1 per cent chewed tobacco, 11.6 per cent drank alcohol and 7.5 per cent smoked.

Multilevel analysis results

The weight-for-age z-score was subjected to multilevel analysis for investigating the determinants of the nutritional status of children considering the selected background characteristics of children aged 1-35 months. The multilevel modeling of weight-for-age was executed in four stages in order to examine the changing nature of the explanatory potential of background characteristics. These four stages were designated as Model I based on only the child-level characteristics, Model II based on both child and parents' background level, Model III which incorporated child-woman and household background and Model IV which also took into consideration the districts of the respective states.

Table 3. Parameter estimates for multilevel models of weight-for-age z-scores for children aged 1-35 months

Variables	Model I	Model II	Model III	Model IV
Individual characteristics				
Age	-0.023**	-0.024**	-0.023**	-0.023**
Sex - female	0.153**	0.144**	0.147**	0.146**
Small size at birth	-0.464**	-0.424**	-0.420**	-0.402**
Home delivery	-0.227**	-0.079	-0.080	-0.083
Birth order	-0.012	-0.003	0.016	0.017
Fed from bottle	-0.057	-0.127*	-0.139*	-0.135*
Breastfeeding up to 6 months	0.808**	0.823*	0.846**	0.847**
Currently breastfeeding 12+	-0.252**	-0.198**	-0.188**	-0.191**
Illness two weeks before survey				
Diarrhoea	-0.012	-	-	-
Fever	-0.095	-0.084	-0.081	-0.080
Cough	-0.053	-0.039	-0.032	-0.028
Heamoglobin level-Anemic child	-0.196**	-0.145**	-0.142**	-0.138**
Preceding birth interval				
24+ months (rc)				
Below 24 months	-0.001	-0.012	-0.012	-0.014
First birth	0.061	0.090	0.090	0.090
Maternal characteristics				
Age at birth of indexed child				
25-34 (rc)				
14-24		-0.037	-0.012	-0.013
35-49		0.004	-0.041	-0.047
BMI below 18.5		-0.291**	-0.254**	-0.239**
Watch tv		0.079	0.051	0.052
Listen to radio		0.031	0.035	0.041
Illiterate (rc)				
Educated up to middle school		0.143*	0.110	0.116
Educated up to high-school & above		0.221*	0.206*	0.216*
Not working (rc)				
Non-manual work		0.065	0.036	0.046
Manual work		-0.014	-0.023	-0.019
Father's education				
Illiterate (rc)				
Educated up to middle school		0.065	0.043	0.050
Educated up to high-school & above		0.124	0.108	0.117
Father's occupation				
Not working (rc)				
Non-manual work		0.132	0.130	0.129
Manual work		0.014	0.048	0.056
Household characteristics				
Drinks piped water			0.031	0.009
Uses pit toilet			0.033	0.020
Separate room for kitchen			0.069	0.086
3+ children below 5			-0.085	-0.091
5+ persons per room			-0.015	-0.020
Sibling deaths			-0.067	-0.062
Rural place of residence			0.035	0.012

(continued)

Table 3. *(continued)*

Variables	Model I	Model II	Model III	Model IV
Type of house				
Pucca (rc)				
Semi Pucca			-0.110	-0.089
Kachha			-0.181*	-0.139
Religion				
Hindu (rc)				
Muslim			-0.188	-0.151
Christian			0.193**	0.268**
Others			0.238**	0.237**
States				
Arunachal (rc)				
Manipur				-0.202
Meghalaya				-0.396**
Mizoram				-0.228
Nagaland				-0.120
Sikkim				0.066
Tripura				-0.210
Variances				
Individual level	1.190**	1.160**	1.163**	1.162**
Household level	-	-	0.384**	0.356**
District level	-	-	-	0.014

Significant level : * p – value < 0.05 ; ** p – value < 0.01; rc – reference category

Table 3 shows the parameter estimates for the multilevel models of weight-for-age z-scores for the above-mentioned north-eastern region of India. Separate state models were not attempted as the number of cases for the background characteristics at different levels was inadequate for the study of determinants of the nutritional status of children. However, the inclusion of these states as categorical variables in Model IV facilitated the comparative assessment of the nutritional status of children in the aforesaid seven states. The estimates of Model I revealed that female children had a significant edge ($p<0.01$) over male children in terms of nutritional status, and breastfeeding at the early six months period had a significant ($p<0.01$) positive relationship with the nutrition of children. The inverse relationship between a child's age and weight-for-age z-score was highly significant at $p<0.01$. Another important determinant of weight-for-age was the size of the baby at birth as reported by the mother. As expected, small babies had lower weight-for-age z-scores, which were highly significant at $p<0.01$. Children still being breastfed beyond the first birthday had highly significantly lower z-scores compared to those who had stopped breastfeeding. Anaemic children tended to have poor nutritional status and it was

highly significant. Morbidity-related variables, such as diarrhoea, cough and fever in the two-week period preceding the survey had a negative impact on the nutritional status of children but was not statistically significant.

Model II incorporated additional background characteristics of the parents, such as age of women at the birth of indexed child, educational level; exposure to mass media, occupation, father's education and occupation and Body Mass Index (BMI) of mother. The estimates of this model showed that weight-for-age z-score values of children born to women with BMI below 18.5 kg/m^2 (the critical value) tended to be lower and it was highly significant at $p<0.01$. Education had a significantly positive impact on the nutritional status of children. Children born to young women and women engaged in manual occupation had lower values of weight-for-age z-scores but were not significant. However, the father's education and occupation had a positive association with the nutritional status of children, but the relationship was not significant. The magnitude, direction and significance of a child's background characteristics in Model I remain unchanged in Model II even after the incorporation of the parents' background characteristics.

To turn to the household level variables influence on the nutritional status of children in terms of weight-for-age z-scores, the authors included the source of drinking water, toilet facility in use, housing conditions, crowdedness, presence of large number of children below five years of age and history of sibling deaths in Model III. Next a two-level hierarchical model was designed. The child and parents' background characteristics which were significant in Models I & II in terms of their relationships with the weight-for-age z-scores were found to be carried forward in Model III with the only change from Model II being those women educated only up to primary level or longer had a significant influence on the nutritional status of children. Children living in poor living conditions (*Kachha* house) had a lower nutritional status and was significant at $p<0.05$. Children born to Christian and other minority religion households had a higher nutritional status, which was significant at $p<0.01$, compared to children in Hindu households. Children belonging to Muslim communities in the region had a poorer nutritional status compared to those of Hindu households, but the relative difference of the two communities was not statistically significant. Children of households with history of sibling deaths, with more than three children under 5 years of age, and with congested conditions of more than five persons per room, had lower weight-for-age z-scores but were not significant.

In Model IV, the authors included the seven states of Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura through dummy

variables in order to facilitate the comparative assessment of the relative nutritional status of children in these states of north-east India. Besides the background characteristics of Model III, three-level hierarchical model was fitted using the MLWiN statistical package. The magnitude, direction and significance of influence of the child's, parents' and household characteristics considered in Model III on weight-for-age z-scores remained unaltered. In terms of this anthropometric measure in all of the other five states, except Sikkim, the nutritional status of children are poorer than that of Arunachal Pradesh but the difference was significant at $p<0.01$ only in Meghalaya, where 37 per cent of children are underweight. Sikkim was the only state in the region which had a higher nutritional status of children.

Table 3 also includes estimated three-level residual variances after adjusting for the child's, parents', household and district characteristics. For all four models, child-parent level and household level variances were significant suggesting an unobserved heterogeneity in nutritional status between children and households. The district level variances were smaller and not significant for Model IV but were significant for the three preceding models.

Clustering effect

Since children living in the same household often shared both a biological inheritance and a nurturing experience, there was a certain amount of correlation in weight-for-age z-scores of children living in the same household, thereby suggesting that undernourished children cluster within certain types of household. This clustering effect was not explained by any of the variables entered into the model. Multilevel modeling has the provision of measuring the clustering effect in terms of intra-correlation coefficient (Goldstein, 1995) between households. The findings also suggested that children living within different family structures had similar probabilities of low weight-for-age z-scores, in terms of the value of 0.24 for the intra-correlation coefficient obtained from Model IV. However the clustering of undernutrition of children within the same village was found to be too small to be significant.

Conclusion

This paper examines the nutritional status of children in the north-eastern states of Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Nagaland, Sikkim and Tripura of the Indian Union based on a representative sample of 2,649 children aged 1-35 months. Nutritional status was assessed on the basis of three anthropometric measures, namely weight-for-height, weight-for-age and height-for-age. Studies of the nutritional status of children is lacking in the region mainly due to the unavailability of anthropometric measures. But the recent

NFHS-II (1998-1999) survey provides the much-needed data to carry out the study. The focus of this study was to identify household, parental and child's background along with behavioural characteristics, such as feeding practices in order to introduce region-specific intervention strategies.

Contrary to the findings in other parts of India mentioned above, in the north-eastern region, female children have a nutritional edge over male children, which cause daughters not to be considered liabilities in the sociocultural orientation of the region. In fact, India's only matriarchal state, Meghalaya, where the dowry system does not exist is in the north-eastern region. The level of undernutrition among children in the north-eastern region of India was much higher than the national average, however more than one third were stunted and more than a quarter were underweight. Yet, less than one tenth experienced wasted growth. With the exception of a couple of states, children at birth had normal a nutritional status which deteriorated with age and stabilized once they reached 18 months of age in the region as a whole. Babies, who were small at birth, tended to have a lower nutritional status. Female children had an edge over the male children. Children born at shorter birth intervals, as expected had lower z-scores of weight-for-age. Haemoglobin level was an important base for determining the health of children and the study confirms that the nutritional status of anaemic children was poor. Children who had suffered from diarrhoea, fever and cough in the two week preceding the survey were also likely to have a poor nutritional status. Feeding practice was also an important criterion for the nutrition of children. It was found from this analysis that children who were breastfed the prescribed optimum duration of 4-6 months were nutritionally better off than those children who were breastfed even beyond their first birthday. This could be due to the fact that children who were given supplementary food at the right age were more healthy. The main reason for the prevalence of aneamia and morbidity in the region was the ignorance of people living in the inaccessible mountainous terrain about the proper and nutritional preparation of food and general hygiene.

To minimize and control aneamia and morbidity from common disease, the mothers' associations, present in almost all villages and involved in socioreligious activities, should be approached to provide education on household hygiene, proper preparation of food and on the practice of effective child breastfeeding as well as knowledge of right time of solid food supplementation. Such Information Education and Communication (IEC) programmes working through the existing social network could be vital and cost-effective in improving the nutritional status of children in the north-eastern region of India. However, as the livelihood of the people depends on the forest and on securing basic amenities, this is not likely to happen in the near future.

The nutritional and physical health structure of the mother provides the background soil for the growth of the child. The nutritional status of children born to mother whose Body Mass Index (BMI) was below the critical value of 18.5 kg/m^2 were significantly poor. It is expected that educated mothers will be more exposed to knowledge and practices of proper childcare. This is confirmed by the present study. The father's background seems to have little impact on the nutritional status of children. Among the household characteristics, the living conditions emerge as the main factor for keeping the nutritional status of children normal. As compared to children living in Hindu households, those living in Christian households were nutritionally better off. In terms of weight-for-age z-scores, Arunachal Pradesh was better off in the nutrition of children, while Meghalaya had a significantly lower nutritional level of children. Though the social status of women in most of the north-eastern states of India is high, it is the women who work in the fields and farms and tend to household chores while the men stay home. After returning home late in the evening from agricultural work, the women must be ready again for work in the field early in the morning. This physical overexertion makes them poor sources of nutrients for children. Therefore, it is imperative to bring about a change in the occupational practices of the region. Village headmen are the caretakers of villages in the hills. They should be educated, particularly during community gathering and gospel prayer meetings, on the need for change in work orientation, considering the ill effect of current practices on the health of women.

A large amount of the variation of the nutritional status of children remains unexplained by the data collected in the NFHS-II. Obviously, there is a presence of household effect with a high intrahousehold correlation coefficient, indicating a tendency of children within the same household to have the same level of nutrition.

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