Urban Health Extension Project

WP 42

Urban FP/MCH Working Paper No. 14

Levels and Correlates of Maternal Nutritional Status and Consequences for Child Survival in Urban Bangladesh

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International Centre for Diarrhoeal Disease Research, Bangladesh

October 1993

The International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) is an autonomous, non-profit organisation for research, education, training and clinical service. It was established in December 1978 as the successor to the Cholera Research laboratory, which began in 1959 in response to the cholera pandemic in southeast Asia.

The mandate of the ICDDR,B is to undertake and promote research on diarrhoeal diseases and the related subjects of acute respiratory infections, nutrition and fertility, with the aim of preventing and controlling diarrhoeal diseases and improving health care. The ICDDR,B has also been given the mandate to disseminate knowledge in these fields of research, to provide training to people of all nationalities, and to collaborate with other institutions in its fields of research.

The Centre, as it is known, has its headquarters in Dhaka, the capital of Bangladesh, and operates a field station in Matlab thana of Chandpur District which has a large rural area under regular surveillance. A smaller rural and a large surveyed urban population also provide targets for research activities. The Centre is organised into four scientific divisions: Population Science and Extension, Clinical Sciences, Community Health, and Laboratory Science. At the head of each Division is an Associate Director; the Associate Directors are responsible to the Director who in turn answers to an international Board of Trustees consisting of eminent scientists and physicians and representatives of the Government of Bangladesh.

The **Urban Health Extension Project (UHEP)** is a follow-on activity of the Urban Volunteer Program (UVP). In 1981, the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) began training women volunteers in urban Dhaka in the use of ORS packets for diarrhoeal disease on the assumption that community women could play an important role in teaching others about the home treatment of diarrhoea with ORS. The United States Agency for International Development (USAID) began funding the project in 1986 with a mandate to provide primary health care services to the urban slums and conduct research on child survival related issues. UHEP continues to focus on health and family planning issues of the urban slums with an overall goal to strengthen the ability of the government and non-governmental agencies to provide effective and affordable family planning and selected maternal and child health services to the urban poor through research, technical assistance, and dissemination of its research findings.

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ICDDR,B Working Paper No. 42

Editing: M. Shamsul Islam Khan

Layout Design and Desktop Publishing: Tanbir Morshed
SAKM Mansur
Jatindra N. Sarker

Printing and Publication: Md. Nurul Huda
Hasan Shareef Ahmed

Cover Design: Asem Ansari

ISBN: 984-551-017-43

Urban FP/MCH Working Paper No. 14
ICDDR,B Working Paper No. 42

October 1993

Published by:
International Centre for Diarrhoeal Disease Research, Bangladesh
GPO Box 128, Dhaka 1000, Bangladesh
Telephone: 600171 (8 lines): Cable: CHOLERA DHAKA, Telex: 675612 ICDD BJ;
Fax: 880-2-883116 and 880-2-886050

Printed by Sheba Printing Press in Dhaka, Bangladesh

Foreword

I am pleased to release these reports on urban health and family planning issues which are based on the activities of the Urban Health Extension Project (UHEP). UHEP is a follow-on activity of the former Urban Volunteer Program, a pilot project funded by the United States Agency for International Development (USAID).

The poor health status and the health needs of the urban poor continues to be an important emerging public health issue in the Developing World. Bangladesh is no exception. Despite the constraints of poverty and illiteracy, there are proven strategies to provide basic health and family planning services to the urban poor. In Dhaka alone, aside from the Government health care facilities, there are numerous NGOs and private sector providers giving needed services to the urban population. The Centre's own Urban Health Extension Project continues to focus on the urban poor, especially the slum populations, in providing basic family planning and health services through outreach activities (viz. health education, ORS distribution and referral services to service points).

However, enormous challenges remain in providing an optimum level of services to the urban poor. The UHEP, with the support of the USAID, will focus on health and family planning services delivery strategies in reaching the needed services to the urban poor. We certainly look forward to learning more about the health and family planning needs of the urban poor, testing sustainable strategies and applying these proven strategies in collaboration with other partners in government, NGOs and the private sector.

Demissie Habte, MD
Director

Acknowledgements

The Urban Health Extension Project (UHEP) is funded by the United States Agency for International Development (USAID) under a Cooperative Agreement No. 388-0073-A-00-1054-00 with the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B). The ICDDR,B is supported by the aid agencies of the Governments of Australia, Bangladesh, Belgium, Canada, Denmark, France, Japan, the Netherlands, Norway, Saudi Arabia, Sweden, Switzerland, the United Kingdom, and the United States; International organizations including the United Nations Development Programme (UNDP), the United Nations Population Fund (UNFPA), the United Nations Children's Fund (UNICEF), and the World Health Organization (WHO); and private foundations including the Ford Foundation (USA) and the Sasakawa Foundation (Japan).

This Working Paper is based on information from the Urban Surveillance System (USS) of the Urban Health Extension Project (UHEP), ICDDR,B. The USS is a comprehensive health and demographic surveillance of the slum populations of Dhaka. Numerous project staff are involved in the functioning and maintenance of the USS. Sincere acknowledgement is extended to the hard work and dedication of the USS staff, both the field-based staff and the data management and the project management support side of the USS.

Much effort has been put into the analysis and review of the information presented in this report. We would like to acknowledge the valuable input of the following individuals in this report.

Dr. Fakir Anjuman Ara, Training Coordination Bureau, ICDDR,B
Dr. O. Massee Bateman, Senior Epidemiologist, CHD, ICDDR,B
Dr. Kanta Jamil, UHEP, ICDDR,B
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Summary

Maternal nutritional status is an important determinant of both mother and child health. Using weight, height and mid-upper arm circumference (MUAC) data from a representative sample of 2,417 non-pregnant Dhaka slum mothers, this study estimated the levels of maternal nutritional status in this population. Mothers' mean weight, height, MUAC and body mass index (BMI) were 41.8 kg, 148.8 cm, 232.5 mm, and 18.8 respectively; 21.6% of the mothers had a height of less than 145 cm and 10.6% of the mothers had a BMI of less than 16.

The association of maternal nutritional status with a standard set of sociodemographic variables, such as age, education, religion and housing material (a proxy measure for household economic status) and their reproductive experiences, such as the number of pregnancies and the number of children born alive now dead, were examined. Sociodemographic information was available for 2,048 mothers, reproductive history information was available for 1,314 mothers, and both information was available for 1,185 mothers. In multivariate regression analyses, mothers' weight, BMI and MUAC were significantly positively correlated with the mothers' years of schooling and household economic status. Mothers' height was significantly positively correlated with the years of schooling but was not associated with household economic status. Maternal height, weight and MUAC were significantly negatively correlated with child deaths. The programmatic implications of these observed associations are discussed.

Introduction

Despite tremendous advances in medical technology, maternal and child morbidity and mortality in developing countries are still high (1). This underscores the complexity of morbidity and mortality processes. There exist morbidity and mortality differentials within any given population; these differentials are determined by a variety of socioeconomic and cultural factors (1-5). An understanding of these factors is critical for the formulation of a sound health policy.

Maternal nutritional status is a key mechanism by which socioeconomic and cultural factors influence maternal and child morbidity and mortality. Studies have shown positive association between socioeconomic status and maternal nutritional status (6-8). Prevalence of maternal stunting and wasting has been consistently observed to be higher in developing countries than in developed countries (9-11). Chronic under-nutrition, during and since childhood, high parity resulting in maternal depletion, and inadequate caloric intake during pregnancy and lactation are important determinants of poor maternal nutrition (8,12-14). There are evidences of the deleterious effect of low maternal weight and short stature on maternal morbidity and pregnancy complications, such as obstructed labour, cephalo-pelvic disproportion (15-17) and on perinatal and infant morbidity and mortality (18-21).

Although effective health technologies are available which can theoretically avert a majority of the premature deaths, resource constraints often do not allow extending these technologies to all members of a population. Selecting out a high risk group and targeting its members may be a cost-effective strategy.

Using data from a sample of non-pregnant mothers living in the slums of Dhaka, this study estimated the levels of maternal nutritional status and attempted to determine the correlates of maternal nutritional status in this population. The implications of the observed associations for maternal and child health programs are discussed.

Methodology

The data for this analysis came from the Urban Surveillance System (USS) of the Urban Health Extension Project (UHEP) of the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B). Using a network of community health volunteers, the UHEP provides preventive health education and referral services in the areas of diarrhoea, nutrition, immunization and family planning to the slum population of five *thana* of Dhaka city. The USS is a health and demographic surveillance system in a probability sample of UHEP's five *thana* slums. The USS sampling and data collection methods have been described previously (22). Briefly, a multi-stage areal sampling method has been used to select the USS sample. The sampling units are clusters of an average size of 33 households. Any household residing for two months or more within a selected cluster is registered in the system. During household registration, baseline socioeconomic and demographic information is collected by professional female interviewers. All vital events, including births, deaths, marriages, divorce, and migrations both in and out, are recorded by household visits in a 3-monthly cycle. Socioeconomic information is updated annually. In addition, special surveys are carried out from time to time as appropriate. During 1991, the total number of clusters under surveillance was 161 comprised of a total population of about 25,000.

This analysis used three different sources of data. The first source of data was the 1991 sociodemographic information collected from the USS households. The second source of data was an anthropometric survey, carried out between March and July of 1991 and included measurements of weight, height and mid-upper arm circumference (MUAC) of a sub-sample of USS mothers who had at least one under-five year old child. The body weights of the mothers with light clothes were measured using a bathroom scale (Misaki Kubota Ltd., Japan) to the nearest 100 gm. The weighing scales were calibrated daily using known weights. Standing heights of the mothers were taken using locally constructed height sticks. These measurements were taken to the nearest 0.1 cm. MUACs of the study mothers were taken with a 2 mm precision using a TALC (Teaching Aids at Low Cost, P.O. Box 49, St. Albans, UK) tape. Body Mass Index (BMI) of the study mothers were calculated using weight and height data (BMI=weight in kg/height in meters squared). The third source of data was the reproductive history information of the USS mothers which was collected between July and September of 1992. This information was collected using a standardized detailed questionnaire in which information was separately requested on sons and daughters living with the parents, sons and daughters living elsewhere, sons and daughters who died, number of still-births and number of abortions. Based on these information, the total number of pregnancies, number of live-births, and number of child deaths were calculated for each mother.

Using weight, height, MUAC, and BMI data of 2,417 non-pregnant mothers, this study estimated the levels of maternal nutritional status. Bivariate and multivariate relationships of maternal nutritional status with a standard set of sociodemographic variables and their reproductive experiences were examined. Of the 2,417 mothers, sociodemographic information was available for 2,048 mothers, reproductive history information was available for 1,314 mothers, and both information was available for 1,185 mothers.

To examine the bivariate relationships between maternal height and child death, the proportion of live-births that died for each study mother (number of child deaths by the time of interview/number of live-births) and mean proportion of live-births that died were calculated for different maternal height categories and plotted.

Two different sets of multiple linear regression models were fitted. Each set comprised four different models. The dependent variables in the first set of models were maternal height, weight, MUAC, and BMI. The independent variables included in these models were mothers' age in years, mothers' years of schooling, household economic status (as assessed by type of housing), religion, and number of pregnancies. In the second set of models, the proportion of live births that died was used as a continuous dependent variable. The independent variables included were mother's age in years, mother's years of schooling, household economic status, religion, and a measure of maternal nutritional status. Maternal height, weight, BMI, and MUAC were separately included (one at a time) in four different models.

Finally, the effect of maternal height on child death was assessed in a logistic regression analysis using child death as a dichotomous dependent variable (one or more deaths versus no death). The independent variables included in this model were mothers' age in years, mothers' years of schooling, type of housing, religion, number of live-births, and maternal height. Maternal height was entered as a dummy variable with five different levels. Maternal height of 155 cm or more was considered as the reference category.

Results

The mean weight, height, MUAC and BMI of the study mothers were 41.8 kg, 148.8 cm, 232.5 mm and 18.8 respectively. About 10% of the mothers weighed less than 35 kg, 21.6% had a height of less than 145 cm, and 10.6% had a BMI of less than 16 (Table 1).

The bivariate relationships of selected sociodemographic and reproductive experience information are presented in Table 2. Maternal weight was statistically significantly related to mothers' age, type of housing, mothers' years of schooling, and religion. Maternal height was significantly related to the type of housing, and the mothers' years of schooling. Mothers' MUAC was associated with the mothers' age, type of housing, religion and the number of pregnancies. Mothers' BMI was associated with the type of housing and religion.

Table 1. Distribution of Dhaka Slum Mothers by Weight, Height, Mid-Upper Arm Circumference (MUAC) and Body Mass Index (BMI)

Anthropometry	No. of Mothers	% of Mothers	Summary Statistics
Weight in kg			
<35.0	249	10.3	Mean=41.82
35.0-39.9	703	29.1	SD=6.58
40.0-44.9	774	32.0	Median=41.0
45.0-49.9	418	17.3	Minimum=25.0
50.0+	273	11.3	Maximum=77.0
Total	2,417	100.0	
Height in cm			
<140.0	120	5.0	Mean=148.82
140.0-144.9	401	16.6	SD=5.42
145.0-149.9	884	36.6	Median=148.8
150.0-154.9	730	30.2	Minimum=120.4
155.0+	282	11.7	Maximum=168.2
Total	2,417	100.0	
MUAC in mm			
<200	148	6.1	Mean=232.50
200-214	440	18.2	SD=24.99
215-229	578	23.9	Median=230
230-244	605	25.0	Minimum=146
245-259	314	13.0	Maximum=338
260+	332	13.7	
Total	2,417	100.0	
Body Mass Index			
<16.0	257	10.6	Mean=18.81
16.0-16.9	309	12.8	SD=2.66
17.0-17.9	417	17.3	Median=18.5
18.0-18.9	446	18.5	Minimum=12.3
19.0-19.9	321	13.3	Maximum=34.0
20.0+	667	27.6	
Total	2,417	100.0	

Table 2. Mean Weight, Height, MUAC and BMI of Dhaka Slum Mothers by Selected Sociodemographic Characteristics

Variables	No. of Mothers	Mean Weight	Mean Height	Mean MUAC	Mean BMI
Age in years					
<20	466	41.15*	148.47	227.66‡	18.60
20-29	1,054	41.85	148.80	231.96	18.83
30-39	671	42.24	149.07	236.08	18.94
40+	226	41.83	148.86	234.35	18.79
Type of housing					
Poor	344	40.43‡	148.16*	224.41‡	18.34‡
Medium	1,225	42.02	148.82	233.68	18.90
Good	479	42.50	149.19	236.98	19.03
Years of schooling					
0	1,674	41.76†	148.58‡	232.75	18.84
1-4	209	41.53	149.36	231.40	18.55
5+	165	43.42	150.30	236.22	19.14
Religion					
Muslim	1,903	41.72‡	148.77	232.57*	18.78*
Hindu	145	43.84	149.09	237.16	19.63
Number of pregnancies					
1-2	323	41.73	149.10	230.19‡	18.71
3-4	393	42.20	148.98	232.41	18.94
5-7	380	42.67	148.92	237.62	19.16
8+	218	42.67	149.26	238.10	19.07
Number of child deaths					
0	626	42.62	149.34	234.30	19.04
1	367	41.97	148.86	233.17	18.88
2	168	42.32	148.88	236.31	19.0
3+	153	41.75	148.42	234.95	18.87

* p<0.05, † p<0.01, ‡ p<0.001 by F or *t* statistic (as appropriate).

Figure 1 shows that maternal height was associated with the proportion of live-births that died. Risk of child death was not graduated, but appeared to display a threshold phenomenon. The risk of child death increased sharply if the maternal height was below 145 cm.

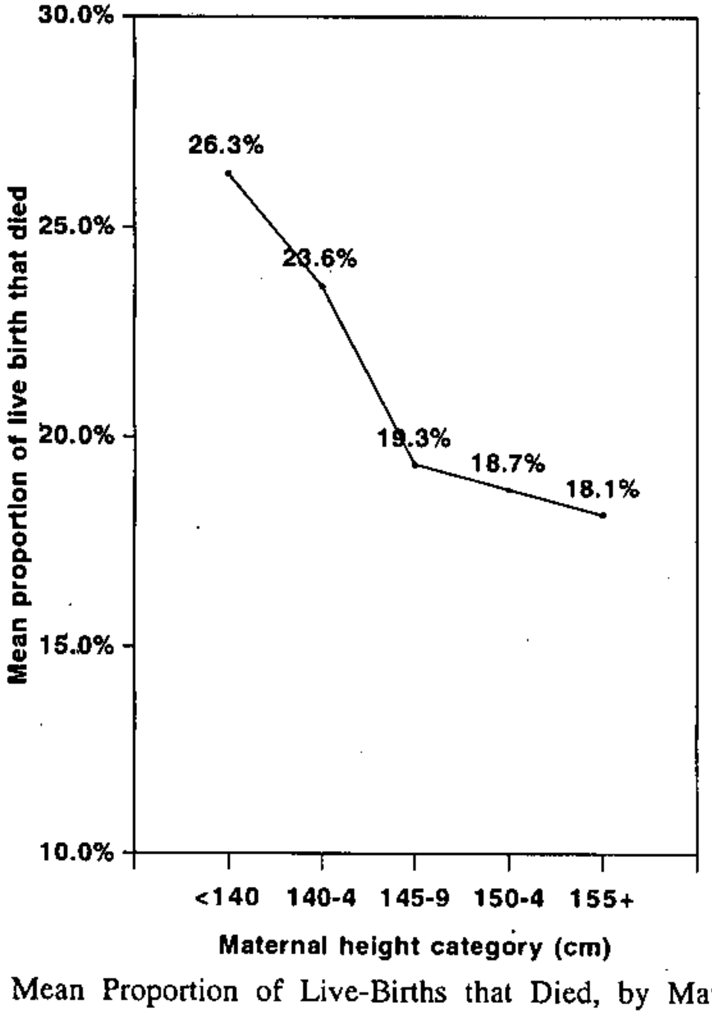

Fig. 1. Mean Proportion of Live-Births that Died, by Maternal Height Category

Table 3 presents the results of the first set of regression analyses. Maternal height was significantly positively associated with mothers' age and years of schooling. Maternal weight was significantly positively associated with mothers' years of schooling and type of housing. Mothers' MUAC was significantly positively associated with mothers' age, years of schooling, and type of housing. Mothers' BMI was significantly positively associated with mothers' years of schooling, type of housing, and religion. None of the measures of maternal nutritional status (height, weight, MUAC or BMI) was significantly associated with number of pregnancies.

Table 3. Regression Analysis Showing the Association of Selected Sociodemographic Variables and Number of Pregnancies with Maternal Height, Weight, MUAC and BMI

	Regression Co-efficients			
Independent Variables	**Height**	**Weight**	**MUAC**	**BMI**
Mothers' age in years	0.08†	0.03	0.37†	-0.01
Mothers' years of schooling	0.23*	0.37†	1.36†	0.11*
Type of housing	0.17	0.40†	2.76‡	0.15†
Religion	-0.74	1.26	-1.39	0.71*
Number of pregnancies	-0.09	0.10	0.33	0.07
Constant	146.05‡	38.3‡	203.5‡	17.82‡
R^2	0.02	0.03	0.06	0.02
Overall significance F Ratio	3.20†	6.93‡	14.73‡	5.83‡

Number of cases = 1,185

* -p<0.05, † -p<0.01, ‡ -p<0.001

Table 4 presents the findings of the second set of regression analyses. In these models the proportion of live births that died was used as the dependent variable. Maternal height and weight were significantly negatively associated with child death, but maternal BMI was not. Mothers' years of schooling was also negatively associated with child death, but the level of significance was marginal ($p<0.1$).

Table 4. Regression Analysis Showing the Association of Selected Sociodemographic Variables and Maternal Height, Weight, MUAC and BMI with Proportion of Live-Births that Died

	Regression Co-efficients			
Independent Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Mothers' age in years	0.004§	0.004§	0.004§	-0.004§
Mothers' years of schooling	-0.007	-0.007	-0.008*	-0.007*
Type of housing	-0.005	-0.005	-0.005	-0.004
Religion	-0.05	-0.04	-0.04	-0.04
Mothers' Height	-0.005§	NI	NI	NI
Mothers' Weight	NI	-0.002†	NI	NI
Mothers' BMI	NI	NI	-0.002	NI
Mothers' MUAC	NI	NI	NI	-0.0005*
Constant	0.79§	0.22§	0.17‡	0.23§
R^2	0.03	0.03	0.02	0.03
Overall significance F Ratio	7.91§	6.42§	5.54‡	6.06§

Number of cases = 1,185 NI - Not Included in the Model

* -p<0.1, † -p<0.05, ‡ -p<0.01, § -p<0.001

Table 5 presents the findings of the logistic regression analyses. Compared to mothers with a height of 155 cm or more, mothers with a height of less than 140 cm had a 2.64 fold higher risk of child death; mothers having a height between 140 and 144 cm had 1.91 times higher risk of child death.

Table 5. Logistic Regression Analysis to Predict Child Death[1] in Dhaka Slum Mothers

Independent Variables	Odds Ratio	95% Confidence Interval
Mothers' age in years	0.97	0.95-1.00
Mothers' years of schooling	0.96	0.88-1.04
Type of housing	0.95	0.87-1.04
Religion[2]	1.26	0.74-2.16
Number of live-births	1.87	1.68-2.06
Maternal height in cm		
<140[3]	2.64	1.21-5.76
140-144[3]	1.91	1.15-3.15
145-149[3]	1.26	0.81-1.98
150-154[3]	1.40	0.89-2.19

Number of cases = 1,185

[1] One or more deaths versus no death

[2] Reference category = Muslim

[3] Reference category = Maternal height ≥155 cm.

Discussion

This study provides descriptive profiles of the nutritional status, socioeconomic status and reproductive experiences of mothers residing in Dhaka slums. The study also attempts to determine the correlates of maternal nutritional status in this population. The study has several limitations. The first limitation is the non-availability of reproductive history information for about half of the mothers whose anthropometric status was assessed. The reproductive history information was collected about 15 months after the anthropometric survey. The Dhaka slum population is highly mobile; most mothers for whom reproductive history information was not available had already moved out of the surveillance area. However, the socioeconomic and anthropometric status of the mothers who moved out and those who stayed were comparable (data not shown). The second limitation is the possible reporting error in reproductive history information as it often involved a long recall. However, this information was collected using a standardized detailed questionnaire. There might have been some errors in reporting still-births and abortions; reporting errors should be minimum for numbers of live-births and child deaths. Furthermore, any reporting error should be random; a differential reporting error by maternal anthropometric status is unlikely. The third limitation is the difficulty to infer causality from the cross-sectional associations that were observed.

Despite these limitations, this study is unique in many ways. As mentioned earlier, this study provides descriptive analyses of the nutritional and socioeconomic status and reproductive experiences of a high-risk population, the mothers residing in Dhaka slums. The levels of nutritional status of Dhaka slum mothers as assessed by maternal weight, height, MUAC, and BMI were low. This level of nutritional status was similar to earlier reports from rural Bangladesh (23-25) and was lower than the nutritional status of lower class women in India (26). Most of the sampled mothers were young (63% below 30 years of age), illiterate (82% had no schooling), and Muslim (93%). Many of the mothers (46%) had 5 or more pregnancies and more than half (52%) had at least one child death.

Although causal relationship may not be determined with certainty, this study provides some important clues to explain the very low level of maternal nutritional status and high level of infant and childhood mortality in this population. The three data sources used were collected independently, thereby reducing the possibility of reporting bias.

The socioeconomic correlates were likely determinants of maternal nutritional status. A woman attains her maximum height at around the age of 16 years (27); thus for most mothers her height represented her past nutritional status. In contrast, maternal weight, MUAC and BMI reflected both past and current status. The positive association of maternal weight, MUAC, and BMI with the mothers' years of schooling and household economic status (as assessed by the type of housing) were expected. Maternal height was also positively associated with the mothers' years of schooling, but not with the household economic status. These findings are not unexpected; mothers' years of schooling perhaps represented the socioeconomic status of their parental household. Socioeconomic status is closely linked to the availability of food and the prevalence of infectious diseases (28). These factors are important determinants of nutritional status (29-31).

Frequent reproductive cycling (episodes of pregnancy and/or lactation) is considered as an important cause of maternal malnutrition in poor women from developing countries (13). The lack of association between number of pregnancies and maternal nutritional status that we observed was, therefore, not expected. As recall of the number of pregnancies could be subject to error, we examined the association of maternal nutritional status with more definite events, such as the number of live-births and the number of full-term births (number of live-births plus still-births) in bivariate and multivariate situations (data not shown). No significant association between these variables and maternal nutritional status was observed.

Maternal height, weight, and MUAC were negatively associated with the proportion of live-births that died. These findings are important. However, as maternal weight and MUAC reflect both past and present nutritional status, their association with child deaths should be interpreted with caution. There might have been a two-way causal relationship. On one hand, low maternal weight may be responsible for poor pregnancy outcome or higher risk of child death. One prospective study from Matlab, Bangladesh has shown that child mortality was consistently higher in lighter mothers than in heavier mothers (32). Another study from Matlab, Bangladesh has demonstrated that maternal nutritional status, indicated by pre-pregnancy weight and weight gain during pregnancy, appears to be related significantly to foetal mortality (33). On the other hand, low maternal weight may also be a consequence of frequent pregnancies as age advances (23). However, since in this population no association between number of pregnancies and maternal weight was observed, the association between maternal weight and child death could be unidirectional.

In the context of child survival, among the four indicators of maternal nutritional status included in this study, height has a special significance. The association of maternal height and child death should be unidirectional. Shorter mothers had a greater risk of child loss. It is believed that women who experience less favourable circumstances in childhood are stunted and are susceptible to reproductive wastage (34). Shorter women more often have cephalo-pelvic disproportion leading to difficult labour (35). Prolonged and difficult labour increases the risk of birth asphyxia and trauma (36). Shorter mothers also have a higher incidence of low birth weight babies (19). Low birth weight, birth asphyxia and birth trauma are important causes of perinatal mortality (37-41).

In this study, the high risk of child loss associated with short maternal stature has been demonstrated clearly. Risk was not graduated, but appeared to display a threshold phenomenon, below which the risk increased sharply. Compared to mothers with height of 155 cm or more, the risk of child loss was 2.64 times greater in mothers shorter than 140 cm and about double in mothers having a height between 140 and 144 cm. Martorell et al.(42) observed a similar negative relationship between infant mortality and maternal height in Guatemalan mothers.

The finding that shorter mothers had a greater risk of child loss suggests possible inter-generational influences of poor childhood nutrition in females. Evidence of similar inter-generational effects are available in the literature. Emanuel et al.(43) using the data of the 1958 British National Birthday Trust Fund cohort documented that birth weights of babies were significantly positively associated with parental birth weights, height of maternal grand mother and the social class of maternal grand father. Thus, an important intervention to improve the health of children in the next generation is to improve the nutritional status of girls' of this generation. However, this will require further research and long-term planning. Poverty, food scarcity and high prevalence of infectious diseases are not the only determinants of health and nutritional status of females. In this culture, there is a strong son preference and, thus, female children who are the future mothers receive less parental attention, less food and less health care (44-46). A variety of socioeconomic and cultural taboos affect women's food intake. Females consume less and poorer quality foods than males, although their needs are greater (47). This gap increases during food scarcity (45).

As an interim measure, maternal and child health programs should target shorter mothers who have a height of less than 145 cm for appropriate antenatal and obstetric services since they have a higher risk of child loss.

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An Appeal

Each year, ICDDR,B treats over 70,000 patients attending its two hospitals, one in urban Dhaka, the other in rural Matlab. Though they are planted in Bangladeshi soil, they grow because of the dedication of thousands of concerned people throughout the world. The patients are mostly children with diarrhoea and associated illnesses and the services are offered free to the poorer section of the community

Hospital Endowment Fund

Since these services are entirely dependent on financial support from a number of donors, now we at the ICDDR,B are establishing an entirely new endeavour: an ENDOWMENT FUND. We feel that, given securely implanted roots, the future of the hospitals can confidently depend upon the harvest of fruit from perpetually bearing vines.

To generate enough income to cover most of the patient costs of the hospitals, the fund will need about five million dollars. That's a lot of money, but look at it this way:

JUST $150 IN THE FUND WILL COVER THE COST OF TREATMENT FOR ONE CHILD EVERY YEAR FOREVER!

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