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The contribution of severe malnutrition to child mortality in rural Bangladesh: Implications for targeting nutritional interventions

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Abstract

The contribution of severe malnutrition to child mortality was examined in a rural Bangladeshi population of 200,000 under intensive demographic surveillance. In 1986–1987 one-third of all the deaths in children between 6 and 36 months of age were associated with severe malnutrition, and 79% of those deaths were associated with persistent diarrhoea. The relative risk of dying from diarrhoea among severely malnourished children, as opposed to those who were not severely malnourished, was 17. The attributable risk was 49%. For all causes of death combined, the relative risk was 8 and the attributable risk 30%. Sixty per cent of all deaths in this age group occurred during the five post-monsoon months. The risk of dying from severe malnutrition was more than twice as high among girls as among boys. The specific mortality due to severe malnutrition was significantly lower in the half of the surveillance area covered by an intensive mother-child health and family planning (MCH-FP) programme than in the half covered by the regular national health services, suggesting the programme's effectiveness.

Key words: *nutrition, child mortality, sex differentials, seasonality, rural Bangladesh.*

Introduction

Malnutrition is the most serious problem of pre-school-age children in the developing world. It stems from several conditions—irregular food supply, inadequate distribution, limited purchasing power, interaction with infections, and insufficient knowledge [1; 2]—and leads to unacceptable levels of mortality, which could be reduced considerably if effective interventions were implemented.

We attempted to assess the contribution of severe malnutrition to child mortality among rural Bangladeshi children, based on observations made in Matlab, where special attention was given to the assessment of cause of death during two years, and used the findings to derive guidelines for targeting supplementary feeding in areas similar to the study area.

Data and methods

The Matlab study area, located in the deltaic flood plain at the junction of the Ganges and Meghna rivers, is representative of rural southern Bangladesh. It has a subsistence agricultural economy, poor infrastructures and communications, and uneven land distribution, and its socio-economic indicators are among the lowest in the world [3].

Since 1966 the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B), has maintained a demographic surveillance system in a population that was 200,000 in 1986–1987. Periodic censuses are updated by longitudinal recording of births, deaths, marriages, and migrations [4]. The primary study area was one in which intensive family planning (FP) programmes and various maternal-child health (MCH) interventions have been operated by the ICDDR,B since 1978 [5]. Also included in the study was a comparison area of the same size, serviced by the national health programme, with the addition of free access to diarrhoea treatment centres operated by the ICDDR,B.

The MCH interventions implemented in the primary study area during 1986–1987 included an expanded programme of immunization, with coverage rates around 80% (as opposed to 5% in the comparison area); a family planning programme, with a contraceptive use rate of 50% (as opposed to 20% in the

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comparison area); a central and two peripheral nutrition rehabilitation units; and nutrition education. Other interventions, such as distribution of oral rehydration therapy (ORT) packets and vitamin-A capsules, were implemented equally in both areas.

The causes of death of children in the study areas in 1986–1987 were assessed through a multiple-step procedure called verbal autopsy. Whenever deaths were reported by community health workers during their routine bi-weekly home visits, health assistants interviewed the nearest relatives to record socio-demographic information and write a semi-structured description of the events and symptoms preceding death. This information was recorded on a special form in the local language, without attempts to make a diagnosis at this stage. These forms were then distributed to three medical officers of the project, who assigned their diagnoses independently, giving priority to the final cause of death and adding underlying conditions. A cause of death was accepted when two or three of the reviewers agreed on the diagnosis, and this diagnosis was coded according to a classification derived from the WHO classification [6]. In case of complete disagreement, which occurred in about 15% of the cases, the forms were returned to the field for additional information and then re-entered into the process. It was impossible to assign a cause in about 8% of the deaths.

The total population under five years of age in the surveillance area was around 30,000. As a result of this large number, in most cases it was impossible to get an objective measure of the degree of malnutrition prior to death. Hence, the term "severe malnutrition" was applied when parents or relatives reported a rapid or recent (or both) wastage of the child's tissues prior to death, or the recent appearance of tibial oedema. In a sub-sample of 253 children in whom mid-upper arm circumference (MUAC) had been measured within a month of death, the degree of agreement between the assessment of severe malnutrition by verbal autopsy and by MUAC was 86% (sensitivity 76%, specificity 91% for MUAC < 110 mm).

The denominators for the calculation of global and cause-specific death rates were provided by the demographic surveillance system and expressed in child-years of exposure to the risk of death. Differences between groups were tested by comparison of incidence: density ratios, and 95%-confidence intervals-of-risk ratios by the Miettinen test–based method [7]. Attributable risks and their confidence intervals were calculated according to Walter [8].

Results

Of the age ranges that have been proposed as most appropriate for estimating the contribution of severe malnutrition to childhood mortality, that of 6–36 months was found to have the highest rate and next to highest proportion of deaths related to severe malnutrition (table 1). It was chosen therefore in preference to that of 12–60 months, proposed elsewhere [9], and was used to report the findings of this study.

TABLE 1. The contribution of severe malnutrition to mortality in children under five years of age, Matlab comparison area, 1986–1987

Age (months)	Exposure[a]	Death rate per 1,000	Deaths with severe malnutrition: Rate per 1,000	Deaths with severe malnutrition: % of all deaths
<60	31,645	36.2	7.0	19
12–60	24,560	17.5	6.8	39
6–36	16,210	25.4	8.6	34
<12	7,085	101.0	8.0	8

a. Total child-years of exposure to the risk of death.

Of the deaths of children 6–36 months old in the comparison area in 1986–1987, 139 (34%) were associated with severe malnutrition (table 2). Among these, 108 (79%) were also associated with persistent diarrhoea. The corresponding death rates in the area covered by the MCH-FP programme were around 40% lower, 8.5 and 6.6 per 1,000 respectively ($P < .0001$).

Applying the previously reported finding that in the comparison area 6% of children 6–36 months old had an MUAC equal to or less than 110 mm in 1986 [10], it was estimated that 115 of the 222 deaths due to diarrhoea occurred among 977 severely malnourished children and, by contrast, that the remaining 107 deaths from diarrhoea occurred among 15,299 children who were not severely malnourished (table 3). Hence, the relative risk of dying from diarrhoea among severely malnourished as opposed to other children was 17 ($P < .001$). The attributable risk was 49%. The relative risks were 4.2 for measles ($P < .001$), 2.1 for other infectious diseases ($P = .02$), and 1.2 for other causes, including accidents and non-infectious diseases (NS). The relative mortality risk for all causes combined was 8 ($P < .001$) and the attributable risk was 30%.

Over the two years of the study, 60% of all deaths occurred during the five post-monsoon months, from September to January (figure 1). The mean number of monthly deaths among males increased from 2.3 during the seven months of the good season to 4.4 during the five months of the bad season. The corresponding figure for females increased from 3.3 to 10.5. Two-way analysis of variance (ANOVA) [11] showed that

TABLE 2. Causes of death among children 6–36 months old by area, Matlab, 1986–1987

Cause of death	Comparison area (N = 16,276)[a] No.	Rate[b]	%[c]	MCH-FP programme area (N = 14,511)[a] No.	Rate[b]	%[c]	Difference in rates (%)
Diarrhoeal diseases	114	7.0	27.7	74	5.1	29.6	27.4*
Severe malnutrition	139	8.5	33.7	76	5.2	30.4	38.8**
with persistent diarrhoea	*108*	*6.6*	*26.2*	*56*	*3.8*	*22.4*	*42.0***
Other infectious diseases	87	5.3	21.1	40	2.7	16.0	48.6**
Injuries/accidents	43	2.6	10.4	45	3.1	18.0	−17.1
Other and unspecified	29	1.8	7.0	15	1.0	6.0	42.1
All causes	412	25.3	100.0	250	17.2	100.0	32.1**

a. Total child-years of exposure to the risk of death.
b. Rate per 1,000.
c. Percentage of all causes, or proportional mortality rate.
*$P < .05$. **$P < .001$.

TABLE 3. Relative and attributable risks of death due to severe malnutrition for various causes of death among children 6–36 months old, Matlab comparison area, 1986–1987

Cause of death	All children (N = 16,276) No.	Rate[b]	With severe malnutrition (N = 977)[a] No.	Rate[b]	Without severe malnutrition (N = 15,299)[a] No.	Rate[b]	Relative risk: Risk	CI[c]	Attributable risk (%): Risk	CI[c]
Diarrhoea	222	13.6	115	117.8	107	7.0	16.8	13.9–20.4	49	42–56
Measles	47	2.9	10	10.2	37	2.4	4.2	2.2–8.0	16	4–29
Other infectious diseases	85	5.2	10	10.2	75	4.9	2.1	1.1–4.0	6	−1–13
All others	58	3.6	4		54	3.5	1.2	0.4–3.2	1	−6–8
All causes	412	25.3	139	142.3	273	17.8	8.0	6.7–9.4	30	25–34

a. Estimated.
b. Rate per 1,000.
c. 95% confidence interval.

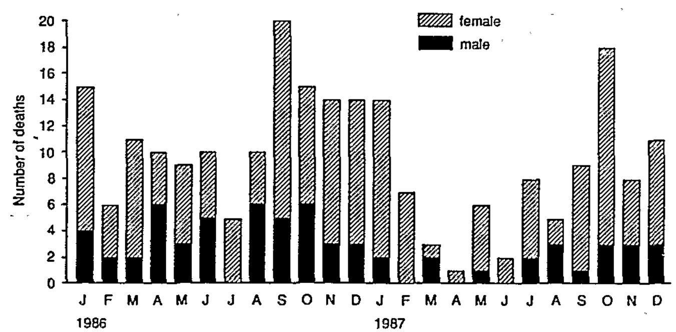

FIG. 1. Seasonality of child deaths due to severe malnutrition, Matlab, 1986–1987

TABLE 4. Cause-specific relative mortality risks for female children 6–36 months old compared to males by area, Matlab, 1986–1987

Cause of death	Comparison area	MCH-FP area
Diarrhoeal diseases	1.6*	1.3
Severe malnutrition	2.1**	1.8*
with persistent diarrhoea	*2.6***	*2.2***
Other infectious diseases	1.6*	0.9
Other causes	1.9**	0.8
All causes	1.8**	1.2*

*P<.05. **P<.001.

girls had a significantly higher mortality rate than boys (P<.001) and that the mortality rate increased significantly more in the bad season among girls than among boys (P for interaction term<.001).

Overall and cause-specific death rates for males and females 6–36 months old are compared in table 4. The risk of dying from severe malnutrition was more than twice as high for females as for males in the comparison area in 1986–1987 (P<.0001). This risk was 2.6 times as high when severe malnutrition was associated with persistent diarrhoea. The corresponding risks were lower, but not significantly so, in the MCH-FP area during the same period. The overall risk of dying for females, however, was significantly lower in the MCH-FP area than in the comparison area (chi-square for heterogenicity 5.6, df=1), suggesting the programme's effect in educating families to stop giving males preference in feeding and health care.

Discussion

This study suggests that, in rural Bangladesh, about one-third of overall mortality in children 6–36 months old is related to severe malnutrition. The figure is likely to be underestimated, however, as the diagnosis was made through lay reporting of events and symptoms preceding death. Severe malnutrition is quite common in this community: in early 1988 the proportion of children 6–48 months old with a weight for age below 60% of NCHS standards was 7% (unpublished data). Thus relatives are likely to notice severe malnutrition only when it has progressed to the stage of extreme wasting. A previous study based on repeated measures of MUAC in a sample of 52 non-accidental deaths, an approach that takes into account less extreme forms of malnutrition, suggested that the proportion of deaths attributable to severe malnutrition was around 53% [10].

The findings of this study should be considered as indicative. In areas such as rural Bangladesh, where 90% of the deaths occur in villages away from medical care or hospital records or autopsies, the verbal autopsy is the only means available to estimate the most likely causes of death and classify them in order to guide health policies [12]. Validation was possible only for those few children who were admitted in the ICDDR,B diarrhoea-treatment ward before they died.

Several findings of this study are relevant to guide planners in designing supplementary feeding programmes. First, the age range 6–36 months corresponds to the introduction of supplementary weaning foods, sometimes contaminated, and the start of recurrent and persistent diarrhoea [13]. Since at least one-third of all deaths in this age group are related to severe malnutrition, it would be justified and convenient to use its overall mortality rate as an indicator of nutritional status and nutritional changes in the rural communities [9]. An additional advantage of considering children as young as 6 months stems from findings on the correlation between weight at that age and at 18 months among rural Bangladeshi children [14]. Thus targeting as early as 6 months for nutritional programmes might be quite effective.

Second, the majority of deaths related to severe malnutrition were associated with persistent diarrhoea. The debate about which comes first and what is the magnitude of their causal relationship continues [15–17]. In any case, interventions to control persistent diarrhoea should be given priority in nutrition strategies.

Third, given the seasonality of severe-malnutrition-related mortality in rural Bangladesh, which confirms the seasonality of food shortages and nutritional status [18–20], it might be worth while, when resources are limited, to concentrate supplementary feeding programmes in, or limit them to, the immediate post-monsoon season. Recent evidence suggesting that children at high risk of dying from malnutrition can be identified readily by monthly measurement of MUAC should help to target these interventions to those who need them most [10; 21].

Fourth, female children account for more than 70% of all deaths associated with severe malnutrition. The roots of this differential, and the respective roles of economic and cultural factors are discussed elsewhere [22–24]. Girls should be given special emphasis when planning selection for, access to, and use of supplementary feeding programmes.

In conclusion, supplementary feeding programmes have been identified in some settings as potentially able to reduce the incidence and prevalence of, and fatality due to, malnutrition if a number of conditions such as good targeting, good supervision, and good logistics are met [1; 25; 26]. If we limit our purpose to targeting, the recommendations arising from this study include early selection (six months) for MUAC screening, inclusion of children with persistent diarrhoea, restriction to the post-monsoon months, and focus on female children.

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