Bulletin of the World Health Organization, **58** (5): 767-772 (1980)

Is income the only constraint on child nutrition in rural Bangladesh?

R. BAIRAGI [1]

A study of malnutrition among children in a rural area of Bangladesh during a famine year has shown that seasonal factors, family income, mother's education, and sex and birth order of the children appear to be important determinants of malnutrition. An interaction between family income and mother's education in relation to child nutrition was quite apparent. A higher family income was of relatively greater benefit to the children of literate mothers than to those of illiterate mothers in improving their nutritional status. There was a threshold point below which income appeared as the main constraint on child nutrition. It is thought that a nutrition education programme may be helpful in improving the nutritional status of children of wealthier families. The importance of education of women as one of the long-term policy measures to improve the nutritional status of children is emphasized.

Malnutrition of preschool children is a serious problem in developing countries. The Food and Agriculture Organization of the United Nations (FAO) contends that malnutrition is the biggest single contributor to child mortality in the developing world (*4*). In these countries, 25–50% of children die before their fifth birthday and more than 50% of these deaths are related directly or indirectly to malnutrition (*9*). The interaction of malnutrition and infection is also well recognized (*10*).

The future of a nation is linked with the wellbeing of its children, which depends to a considerable extent on their nutritional status. In this sense, the nutritional status of children may be considered representative of the level of development of a nation. Nutrition as a whole, and particularly of children, is the outcome of a complex interaction of a broad range of physical and cultural factors. To develop a rational policy for solving the malnutrition problems of children, it is important to have a precise knowledge of the magnitude of the problem and of related factors. Most of all, it is necessary to know whether malnutrition of children is determined entirely by economic factors or in part by other factors, such as birth order and family education.

A nutrition survey has shown that in Bangladesh 25% of children suffer from severe malnutrition (*1*). Such a high proportion of severely malnourished children is rare in other parts of the world. Bangladesh is one of the poor countries of the world. Its *per capita* income is only about US $100.00. Naturally, income is felt to be the main constraint on child nutrition in this country. In this paper, an attempt is made to investigate the importance of family income in relation to some other sociodemographic factors that might affect the nutritional status of children in the rural areas of Bangladesh. The factors analysed in addition to family income are: age of the children, sex of the children, birth order of the children, ownership of land by the family, father's occupation, housing conditions, season, sources of drinking water, father's education, mother's education, and participation of the children in food supplementation programmes.

STUDY AREA AND POPULATION

The data for this study came from the Companigonj Health Project, Noakhali. This area is located about 160 km south-east of Dacca, the capital of Bangladesh. The project covers an area of about 128 square km with a population of 118 000 in 1975. It is a typical rural area of Bangladesh and is composed of groups of houses (baris) belonging to patrilineally related families surrounded by agricultural holdings. All the agricultural holdings are submerged under water during the monsoon season and the baris are on elevated ground.

The population is very young as a result of the high birth rate and moderately low death rate. More than 16% of the population is under 5 years of age and 50% of the population is under 16 years of age. The population density exceeds 900 people per square km. The average family size is slightly more than 5 persons who usually live in a hut having 1 or 2 rooms with mud

[1] Assistant Professor, Institute of Statistical Research & Training (ISRT), University of Dacca, Dacca - 2, Bangladesh; Consultant, Companigonj Health Project, Noakhali, Bangladesh.

floors and straw or tin roofings. Sanitation facilities are traditional and very few houses have latrines. The main sources of drinking water are tubewells and open ponds. The women are usually extremely busy with household work, some of which is very strenuous. All of them breast feed their children for two years or more or until they have another child. There is an active family planning programme in this area, and in November 1976 18% of couples were practising family planning.

There are 7 clinics in the Companigonj Health Project area; at these the services of qualified physicians are available twice a week and the services of auxiliary health workers are always available. In addition to these clinics, there is a project hospital. Preventive programmes against malaria, smallpox, diphtheria, whooping cough, and tetanus are available.

A longitudinal nutrition study was started within the Companigonj Health Project area in late August, 1974 and it continued until November, 1975, with financial support from UNICEF. During the study period there was a famine throughout Bangladesh. Food supplies were low for many of the families and malnutrition was the most important medical problem. In an attempt to provide an inexpensive food supplement for small children, shops were established adjacent to all 7 project clinics as distribution centres for a locally produced mixture of 75% wheat and 25% chick peas. This supplement was sold at one-half the market price of wheat. Wheat was available free from CARE and the World Food Programme. Families with children under the age of 3 who regularly attended the project clinics were issued with a ration card that allowed them to purchase an amount of the supplement equivalent to about one-third of the child's energy requirement. Though the supplement was sold throughout the Companigonj Health Project area, nutritional surveillance was carried out only in the area within 2 miles of one of the most active clinics. All the children of that subarea (517 in number) who were aged 3 years or less in August 1974 were included in the study. As reported elsewhere (*2*), food supplementation had little success in improving the nutritional status of the children in the study area.

FIELD PROCEDURES AND METHODS OF ANALYSIS

The weights of the children were determined monthly from August, 1974 to November, 1975 by three field assistants, using spring balances (Salter scale), which were calibrated monthly. The measurements were taken to the nearest quarter of a kilogram. The children were weighed at home as a part of a monthly survey.

Very few families remembered the date of birth of their children, even those below the age of 3 years. The dates of birth were therefore estimated by a well-qualified sociologist using a calendar of local events. The estimated date of birth was believed to be within plus or minus 15 days of the exact date of birth.

Income was calculated in takas (1 dollar = 15 takas) on a per month per family basis. In the case of salaried persons this was relatively easy. For landless agricultural labourers, an attempt was made to calculate the total monetary value of wages and payment in kind for an estimated number of days worked in an average month. For the landed agriculturists, income calculation was based on the value of their agricultural goods (consumed and not consumed). This is a rural community and most of the families grow some vegetables for household consumption and keep cattle, goats, and some poultry. Those items were not included in the income calculation so the monthly income may be consistently underestimated.

The data on landownership may be considered quite reliable because every head of household, literate or illiterate, knew how much land he had in local units, which were easily converted into square km.

The classifications used to describe housing were straw, tin, and pacca, the materials from which the roofs of the main houses were constructed. In the study area, very few families had a water supply to the house. The source from which drinking water was drawn for more than 50% of the year was considered as the source of drinking water. Tubewells and ponds were the main sources of drinking water in the study area.

Father's education and mother's education were recorded in number of years of schooling. Mothers who had had at least one year of schooling or could read or write simple sentences in Bengali were considered as literate.

Birth order was calculated from the record of all previous live births (whether still living or not), including the study child. Birth order may have been slightly underestimated as a result of failure to recall the deaths of some children.

A child for whom supplemented food was purchased on at least one occasion was given a food card. Food for a child could be purchased a maximum of 15 times during this study.

Weight for age expressed as a percentage of the Harvard Standards was considered as an indicator of the nutritional status of the children and was treated as the dependent variable in this analysis. It has been demonstrated in many studies that this index is a satisfactory measure of protein-energy malnutrition in children (*5*, *6*, *11*). Most children in developing countries have the potential to follow the same weight-

for-age growth curve as children in the developed world, at least for the first five years of life, and genetic factors make little contribution to weight gain in this age group.

The nutritional status of a child at the beginning of its life is closely related to that of the mother and the socioeconomic status of the family has, in itself, little effect (*2*). In this study we did not have reliable data on the nutritional status of the mothers, so the analysis was confined to children aged 12–36 months, the group most vulnerable to malnutrition.

Preliminary evaluation was performed using multiple regression analysis (*3*), which was applied to data obtained during two seasons: November to January, thought to favour the nutritional status of children, and May to July, believed to be unfavourable. Correlation between many of the independent variables, such as income and landownership, was quite high. A stepwise regression procedure (*3*, pp. 169–172) was therefore followed.

It was essential to investigate the changes that occur in the estimated effects of the independent variables as a result of adding other independent variables. If a dummy independent variable (sex, religion, etc.) was added and its explanatory value was very low in comparison with the others, that variable was dropped from the model. Independent variables that were found to be significant at the 10% level or below in regression analysis were selected for covariance analysis (*8*). In multiple regression analysis, out of the variables mentioned earlier, only family income, mother's education, sex of the child, birth order, and age of the child were found to be significantly related to the child's nutritional status. In covariance analysis, family income and mother's education were considered as main variables; and sex of the child, birth order, and age of the child were considered as covariates.

Table 1. Distribution of family monthly income

Income (takas)	Percentage of families
0 - 100	4.5
101 - 300	61.1
301 - 600	26.2
601 - 1000	6.9
Above 1000	1.3
Median: 275.00[a]	
Mean: 395.00[a]	

[a] Mean and median incomes are calculated from ungrouped data.

Table 2. Distribution of mothers by educational level

Years of schooling	Percentage of mothers
0	73.7
1 - 5	20.1
6 - 10	6.1
Above 10	0.2

Table 3. Distribution of study children by birth order

Birth order	Percentage of children
1	17.8
2 - 3	34.7
4 - 5	21.9
Above 5	25.6

RESULTS

Out of 517 children in the study, 376 were between 12 and 36 months of age at the beginning of the study. The number of children in this age group who were available for at least one weight measurement in each of the two seasons (November–January and May–July) was 326 and 356, respectively.

The average monthly income of the families of the study children was 395.00 takas, the median income being 275.00 takas (Table 1). Of the mothers, 73.7% had no schooling and only 6.3% had more than 5 years' of schooling (Table 2).

Of the study children, 17.6% were of birth order 1, whereas 25.6% were of birth order 6 or more (Table 3).

The nutritional status of the children was found to be significantly different ($P<0.01$) in the two seasons. Table 4 presents the distribution of the children according to the Wellcome Trust Classification (*7*) for the two seasons and also the means and standard deviations for the two seasons. In November–January, 15.0% of the children were severely malnourished (weight for age less than 60% of the Harvard Standards) and in May–July the proportion was increased to 25.6%. Only 11.1% in November–January and 6.7% in May–July appeared to be nutritionally normal. November–December is the harvest season for the main crop "aman" and every family has something to eat during this season. Even landless labourers get some rice as share croppers or as payment in kind for their labours. In

Table 4. Distribution of study children by nutritional status and by seasons

	Seasons			
	Nov. – Jan.		May – July	
Weight for age[a]	No.	%	No.	%
Less than 60	49	15.0	91	25.6
60 – 80	241	73.9	241	67.7
Above 80	36	11.1	24	6.7
Total	326	100.00	356	100.00
Mean[b]	68.44		66.15	
SD[b]	9.67		10.05	
	$P < 0.01$			

[a] As percentage of Harvard Standards.
[b] Means and standard deviations are calculated from ungrouped data.

Table 6. Means and standard deviations of nutritional status of the children by income and mother's education

	Mother's education					
	Illiterate			Literate		
Income (takas)	Mean	SD	No.	Mean	SD	No.
	A. November – January					
0–250	67.4	9.3	129	64.8	10.8	20
251–450	67.3	9.4	80	71.6	10.0	30
⩾ 451	68.9	9.1	38	74.9	9.4	29
All	67.6	9.3	247	71.1	10.6	79
	B. May – July					
0–250	64.2	9.0	135	62.7	8.9	22
251–450	65.5	10.8	92	71.7	8.6	33
⩾ 451	67.3	9.8	46	72.0	10.8	28
All	65.2	9.8	273	69.4	10.2	83

this season, not only rice but vegetables and fish are available in larger quantity. May–July is the scarce season when no staple food is available inland. The findings indicate that both the quantity and the quality of the food the children received probably improved during the harvest season.

Table 5 presents the results of covariance analysis. Among the covariates, sex appears to be highly significant in both seasons ($P<0.01$): male children had better nutrition. This significant difference is an indication of the high premium placed on the health of the male child.

Birth order appears to be a significant determinant of nutritional status in the scarce season ($P<0.05$). Nutritional status decreased with birth order. This may be due to the lower availability of food or child care with high birth order. In the harvest season, food was more plentiful, which was probably why the effect of birth order on food intake was less marked.

Table 5. Results of the analysis of covariance by seasons

	P values	
Sources of variation	Nov. – Jan.	May – July
Main effects	0.001	0.001
Family income (IN)	0.016	0.006
Mother's education (ME)	0.053	0.004
Age of child (Covar)	0.140	0.272
Sex of child (Covar)	0.001	0.001
Birth order (Covar)	0.999	0.013
Interaction between IN and ME	0.024	0.050

For covariance analysis, family monthly income was classified into three groups: 0–250, 251–450, and more than 450 takas per month. Mothers were classified by education as literate or illiterate. Mothers who could write or read or had had at least one year's schooling were considered as literate. As Table 5 reveals, income and mother's education were both significantly related to the nutritional status of the children for both seasons. Moreover, the interaction between income and mother's education was also significant ($P \leqslant 0.05$) for both seasons. This interaction is quite apparent in Table 6. The improvement in nutritional status of the children of illiterate mothers with increasing income is slight, whereas for the children of literate mothers there is a substantial improvement with increasing income. It may be noted that the difference in nutritional status between the children of educated and those of uneducated mothers in the lowest income group is not significant ($P>0.30$).

DISCUSSION AND CONCLUSIONS

It should be noted that the variables considered in this analysis are proxy variables of some of the causes of malnutrition, such as food intake, diseases, and child care. It appears that the nutritional status of the children is related to family income and for the

children in the lowest income group (less than 250 takas per month), an increase in family income is essential before any other attempt is made to improve their nutritional status. The contribution of increased income to improvement in the nutritional status of the children of illiterate mothers was very slight. This indicates that improvement in the nutritional status of the children is not constrained by income alone. Mother's education, sex of the child, and birth order also appear to be significant determinants of the nutritional status of the children. Preference for the male child is deeply rooted in the socioeconomic structure in Bangladesh.

From the above data, it was not possible to infer how a literate mother improved the nutritional status of her child to a greater degree than an illiterate mother. It is possible that the child received better food or better care or both in the household of the literate woman. An illiterate mother with a higher income seems for some reason less able than a literate woman to utilize her resources for the welfare of her child. This suggests that a nutrition education programme could improve the nutritional status of the children at least among the upper income group. What the mother or the family lacks in understanding the nutritional needs of the child, what type of nutrition education would be appropriate, and how long this education ought to continue should be decided on a sound scientific basis.

This study was undertaken at a time when there was a state of famine throughout Bangladesh, so that the findings relate to a specific, time-limited nutritional situation. Any attempt to generalize the conclusions drawn from these findings should therefore be made with caution.

ACKNOWLEDGEMENTS

The author is grateful to the authority of the Companigonj Health Project, Bangladesh for the data and to Dr C. W. McCord of the United Nations Fund for Population Activities and Dr L. C. Chen of the International Centre for Diarrhoeal Disease Research, Bangladesh for their comments on an earlier draft.

RÉSUMÉ

LE REVENU EST-IL LE SEUL FACTEUR INFLUANT SUR LA NUTRITION DES ENFANTS DANS LES PARTIES RURALES DU BANGLADESH?

De août 1974 à novembre 1975, on a recueilli dans une zone rurale du Bangladesh des données mensuelles longitudinales sur le poids parmi 350 enfants âgés de un à trois ans. Au cours de cette période, il y a eu une famine dans l'ensemble du Bangladesh. Certaines caractéristiques socio-économiques et démographiques des familles auxquelles appartenaient ces enfants ont été enregistrées.

On a pris comme indicateur de l'état nutritionnel le poids pour l'âge exprimé sous la forme d'un pourcentage des valeurs de référence de Harvard, et on a analysé les données à l'aide de la méthode de régression multiple et de l'analyse de covariance. La saison, le revenu familial, le niveau d'instruction de la mère, le sexe des enfants et leur rang de naissance se sont révélés d'importants déterminants de leur état nutritionnel. Il y avait une très nette interaction entre le revenu familial et le degré d'éducation de la mère en ce qui concerne l'effet sur l'état nutrionnel des enfants. Ainsi l'accroissement du revenu familial était relativement plus bénéfique pour les enfants des mères alphabétisées que pour ceux des mères analphabètes. Un revenu familial mensuel d'environ taka 250,00 (l'équivalent de US$ 16) semblait être le minimum au-dessous duquel aucun autre facteur favorable ne pouvait aider à améliorer l'état nutritionnel des enfants.

A la lumière des résultats de ces études, on pense qu'un programme d'éducation nutritionnelle pourrait être utile en vue d'améliorer l'état nutritionnel des enfants des familles les plus aisées. L'importance de l'éducation des femmes dans une politique à long terme visant à améliorer l'état nutritionnel des enfants est soulignée.

REFERENCES

1. AHMAD, K. ET AL. *Nutrition survey of rural Bangladesh 1975–76*, Institute of Nutrition and Food Science, University of Dacca, Bangladesh, 1977.
2. BAIRAGI, R. *An analysis of malnutrition among young children in rural Bangladesh.* Thesis, Johns Hopkins University, 1978.
3. DRAPER, N. R. & SMITH, H. *Applied regression analysis*, New York, Wiley, 1966.
4. *Lives in peril, protein and child*, Rome, Food and Agriculture Organization of the United Nations, 1970.

5. HABICHT, J. ET AL. Height and weight standards for pre-school children. How relevant are ethnic differences in growth potential? *Lancet*, **1**: 611–615, (1974).
6. JELLIFFE, D.B. The assessment of the nutritional status of the community, Geneva, World Health Organization, 1966 (WHO Monograph Series, No. 53).
7. Classification of infantile malnutrition. *Lancet*, **2**: 302–303 (1970).
8. NIE, N. H. ET AL. Statistical package for the social sciences, 2nd ed., New York, McGraw-Hill, 1975, pp. 398–433.
9. PUFFER, R. R. & SERRANO, C. U. Patterns of mortality in childhood, Washington DC, Pan American Health Organization, Pan American Sanitary Bureau, 1973.
10. SCRIMSHAW, N. S. ET AL. Interaction of infection and nutrition, Geneva, World Health Organization, 1968 (WHO Monograph Series, No. 57).
11. WOODRUFF, C. W. An analysis of the ICNND data on physical growth of the pre-school child. In: *Pre-school child malnutrition: primary deterrent to human progress. An international conference on prevention of malnutrition in the pre-school child, Washington D.C., December 7–11, 1964*, Washington DC, National Academy of Sciences—National Research Council, 1966, pp. 22–28.