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A BRIEF ORIGINAL CONTRIBUTION

The Risk Approach to Intervention in Severe Malnutrition in Rural Bangladesh

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To determine whether clinical marasmus occurs in small groups of children from easily recognizable high-risk households, the authors conducted a case-control study to identify risk indicators that may be used in targeted interventions. Cases were children whose mid-upper arm circumference measured less than 110 mm, and controls were children matched for age and sex with arm circumferences greater than 120 mm. Between June 1988 and June 1989, 164 such pairs of children aged 1–4 years were studied in Matlab, Bangladesh. Conditional logistic regression analysis showed an increased risk of marasmus among children from families with other children under 5 years of age (odds ratio = 2.80, 95% confidence interval 1.56–5.02) and children who consumed formula foods (odds ratio = 18.81, 95% confidence interval 4.15–85). Higher maternal education was associated with reduced risk of marasmus. Further examination of these risk indicators suggests that the resources saved through targeting fewer households will be negated by missing many children with marasmus. The authors conclude that the application of targeted interventions against marasmus, using the risk approach, is unlikely to be efficient. *Am J Epidemiol* 1992;136:460–3.

child; developing countries; education; family planning; intervention studies; nutrition disorders; risk factors

Because many countries lack the resources to intervene in the lives of all individuals who may be at risk for certain diseases, the World Health Organization has recommended the development of methods to identify individuals at highest risk so that intervention may be targeted to them (the risk approach) (1, 2). It is often difficult to select interventions in countries where poverty is pervasive, because the risks associated with key factors may not vary much between individuals. For example, a study in Bangladesh reported that household economic characteristics and age were the most important risk factors for malnutrition in children, but these accounted for only 4.9–8.5 percent of the variation in nutritional status (3). Among the Bangladeshi studies that show an association between malnutrition and socioeconomic factors, only a few (3–5) attempted to control for confounding.

We conducted a matched case-control study in preschool children in Bangladesh, where the prevalence of severe childhood malnutrition is among the highest in the world (6). Demographic, economic, hygienic, biologic, dietary, and morbidity variables were evaluated as risk factors for marasmus. The analysis sought a risk prediction model that was sensitive and specific and could be adopted as a risk assessment tool for health care workers in the community.

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MATERIALS AND METHODS

Matlab, Bangladesh, is an area 45 km from Dhaka with a subsistence agricultural economy, poor infrastructure and communication, and uneven land distribution. The study was conducted in an area of Matlab known as MCH-FP (population 95,000) which has been provided with family planning and health services since 1978 (7).

Children were considered to have marasmus, a condition characterized by severe muscle wasting, if their mid-upper arm circumference was less than 110 mm (8). Mid-upper arm circumference was used rather than weight-for-age measures because the latter measures tend to include older children who are stunted but not wasted and who have lower mortality than children with reduced mid-upper arm circumference (9).

Every month, community health workers measured the mid-upper arm circumference of all children aged 6–59 months in the MCH-FP area. About 200 of the 12,000 children screened each month had a mid-upper arm circumference less than 110 mm. One hundred and sixty-four of these children were randomly selected for the study. Each child was matched with a control with mid-upper arm circumference greater than 120 mm who was of the same sex and age (±2 months). Data were collected by female health workers in interviews with mothers or guardians between June 1988 and June 1989.

Information on a wide range of variables was recorded (table 1). Because many of these factors are interrelated, and also because the association with marasmus may be confounded by some of the other factors, a reduced set of explanatory factors was selected for the multivariate model. Multicollinearity could limit the interpretation of correlated variables simultaneously used in one model. We therefore used a stepwise conditional logistic regression to estimate odds ratios and their 95 percent confidence

TABLE 1. Variables used in an analysis of risk factors for marasmus, Matlab, Bangladesh, 1988–1989

Demographic/biologic factors
Maternal age
Marital status
Marital problems
Father resident in the home
Birth order
Family size
Maternal weight and mid-upper arm circumference
Maternal pregnancy status
Subsequent sibling within 1 year
Caretaker of child
Singleton or twin
No. of siblings aged <5 years who were currently marasmic
No. of siblings aged <5 years living
No. of siblings aged <5 years deceased
Birth weight
Socioeconomic factors
Mother's education and occupation
Father's education and occupation
Size and type of housing
Family income and debt
Land ownership and use
Amount of food (rice, wheat) stored
Religion
Household possessions (hurricane lamp, watch, radio, bed, quilt, plough)
Morbidity
Diarrhea in the past 15 days
History of hospital admission
Attendance at health clinic
Respiratory infections in the past 15 days
Maternal or paternal illness
Dietary factors
Breast-feeding status
Use of bottle/formula foods
Age at introduction of solid foods
Food consumption in the previous 24 hours (banana, biscuit, chapati, egg, potato, dark green leaved vegetables, fish, other*)
Environmental factors
Household water source/distance
Water quantity/use
Latrine presence and use
Refuse disposal
Handwashing materials used

* Includes local foods such as suji, muri, and khitchri.

intervals. Significance levels were assessed by likelihood ratio test. Analyses for matched data were conducted using SPSS-PC+ and EGRET (10).

RESULTS

Complete data were available for 142 (87 percent) case-control pairs, and these were used in the stepwise regression analysis. Four factors were selected by this method as being significant predictors of marasmus. The final model with all four factors was then rerun for case-control pairs with complete data on these factors (161 pairs; 98 percent). This yielded similar results to the model based on 142 case-control pairs but gave more precise estimates because of the larger sample size. The odds ratios and confidence intervals for these risk factors are presented in table 2. For each risk factor, the crude odds ratio and that adjusted for the other three factors in the multivariate model are presented.

The largest adjusted odds ratio for marasmus was related to the consumption of formula food (odds ratio = 18.8 95 percent confidence interval 4.2–85). However, the wide 95 percent confidence interval suggests that the estimate must be interpreted with caution. Of the sociodemographic factors, children who had a young sibling or whose mother had a lower educational level were at increased risk of marasmus (table 2). Similarly, children whose mothers were pregnant at the time of interview also had increased risk of marasmus.

The data were used to calculate, for each factor, sensitivity (the percentage of children with marasmus who had the risk factor) and specificity (the percentage of children without marasmus who did not have the risk factor). For the three main risk factors shown in table 2, the presence of a sibling under 5 years of age was associated with a sensitivity of 56 percent and a specificity of 63 percent; the absence of maternal education was associated with a sensitivity of 76 percent and a specificity of 35 percent; and consumption of formula food had a sensitivity of only 17 percent and a specificity of 98 percent.

TABLE 2. Odds ratios for marasmus among 161 matched cases and controls, by selected risk factors, Matlab, Bangladesh, 1988–1989

Risk factor	% of cases	% of controls*	OR†	95% CI†	Adjusted‡ OR	95% CI
No. of siblings aged <5 years						
0	44	63	1.00		1.00	
≥1	56	37	2.25	1.39–3.64	2.80	1.56–5.02
			χ^2 (1 df) = 11.8, $p < 0.001$		χ^2 = 13.5, $p < 0.001$	
Mother's education (years)						
None	76	65	1.00		1.00	
<5	14	11	1.02	0.51–2.00	0.66	0.29–1.47
≥5	10	24	0.36	0.19–0.69	0.26	0.12–0.57
			χ^2 (2 df) = 11.2, $p = 0.004$		χ^2 = 13.5, $p = 0.001$	
Mother pregnant						
No	84	91	1.00		1.00	
Yes	16	9	1.91	0.92–3.96	2.32	0.99–5.41
			χ^2 (1 df) = 3.2, $p = 0.08$		χ^2 = 4.0, $p = 0.05$	
Consumption of formula food						
No	83	98	1.00		1.00	
Yes	17	2	13.00	3.08–54.77	18.81	4.15–85
			χ^2 (1 df) = 24.4, $p < 0.001$		χ^2 = 27.4, $p < 0.001$	

* Unmatched percentage distribution.
† OR, odds ratio; CI, confidence interval.
‡ Adjusted for other factors listed in this table.

DISCUSSION

The logic of the risk approach, as advocated by World Health Organization (1, 2), is to target households at highest risk to enhance efficiency in the delivery of interventions. The first objective is to identify key risk factors which could lead to interventions. This study examined a large variety of variables and identified four significant risk factors for marasmus after controlling for confounding. One such factor was the presence of a sibling under 5 years old. The odds ratios for other risk indicators (such as the mother's being pregnant) suggest that the "other sibling" variable is more a function of birth spacing than of total family size. In addition, competition for the mother's time would seem to be more important than food, since no relation was found between food availability and marasmus. Better-educated mothers often live in families with more income and resources, which can reduce the risk of marasmus. On the other hand, better-educated mothers often work outside the home and have less time for child care, which may lead to early weaning and use of bottled food and other inadequate diets—factors that could increase the risk of marasmus. Independently of these factors, the risk of marasmus increased as maternal education decreased. The consumption of formula food is also associated with increased risk of marasmus.

The purpose of the risk approach is to apply interventions in settings where risk groups can be efficiently identified by primary health care workers. In India, for example, 92 percent of neonatal deaths occurred in only 28 percent of all the newborns who formed the groups at risk (11). Identification of at-risk neonates was not difficult for the community workers; the confirmed detection rate was 78 percent (11). The utility of the risk approach, however, needs to be demonstrated in other settings.

In the present study, children at high risk of marasmus could not be efficiently identified by risk factors such as maternal education, birth interval, and infant feeding. For example, if households with "other siblings" are selected for special care, 63 percent of households will not have to be visited, but 44 percent of cases will be missed. These results do not support the use of a household risk assessment instrument appropriate for field use by village health workers. This study concludes that the risk approach is not an efficient strategy for combatting marasmus in Bangladesh.

REFERENCES

1. Backett EM, Davies AM, Petros-Barvazian A. The risk approach in health care: with special reference to maternal and child health, including family planning. Public Health Pap 1984;76:1–113.
2. World Health Organization. Risk approach for maternal and child health care. World Health Forum, 1981;2:413–22.
3. Bhuiya A, Wojtyniak B, D'Souza S, et al. Socio-economic determinants of child nutritional status: boys versus girls. Food Nutr Bull 1986;8:3–7.
4. Bhuiya A, Zimicki S, D'Souza S. Socio-economic differentials in child nutrition and morbidity in a rural area of Bangladesh. J Trop Pediatr 1986;32: 17–23.
5. Bairagi R. Is income the only constraint on child nutrition in rural Bangladesh? Bull World Health Organ 1980;58:767–72.
6. Grant JP. State of the world's children. New York: United Nations Children's Fund, 1990.
7. Bhatia S, Morley WH, Faruque ASG, et al. The Matlab Family Planning and Health Services Project. Stud Fam Plann 1980;11:202–12.
8. Van Loon H, Saverys V, Vuylsteke JP, et al. Screening for marasmus: a discriminant analysis as a guide to choose the anthropometric variables. Am J Clin Nutr 1987;45:488–93.
9. Briend A, Wojtyniak B, Rowland MGM. Arm circumference and other factors in children at high risk of death in rural Bangladesh. Lancet 1987;2: 725–8.
10. Statistics and Epidemiology Research Corporation. EGRET: Epidemiological Graphics, Estimation, and Testing package. Seattle, WA: Statistics and Epidemiology Research Corporation, 1988.
11. Pratinidhi A, Shah U, Shrotri A, et al. Risk approach strategy in neonatal care. Bull World Health Organ 1986;64:291–7.