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SOCIOECONOMIC DIFFERENTIALS IN NUTRITIONAL STATUS OF CHILDREN IN THE STATES OF WEST BENGAL AND ASSAM, INDIA

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Summary. Malnutrition among children is prevalent in almost all the states in India. This study assesses the extent and causes of malnutrition in two eastern Indian states with similar climates, namely West Bengal and Assam, using data from the National Family Health Survey 1998–99 (NFHS-2). The three indices of malnutrition taken for analysis are weight-for-height (WHZ), height-for-age (HAZ) and weight-for-age (WAZ). These are assumed to depend on birth order, preceding birth interval, parent's educational status, working status of the mother, mother's age at delivery of the children, source of drinking water, toilet facilities and standard of living of the household. Logistic regression was carried out separately for each of the three indices on the explanatory variables for both the states. It was found that not all variables are equally important in determining whether a baby is underweight, or suffering from acute or chronic malnutrition. Also, the importance of variables is not the same in the two states. It was observed that the coefficients associated with the variables in determining weight-for-height are not significant compared with those for weight-for-age and height-for-age.

Introduction

Infant morbidity and mortality are closely related to socioeconomic status. An inverse relationship between socioeconomic status and infant mortality is a common phenomenon observed all over the world. Socioeconomic inequalities in health are also observed in all age groups. Several studies have revealed wide socioeconomic differences in morbidity and mortality rates among children (Wagstaff, 2000; Brockerhoff & Hewett, 2000; Gilson & McIntyre, 2001). Alderman (1993) determined child health with the help of survival rate, mortality, height, weight etc. Inequalities in health care in the early years of life draw special attention as the nutritional status

of under-five children is one of the most important indicators of a household's living standard and determinant of child survival (Thomas *et al.*, 1990).

Nutritional status is an integral component of the overall health of an individual. In the case of children, nutritional status can affect growth, development and immunity to disease. Nutritional deprivation is regarded as the most basic and acute of all deprivations. Over the last 30 years, the proportion of malnourished children has reduced by 20% in developing countries (WHO, 1999; Smith & Haddad, 2000). UNICEF reported that about 55% of the deaths of children below 5 years of age are due to malnutrition (UNICEF, 1994). According to Dev (1997), half of the world's malnourished children are found mainly in three countries: Bangladesh, India and Pakistan. Dreze & Sen (1989) stated that child malnutrition and infant mortality kill more people slowly in the long run than famines do.

It has been observed that the education of an adult member of a household above the level of primary school has more positive effect on the nutritional status of its children than that of the illiterate or below primary level adult member of a household. The education of both mother and father facilitates the acquisition of information about better child care and feeding practices. It is recognized that infants suffering from parental neglect are more likely to have a low level of nutrition (BAIF, 1997).

Different studies have focused on the determinants of child health showing that social and economic factors play a significant role in explaining some differences in health (Pal, 1999; Zere & McIntyre, 2003; Rao *et al.*, 2004). Studies by Pal (1999) and Mazumder *et al.* (2000) established that infant and child mortality are very much linked with birth order and birth spacing. Child malnutrition is also one of the measures of health status recommended by WHO for assessing equity in health (Braveman, 1998). Behrman & Wolfe (1984) showed that household characteristics, especially female literacy, are very important in child malnutrition.

Changes in body dimensions reflect the overall health and welfare of individuals and populations. Anthropometry has been used to assess performance, health and survival of individuals and to reflect the economic and social well-being of populations. Recently, Rajaram *et al.* (2003) assessed the nutritional status of children below five years using the three anthropometric measures weight-for-age, height-for-age and weight-for-height in two states of India – Kerala and Goa. They found prevalence of underweight, wasting and stunting among children was very high in the two states and the socioeconomic and family planning variables had significant influence on the degree of malnutrition.

The main purpose of this study is to find out the effects of different socioeconomic indicators on nutritional status differentiation with the help of anthropometric measurements of children under the age of 3 in two states of India, West Bengal and Assam, which were chosen for analysis for their geographic and cultural similarity.

Methods

This study uses data from the National Family Health Survey-2 (NFHS-2) conducted by the International Institute for Population Sciences (IIPS), Mumbai, in 1998–99. The data were collected from 90,303 ever-married women aged 15–49 from all 26

Indian states that existed at the time of the survey. The survey included women who were usually resident in the sample households or who were visitors who had stayed in the sample households the night before the interview. Information was also collected on height, weight and other measurements of ever-married women aged 15–49 years and children born to these women in the three years preceding the survey. The guidelines for measuring height and weight prescribed in the manual of the United Nation (1986) were followed. The analysis assessed the nutritional differentials by various socioeconomic characteristics. In West Bengal and Assam, the number of children born during the three years preceding the survey and alive at the time of survey were 1316 and 1129 respectively. However, information on vital items was only available for 1026 children in West Bengal and 763 children in Assam. (However, in some cases the numbers shown in the tables may not be the same if there was a non-response for a particular item; also, some outlying observations had to be deleted.)

Anthropometric indices are computed on the basis of information such as height, weight, age and sex. To assess the nutritional status of individual children, the World Health Organization recommends the use of *Z*-score indicators (Waterlow *et al.*, 1977; Dibley *et al.*, 1987). The World Health Organization (1995) has transformed the international growth reference curves into a *Z*-score representation that has been used worldwide to assess the nutritional status of children in cross-sectional surveys. In this study the growth indices used are weight-for-height (WHZ), height-for-age (HAZ) and weight-for-age (WAZ). The weight, height and age data for each child are transformed into the weight-for-height, height-for-age and weight-for-age indices (*Z*-score), which are expressed as standard deviation values after taking deviations from their respective medians of the international reference population (WHO, 1995).

Height-for-age (HAZ) and weight-for-height (WHZ) are used to measure whether a child has chronic and acute malnutrition respectively, in which case a child is correspondingly termed as 'stunted' or 'wasted', respectively. Weight-for-age (WAZ) is used to measure whether a child is underweight. It is a composite measure of both chronic and acute under-nutrition (Gillespie & McNeill, 1994; Arnold & Kapila, 2003). A cut-off point *Z*-score of -2 is most commonly used irrespective of the indicator used, and corresponds to the three anthropometric indices (HAZ, WAZ and WHZ), being equal to -2 times the standard deviation (SD) from the median. Children whose *Z*-scores of the anthropometric measures are less than -3 are labelled as severely malnourished. If the *Z*-score is in between -3 and -2 then the child is moderately malnourished (Radhakrishna & Ravi, 2004). The World Health Organization (1995) classified children under 5 years of age with WHZ, WAZ and HAZ values less than -2SD from median as malnourished. According to this criterion, the WHO has classified incidences of malnutrition for a given region. The criterion is different for WHZ, WAZ and HAZ. For example, if the prevalence of malnutrition is less than 5% for WHZ among children under five, then the population is considered to have a low prevalence of malnutrition. The corresponding upper limits for low prevalence of malnutrition for HAZ and WAZ are 20% and 10% respectively (see Table 1, where medium and high prevalence of malnutrition are also defined).

To see the effect of covariates on the nutritional status of children, logistic regression models were used. Logistic regression is a more appropriate statistical

Table 1. Criteria for prevalence of malnutrition on the basis of percentage of children under 5 years of age with Z-scores < -2

Index	Low	Medium	High	Very high
HAZ	<20·0%	20·0–29·9%	30·0–39·9%	≥40·0%
WAZ	<10·0%	10·0–19·9%	20·0–29·9%	≥30·0%
WHZ	<5·0%	5·0–9·9%	10·0–14·9%	≥15·0%

Source: World Health Organization (1995).

method to apply here because the dependent variable is categorical and dichotomous (Alison, 1984; Hosmer & Lemeshow, 2000). The logistic regression technique is used for the estimation of the odds of being malnourished. Multivariate analysis is carried out to study separately the odds of being underweight, and of stunting and wasting among children in the study population. Covariates such as age and sex of the children are not included in the regression analysis as they are already taken care of while computing Z-scores.

Children whose Z-score are below -2 are coded 1 and those with Z-scores of -2 or higher are coded 0. These values are entered into the regression as response variables and are termed dummy variables, since these are used instead of the actual Z-scores. Thus, the results obtained are compared with the reference category. An estimated odds ratio of 1 indicates that the odds of being malnourished are no different from the reference category. If the estimated odds ratio is greater than 1, the likelihood of being malnourished is higher relative to the reference category. And if the estimated odds ratio is less than 1, then the probability of being malnourished is lower relative to the reference category.

The predictor variables used in the logistic regression model are place of residence, use of electricity, source of drinking water and toilet facilities (these three are taken as a proxy for household economic conditions), standard of living index (a reflection of economic status of the household, which is calculated by adding scores of some durable goods of the household, prepared by the NFHS), birth order, birth interval, mother's education, father's education, ethnicity, mother's age at the time of delivery and mother's working status. The reference categories for the different variables mentioned above are: rural residence, household with electric connection, highest maternal and paternal education, birth spacing less than 24 months, first birth order, mother's age at delivery less than 20 years, open drinking water resource, with toilet facilities, mother with no outside working status, standard of living index high and the group with scheduled caste (SC), tribe (ST) and other backwards caste (OBC) (see Table 7).

Results

The categorization of prevalence of malnutrition of children below 5 years of age in a population is made on the basis of percentage of children with Z-scores below -2

Table 2. Percentage of malnourished (Z-score< -2) and severely malnourished (Z-score< -3) children in the states of West Bengal and Assam

	West Bengal			Assam		
Index	Malnourished ($Z< -2$)	Moderately malnourished ($-3 \leq Z< -2$)	Severely malnourished ($Z< -3$)	Malnourished ($Z< -2$)	Moderately malnourished ($-3 \leq Z< -2$)	Severely malnourished ($Z< -3$)
WAZ	45·80(VH)	30·60	15·20	36·17(VH)	20·97	15·20
HAZ	38·89 (H)	20·86	18·03	57·54(VH)	13·24	44·30
WHZ	13·94 (H)	11·21	02·73	14·42 (H)	7·60	6·82

H, high prevalence; VH, very high prevalence.

(Table 1). Since the results are based on data on children less than 3 years of age, this type of classification for West Bengal and Assam cannot be made. However, assuming that the same rate of prevalence exists for the rest of the children less than 5 years of age, some observations can be made on the prevalence of malnutrition in the two states. Table 2 shows that the prevalence of malnutrition in both the states is either high or very high. Chronic malnutrition (HAZ) is very high in Assam. Though acute malnutrition (WHZ) in both states is high, its incidence is greater in Assam, whereas the incidence of overall malnutrition (WAZ) is very high in both the states. Comparison of the percentages of severely malnourished children ($Z< -3$) in the two states shows that the chronic and acute cases of severely malnourished children are greater in Assam than in West Bengal (Table 2).

There is no marked difference in the mean weight and height of children between the states, but from the value of the standard deviation it is clear that the variation is higher in Assam than in West Bengal (Table 3). It seems that for Assam the variation in weight (reflected by the SD column corresponding to Wt column) for both male and female children gradually increases as the age increases. In West Bengal it is not so conspicuous. For a better understanding of the situation shown in Table 3 two more tables (Tables 8 and 9) have been included showing the means and standard deviations of heights and weights of children for each age in months. Since the sample size is not very large for each age in months, the mean heights and weights may not be very reliable and may not show the desired trend in some cases. Hence, the children were grouped into consecutive three-month intervals (Table 3).

Tables 4, 5 and 6 shows the nutritional status of children below 3 years of age in terms of three indices, WAZ, HAZ and WHZ, according to selected socioeconomic characteristics. In both states the extent of malnutrition with respect to WAZ, which indicates a combined effect of both chronic and acute under-nutrition, is more among children born in the rural areas, living in households without electricity and of young mothers, and is inversely related to the level of parental education. The effect is more pronounced in the state of West Bengal. Sex of the child shows a significant effect in the case of West Bengal. A significant effect is also found in the case of birth spacing. The other health and hygiene characteristics, such as presence of a toilet facility or

Table 3. State-wise distribution of mean weight and height according to sex and age of the children

Age group (months)	Male					Female				
		Weight		Height			Weight		Height	
	N	Mean	SD	Mean	SD	*N*	Mean	SD	Mean	SD
Assam										
0–<3	27	4·16	1·15	51·33	7·55	24	3·87	0·99	52·68	7·78
3–<6	45	5·50	1·35	57·51	6·92	43	5·58	1·51	58·89	9·85
6–<9	46	7·10	1·68	64·16	7·56	29	6·42	1·22	63·12	6·09
9–<12	25	7·73	1·49	66·36	7·58	25	7·95	1·92	63·53	6·76
12–<18	89	8·67	1·97	69·27	8·26	77	8·07	2·19	69·48	9·34
18–<24	78	10·47	2·61	75·57	8·64	43	9·97	2·50	73·01	8·49
24–<30	78	11·62	2·96	77·65	8·42	52	10·92	2·68	76·66	8·94
30–<36	37	13·72	3·51	84·87	7·46	45	11·68	3·18	80·48	9·99
West Bengal										
0–<3	37	4·06	0·78	54·10	3·57	33	3·53	0·87	51·65	3·77
3–<6	63	5·91	0·92	61·51	6·49	49	5·42	1·15	59·91	4·68
6–<9	58	7·11	0·83	66·36	2·62	45	6·39	1·13	64·50	3·40
9–<12	42	7·82	1·30	69·50	4·91	31	7·40	1·86	67·69	7·09
12–<18	107	8·43	1·13	73·09	3·99	104	7·97	1·39	71·84	5·38
18–<24	72	9·46	1·60	78·71	4·38	77	8·58	1·43	75·13	4·46
24–<30	89	10·28	1·35	81·79	4·35	88	9·55	1·53	79·90	5·39
30–<36	74	11·09	1·61	85·41	6·22	57	10·20	1·45	81·93	6·63

safe drinking water, play a significant role in the case of West Bengal. The manual work (in the agriculture) of the mother plays a more significant role than that of the non-working mother. For Assam a clear-cut conclusion cannot be drawn for other variables such as birth interval or birth order. In the case of stunted (HAZ) children the results are similar to those of WAZ for both West Bengal and Assam (Table 5). When the effect of wasted (WHZ) children under the age of 36 months is compared between West Bengal and Assam, the results are not the same for all variables. For example, residential status (rural or urban) has no differential effect on WAZ, as is the case for toilet facility and availability of drinking water. In all the cases discussed above, West Bengal corroborates with the popular expected beliefs more clearly than Assam except in the case of standard of living. Also, a better picture is seen in the case of chronic malnutrition and acute malnutrition.

Multivariate logistic regression analysis was carried out separately to study the odds of being underweight, stunted and wasted among children in the study populations. The results are shown in Table 7. It is seen that not all variables are equally important in determining whether a baby is underweight, or suffering from acute or chronic malnutrition. Also, the importance of variables is not the same in the

two states. Most of the coefficients attached to the variables in determining weight-for-height are not significant compared with those of weight-for-age and height-for-age. Also, the coefficients in West Bengal are more significant than those in Assam. These corroborate the findings in Tables 4, 5 and 6. The odds ratio is greater than one when the variable causes the response to increase more than that of the base category. Otherwise the value is less than or equal to one. For example, there is an increase in the level of malnutrition among children born in households with no electricity as the odd ratios are greater than one for both West Bengal and Assam in the no-electricity category, except for the cases of weight-for-height and height-for-age in Assam. The same was found in Tables 4, 5 and 6. The difference between Table 7 and Tables 4, 5 and 6 is that the test to see the effect of the covariates in Table 7 is automatically done after taking the effect of other variables into consideration. A significant effect of electricity, mother's education and birth order was found on the status of malnutrition in West Bengal for most of the measures and is more pronounced for WAZ and HAZ. For Assam a significant effect was found mostly for WAZ, that too with covariates residential status, electricity facility, ethnicity, father's education and toilet facility only. For rural–urban category, the odd ratios for West Bengal behaved differently from the odds ratios for Assam. The interpretation of the odds ratios in Table 7 is same as that of Tables 4, 5 and 6, but not much importance should be given to the coefficients giving rise to non-significant odds ratios.

Discussion

Malnutrition continues to be a problem of considerable magnitude in most developing countries of the world. Children below 3 years of age are nutritionally the most vulnerable group. More than half of Indian children are unable to grow to their full physical and mental potential due to malnutrition. The main emphasis of the present study is to examine the nutritional status of children with respect to household characteristics in Assam and West Bengal. The results revealed that there is some significant effect of the variables present in both states in determination of the nutritional level of children. So far as the studies of nutritional measurements are concerned, namely weight-for-height (wasting), weight-for-age (underweight) and height-for-age (stunting), it is found that the states show some common significant features for many of the variables. The magnitude of regional differences is not same for all the nutritional status indicators for the two states. The effect of various socioeconomic, demographic and cultural factors on malnutrition has been observed with some minor variation depending on the situations of the states. For example, while mother's illiteracy is likely to increase malnutrition in West Bengal, its effect may not be so prominent in Assam. Even the effect of mother's education was not found to be so significant in West Bengal for WHZ when compared with WAZ and HAZ. Father's education, however, plays almost the same role in both states. Children from households with better economic conditions have better nutritional status in West Bengal. In Indian society, where there is a pronounced preference for male children (Kishor, 1993), the significance of birth order for girls cannot be ignored. The current study shows that both birth order and birth spacing have significant effects on the measures of nutritional status, especially in West Bengal.

Table 4. Percentage and p values of demographic and socioeconomic variables for underweight children aged <36 months in West Bengal and Assam

Variable		West Bengal					Assam				
		WAZ	N	p value			WAZ	N	p value		
Residence	Rural	53·61	679	0·000			39·06	640	0·000		
	Urban	30·55	347				21·14	123			
Sex of child	Male	43·54	542	0·123			35·53	425	0·679		
	Female	48·35	484				36·98	338			
Electricity	No	57·03	640	0·000			40·98	571	0·000		
	Yes	27·20	386				21·88	193			
				ST	OBC	Other			ST	OBC	Other
Ethnicity	SC	55·51	245	0·871	0·009	0·000	27·84	97	0·629	0·225	0·006
	ST	56·67	60		0·023	0·485	25·00	132		0·385	0·000
	OBC	33·33	39			0·279	19·35	62			0·000
	Other	42·12	679				42·70	459			
				Primary	Sec.	HS+			Primary	Sec.	HS+
Mother's education	Illiterate	57·55	417	0·327	0·000	0·000	41·62	370	0·433	0·004	0·003
	Primary	53·59	237		0·000	0·000	37·69	130		0·118	0·027
	Secondary	31·72	290			0·000	29·52	210			0·202
	HS+	13·41	79				20·75	53			
				Primary	Sec.	HS+			Primary	Sec.	HS+
Father's education	Illiterate	63·57	269	0·787	0·000	0·000	42·86	273	0·677	0·000	0·000
	Primary	51·92	260		0·000	0·000	45·00	140		0·000	0·000
	Secondary	37·50	344			0·000	28·97	252			0·257
	HS+	19·86	141				22·92	96			

Table 4. *Continued*

Variable		West Bengal					Assam				
		WAZ	*N*	*p* value			WAZ	*N*	*p* value		
				24–47	48+				24–47	48+	
Birth interval (months)	<24	53·39	117	0·950	0·035		30·23	86	0·083	0·628	
	24–47	53·05	328		0·008		40·53	301		0·146	
	48+	41·31	213				33·33	141			
				2–3	4–5	6+			2–3	4–5	6+
Birth order	1	39·01	364	0·036	0·000	0·000	34·47	235	0·445	0·640	0·213
	2–3	46·25	467		0·057	0·024	37·62	319		0·264	0·445
	4–5	55·56	135			0·391	32·06	131			0·135
	6+	61·67	60				42·31	78			
				20–29	30+				20–29	30+	
Mother's age at delivery (years)	<20	53·27	199	0·018	0·134		40·70	172	0·183	0·244	
	20–29	43·81	687		0·796		35·06	462		0·841	
	30+	45·00	140				34·11	129			
				Medium	High				Medium	High	
Standard of living index	Low	44·39	455	0·639	0·596		40·15	365	0·048	0·000	
	Medium	45·96	433		0·825		33·11	299		0·092	
	High	47·10	120				22·97	74			
Toilet facility	Yes	30·02	473	0·000			36·50	474	0·810		
	No	58·59	553				35·64	289			
Drinking water	Piped/covered	44·47	922	0·010			35·76	481	0·763		
	Open/surface	57·69	104				36·88	282			
				Prof./serv.	Agri./man.				Prof./serv.	Agri./man.	
Mother's working status	No work/domestic	42·70	829	0·386	0·000		35·76	646	0·954	0·546	
	Prof./sale/service	28·57	21		0·857		36·36	22		0·822	
	Agri.+manual	63·09	168				38·95	95			

Table 5. Percentage and p values of demographic and socioeconomic variables for stunted children aged <36 months in West Bengal and Assam

Variable		West Bengal					Assam				
		HAZ	N	p value			HAZ	N	p value		
Residence	Rural	45·21	679	0·000			58·44	640	0·251		
	Urban	26·51	347				32·85	123			
Sex of child	Male	35·42	542	0·016			57·88	425	0·828		
	Female	42·77	484				37·10	338			
Electricity	No	49·37	640	0·000			58·84	571	0·208		
	Yes	21·50	386				53·65	193			
				ST	OBC	Other			ST	OBC	Other
Ethnicity	SC	44·49	245	0·119	0·056	0·031	62·89	97	0·136	0·542	0·349
	ST	46·67	60		0·066	0·125	53·03	132		0·939	0·275
	OBC	28·21	39			0·357	58·06	62			0·961
	Other	36·67	679				57·73	459			
				Pri-mary	Sec.	HS+			Pri-mary	Sec.	HS+
Mother's education	Illiterate	52·76	417	0·005	0·000	0·000	61·08	370	0·000	0·206	0·159
	Primary	41·35	237		0·000	0·000	53·08	130		0·636	0·792
	Secondary	24·48	290			0·019	55·71	210			0·533
	HS+	12·20	79				50·94	53			
				Pri-mary	Sec.	HS+			Pri-mary	Sec.	HS+
Father's education	Illiterate	56·51	269	0·006	0·000	0·000	61·17	273	0·516	0·214	0·083
	Primary	44·62	260		0·000	0·000	37·86	140		0·772	0·300
	Secondary	30·52	344			0·000	36·35	252			0·368
	HS+	14·18	141				51·04	96			

Table 5. *Continued*

Variable		West Bengal					Assam				
		HAZ	*N*	*p* value			HAZ	*N*	*p* value		
				24–47	48+				24–47	48+	
Birth interval (months)	<24	46·61	117	0·782	0·277		58·14	86	0·868	0·677	
	24–47	45·12	328		0·012		59·14	301		0·448	
	48+	34·27	213				55·32	141			
				2–3	4–5	6+			2–3	4–5	6+
Birth order	1	33·24	364	0·130	0·000	0·000	56·60	235	0·582	0·872	0·714
	2–3	38·33	467		0·028	0·013	58·62	319		0·573	0·955
	4–5	48·89	135			0·431	55·73	131			0·648
	6+	55·00	60				58·97	78			
				20–29	30+				20–29	30+	
Mother's age at delivery (years)	<20	53·77	199	0·000	0·149		57·56	172	0·41	0·568	
	20–29	34·50	687		0·360		58·44	462		0·395	
	30+	39·29	140				54·26	129			
				Medium	High				Med.	High	
Standard of living index	Low	38·02	455	0·556	0·939		59·45	365	0·397	0·325	
	Medium	39·95	433		0·760		56·19	299		0·588	
	High	38·41	120				52·70	74			
Toilet facility	Yes	25·79	473	0·000			58·02	474	0·731		
	No	50·09	553				56·75	289			
Drinking water	Piped	37·85	922	0·066			57·80	481	0·848		
	Open	47·12	104				57·09	282			
				Serv.	Agri.				Serv.	Agri.	
Mother's working status	No work	36·31	829	0·867	0·000		57·28	646	0·270	0·374	
	Service	38·09	21		0·182		45·45	22		0·153	
	Agri. work	53·57	168				62·10	95			

Table 6. Percentage and p values of demographic and socioeconomic variables for wasted children aged <36 months in West Bengal and Assam

Variable		West Bengal					Assam				
		WHZ	N	p value			WHZ	N	p value		
Residence	Rural	14·29	679	0·653			15·31	640	0·108		
	Urban	13·26	347				9·76	123			
Sex of child	Male	14·58	542	0·532			14·35	425	0·953		
	Female	13·22	484				14·50	338			
Electricity	No	16·41	640				14·89	571	0·523		
	Yes	9·84	386	0·003			13·02	193			
				ST	OBC	Other			ST	OBC	Other
Ethnicity	SC	17·14	245	0·931	0·786	0·089	5·15	97	0·106	0·273	0·000
	ST	16·67	60		0·865	0·357	8·33	132		0·757	0·007
	OBC	15·38	39			0·602	9·68	62			0·090
	Other	12·52	679				18·00	459			
				Primary	Sec.	HS+			Primary	Sec.	HS+
Mother's education	Illiterate	16·79	417	0·594	0·056	0·005	16·49	370	0·617	0·135	0·185
	Primary	15·19	237		0·242	0·008	14·62	130		0·468	0·345
	Secondary	11·72	290			0·038	11·90	210			0·613
	HS+	3·80	79				9·43	53			
				Primary	Sec.	HS+			Primary	Sec.	HS+
Father's education	Illiterate	18·22	269	0·214	0·063	0·000	16·48	273	0·865	0·102	0·239
	Primary	14·23	260		0·607	0·034	17·14	140		0·118	0·228
	Secondary	12·79	344			0·069	11·51	252			0·989
	HS+	7·09	141				11·46	96			
				24–47	48+				24–47	48+	
Birth interval (months)	<24	17·95	117	0·443	0·194		11·63	86	0·437	0·923	
	24–47	14·94	328		0·787		14·95	301		0·414	
	48+	12·68	213				12·06	141			

Table 6. *Continued*

Variable		West Bengal					Assam				
		WHZ	*N*	*p* value			WHZ	*N*	*p* value		
				2–3	4–5	6+			2–3	4–5	6+
Birth order	1	12·09	364	0·123	0·307	0·000	16·17	235	0·226	0·413	0·533
	2–3	15·85	467		0·935	0·060	12·54	319		0·899	0·125
	4–5	15·56	135			0·087	12·98	131			0·225
	6+	6·67	60				19·23	78			
				20–29	30+				20–29	30+	
Mother's age at delivery (years)	<20	16·58	199	0·358	0·843		19·19	172	0·034	0·311	
	20–29	13·97	687		0·208		12·55	462		0·515	
	30+	10·00	140				14·73	129			
				Medium	High				Medium	High	
Standard of living index	Low	15·16	455	0·874	0·053		15·62	365	0·572	0·170	
	Medium	14·78	433		0·066		14·04	299		0·296	
	High	8·33	120				9·46	74			
Toilet facility	Yes	10·99	473	0·015			13·29	474	0·252		
	No	16·27	553				16·26	289			
Drinking water	Piped	13·88	922	0·881			15·80	481	0·155		
	Open	14·42	104				12·06	282			
				Serv.	Agri.				Serv.	Agri.	
Mother's working status	No work	14·00	829	0·225	0·204		13·62	646	0·542	0·167	
	Service	4·76	21		0·768		18·18	22		0·934	
	Agri. work	14·88	168				18·94	95			

Table 7. Odds of being below −2 SD for weight-for-height, weight-for-age and height-for-age in West Bengal and Assam

		West Bengal			Assam		
	Variables	WHZ	WAZ	HAZ	WHZ	WAZ	HAZ
Residence	Rural (ref.)	1·00	1·00	1·00	1·00	1·00	1·00
	Urban	0·46**	1·05	0·86	1·58	1·90**	1·30
Electricity	Yes (ref.)	1·00	1·00	1·00	1·00	1·00	1·00
	No	2·35**	1·64**	2·03***	0·71	2·22***	1·15
Ethnicity	SC/ST/OBC (ref.)	1·00	1·00	1·00	1·00	1·00	1·00
	Other	1·13	1·16	1·02	0·34***	0·45***	1·03
Mother's education	Secondary+ (ref.)	1·00	1·00	1·00	1·00	1·00	1·00
	Primary	1·21	1·28	1·82***	0·95	0·93	1·12
	Illiterate	1·14	1·63**	1·54**	0·93	0·87	0·85
Father's education	Secondary+ (ref.)	1·00	1·00	1·00	1·00	1·00	1·00
	Primary	1·25	1·71**	1·66**	1·29	1·70**	1·24
	Illiterate	0·99	1·20	1·25	1·51	1·90**	1·11
Birth order	1 (ref.)	1·00	1·00	1·00	1·00	1·00	1·00
	2–3	1·99	0·47*	0·35**	0·40	1·57	0·66
	4–5	2·80*	0·69	0·54*	0·58	0·97	0·72
	6+	2·57*	0·91	0·75	0·64	1·13	0·68
Mother's age at delivery (years)	<20 (ref.)	1·00	1·00	1·00	1·00	1·00	1·00
	20–29	1·35	1·40	2·69***	1·78	1·20	1·11
	30+	1·51	1·25	1·28	1·11	1·14	1·20
Sources of drinking water	Open (ref.)	1·00	1·00	1·00	1·00	1·00	1·00
	Covered	0·65	1·04	0·98	0·76	0·96	0·88
Working status of mother	Not working (ref.)	1·00	1·00	1·00	1·00	1·00	1·00
	Services	1·19	0·73*	0·95	0·00	1·16	0·91
	Agri.+manual	0·45	0·59	1·43	1·42	1·30	0·41*
Toilet facility	Yes (ref.)	1·00	1·00	1·00	1·00	1·00	1·00
	No	1·37	1·53**	1·16	1·54*	0·71*	0·75*
Birth interval (months)	<24 (ref.)	1·00	1·00	1·00	1·00	1·00	1·00
	24–47	1·40	1·68**	1·43	0·86	1·19	1·28
	48+	1·24	1·33	1·13	1·18	1·50*	1·34
Standard of living index	High (ref.)	1·00	1·00	1·00	1·00	1·00	1·00
	Medium	1·74*	0·70*	0·87	1·10	0·87	0·98
	Low	1·85*	0·83	1·03	1·56	0·90	0·96
Constant		0·01***	0·42*	0·27***	0·17**	0·12***	1·11
Log likelihood		767·24	1215·55	1167·56	546·55	866·62	974·24
Chi squared		34·53	138·75	141·33	35·47	74·58	16·68

Ref., reference category.
**$p<0·001$; **$p<0·05$; *$p<0·10$.

Assam and West Bengal are at different stages of socioeconomic development and demographic transition, the situation being relatively better in West Bengal. The children of West Bengal have relatively higher levels of calorie intake (Radhakrishna

Table 8. Distribution of mean weight and height according to sex and age of the children: West Bengal

	Male					Female				
		Weight (kg)		Height (cm)			Weight (kg)		Height (cm)	
Age (months)	*N*	Mean	SD	Mean	SD	*N*	Mean	SD	Mean	SD
0	5	3·18	0·34	52·60	3·65	4	2·55	0·82	45·98	4·14
1	10	3·51	0·59	51·11	3·65	12	3·22	0·71	51·67	3·16
2	22	4·51	0·58	55·81	2·41	17	3·98	0·71	52·97	2·89
3	15	5·20	0·62	58·65	4·18	14	4·96	0·83	58·67	5·35
4	19	5·85	0·72	63·00	9·85	16	5·33	1·46	59·58	5·69
5	29	6·32	0·95	62·02	3·99	19	5·84	0·94	61·11	2·82
6	18	7·07	0·75	65·76	3·08	18	6·07	1·29	63·47	4·69
7	17	7·03	0·87	66·26	2·44	13	6·37	0·64	64·93	1·79
8	23	7·19	0·88	66·90	2·35	14	6·82	1·21	65·41	2·17
9	18	7·79	1·35	68·02	5·72	6	7·45	0·71	68·63	2·11
10	10	7·29	0·75	69·13	3·74	11	7·09	1·65	65·82	7·36
11	14	8·22	1·46	71·67	3·93	14	7·71	2·35	68·75	8·25
12	19	8·05	1·33	70·82	3·09	13	7·23	1·22	67·38	7·49
13	16	8·15	1·27	72·71	4·41	12	8·18	1·58	72·32	5·15
14	16	8·45	0·88	72·82	4·36	19	7·83	1·15	72·42	5·15
15	21	8·54	1·13	73·75	3·57	14	7·92	1·48	70·44	3·78
16	21	8·79	1·12	74·12	4·80	26	7·99	1·40	72·35	4·99
17	14	8·56	0·91	74·36	2·29	20	8·44	1·46	74·20	4·05
18	20	9·13	1·86	77·75	3·81	18	8·62	1·31	75·75	3·54
19	8	9·70	0·91	79·21	2·86	11	8·31	0·96	73·61	3·55
20	15	10·15	1·71	79·74	3·34	21	9·12	1·46	76·29	4·62
21	12	9·56	1·46	78·70	4·72	7	8·96	1·79	76·71	4·63
22	8	8·29	0·43	77·31	4·69	7	8·07	1·67	75·61	5·26
23	9	9·78	1·73	79·91	7·14	13	7·92	1·39	72·55	4·88
24	12	9·54	1·18	80·09	4·19	17	9·05	1·49	78·21	5·21
25	16	10·47	1·53	82·54	4·24	13	8·75	1·52	76·86	5·58
26	19	10·16	1·33	82·13	4·22	16	10·02	1·25	81·26	4·97
27	18	10·43	1·32	82·68	3·30	22	9·43	1·55	80·06	5·23
28	9	10·60	1·05	82·13	3·03	10	10·09	1·69	80·65	4·89
29	15	10·45	1·67	80·63	6·19	10	10·38	1·29	83·47	4·99
30	9	10·19	1·66	84·51	5·65	21	9·83	1·41	81·17	6·08
31	10	10·82	1·42	85·16	5·25	11	11·01	1·35	84·44	6·06
32	11	11·84	1·84	88·06	4·72	9	10·28	1·41	83·61	6·03
33	11	11·37	0·61	87·57	3·97	7	10·69	2·00	78·47	11·49
34	22	11·12	1·82	85·07	7·94	4	9·73	1·01	81·25	3·27
35	11	10·21	1·56	82·26	6·07	5	9·48	0·76	81·96	3·51
Total	542	8·46	2·35	73·31	10·28	484	7·87	2·29	71·48	10·04

& Ravi, 2004). Assam has a relatively high percentage of the population below the poverty line and a very poor rural infrastructure, as pointed out by Swaminathan in

Table 9. Distribution of mean weight and height according to sex and age of the children: Assam

Age (months)	Male					Female				
		Weight (kg)		Height (cm)			Weight (kg)		Height (cm)	
	N	Mean	SD	Mean	SD	*N*	Mean	SD	Mean	SD
0	2	3·25	0·64	49·60	1·98	4	3·00	0·29	54·40	4·96
1	12	3·75	0·98	51·96	8·21	9	3·96	1·39	50·44	10·44
2	13	4·68	1·17	51·02	7·78	11	4·11	0·56	53·89	6·10
3	21	4·77	1·12	54·42	4·93	11	4·57	0·81	54·16	6·04
4	11	5·85	1·23	59·02	7·51	12	6·12	1·68	60·32	9·44
5	13	6·39	1·18	61·18	7·37	20	5·80	1·49	60·64	11·23
6	12	6·41	0·72	63·19	7·11	12	6·64	1·38	62·14	7·31
7	20	7·35	2·14	62·80	7·66	15	6·52	1·17	66·04	6·85
8	14	7·36	1·42	66·82	7·62	12	6·15	1·11	62·89	4·34
9	9	7·74	1·61	67·11	10·20	6	7·43	0·85	61·03	7·10
10	7	7·67	1·14	65·03	6·12	13	8·70	2·02	63·92	5·49
11	9	7·76	1·77	66·64	6·17	6	6·83	1·97	65·18	9·25
12	12	7·74	1·99	68·02	4·89	14	8·12	1·59	69·41	8·63
13	16	8·71	2·00	69·01	7·13	11	7·74	1·92	68·65	9·33
14	10	8·26	2·56	64·60	9·77	15	6·80	2·05	65·15	7·45
15	18	8·83	2·28	68·71	6·43	14	7·59	1·60	66·04	6·55
16	20	9·01	1·65	71·09	11·21	17	9·25	2·78	75·06	11·43
17	13	9·04	1·36	72·28	7·10	6	9·55	1·63	74·17	7·06
18	16	10·92	2·53	78·09	8·66	10	8·60	1·26	72·10	7·85
19	13	9·21	2·87	73·73	8·90	6	9·70	2·88	70·77	7·06
20	13	10·35	2·00	77·51	9·51	9	10·23	3·20	72·51	8·47
21	16	10·12	2·62	75·44	8·02	8	10·86	3·17	71·75	9·94
22	14	10·39	2·00	73·56	8·15	3	9·23	0·10	73·30	3·72
23	6	13·35	3·18	74·10	9·77	7	11·14	1·61	78·20	10·73
24	12	11·47	2·71	73·58	6·01	8	10·39	1·91	79·23	5·27
25	15	11·50	2·92	77·63	8·43	10	10·44	1·90	73·20	12·35
26	15	10·87	2·46	75·28	10·57	8	10·12	1·85	73·13	4·81
27	19	12·45	3·44	78·75	7·59	10	10·35	2·26	72·59	7·68
28	12	10·66	2·04	79·56	8·29	5	11·06	2·96	78·50	4·62
29	5	13·76	4·38	85·88	2·00	11	12·76	3·90	83·38	8·84
30	8	11·61	3·05	82·20	8·07	11	11·17	3·03	77·66	3·44
31	7	12·40	0·88	81·19	7·52	9	12·58	3·22	77·51	12·32
32	7	13·43	3·49	86·36	6·33	3	13·07	4·37	81·80	10·28
33	3	16·57	4·12	88·60	7·21	7	12·21	2·71	81·39	7·60
34	6	18·43	2·02	88·32	4·73	11	11·15	3·75	85·15	13·78
35	6	12·27	2·32	85·70	9·64	4	10·55	2·73	79·43	7·75
Total	425	9·13	3·50	70·21	11·92	338	8·46	3·25	68·97	11·93

his convocation address in 2002 at Assam Agricultural University. He also noted that Assam is the fifth lowest state in India with regard to food consumption and

nutritional status. It should be noted here that Assam experienced a turbulent period during the 1990s due to certain extremist movements. On the other hand, West Bengal was relatively peaceful with no political disturbance during this period. Intra-household distribution of food also may have some impact on the nutritional situation. The different ethnic groups show variation with respect to nutritional status in Assam. However it is not clear whether causal relations exist between them. But it is known that economically low castes and tribal groups are poorer compared with the general castes (Radhakrishna & Ravi, 2004). Moreover the percentage of urban areas is greater in West Bengal than in Assam. These areas need further intensive investigation for a better understanding of the problems.

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