

Women focused development intervention reduces neonatal mortality in rural Bangladesh: a study of the pathways of influence

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ABSTRACT

Background: There has been a substantial reduction in hazard of childhood death in Bangladesh over the last decade. The reduction was much greater in case of infants whose mothers participated in the development program. However, the pathways through which development interventions influence neonatal survival remain to be explored.

Objective: Study the impact of BRAC's women focused development interventions on neonatal mortality in Matlab.

Methods: A case-control study comprising 117 cases (died within 28 days) and 351 controls (live children taken from the nearest door of cases) born during the year 1999-2000 was employed. Twelve case studies from both cases and controls were done to complement the quantitative data. ICDDR, B surveillance database provided the sampling frame. The risk ratio was estimated to see how BRAC program participation reduces risk of mortality, and stratified analysis was done to see the effects of third variables over the association. Finally, log regression was done to see the net effect of variables on neonatal death.

Results: Neonates of BRAC non-members were at 1.9 times increased risk (CL; 1.09-3.25) of dying compared to neonates of BRAC members. This association works through two intermediate variables including antenatal care and family planning. Mothers' age and fathers' occupation acted as confounders over this association. Physical violence against mothers and psychological stress, pre-maturity and low-birth-weight had respectively 2.2, 1.7, 13 and 2 times increased risk of neonatal death. However, BRAC membership did not have any influence over these factors. When simultaneously accounting for all variables in a multivariate log regression, a dose response association was maintained for antenatal care, family planning, physical violence and pre-maturity.

Conclusion: There has been a substantial reduction of neonatal mortality among mothers who participated in BRAC intervention. For an effective reduction of these deaths, program planners should think about ways to address all risk factors together rather than antenatal care and family planning alone.

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Key words: Neonate, Mortality, Women's development, BRAC, Bangladesh.

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INTRODUCTION

Background

Each year globally, around four million babies die during neonatal period (Save the Children, 2002). It is a serious problem in developing countries where about 98% of these deaths take place (id21 health, 2002). The estimated neonatal mortality rate in Bangladesh during 1995-99 was 42 per thousand live births (Mitra et al., 2001). Neonatal death accounted for 60% of infant deaths in the late 1980s and this proportion has remained roughly the same in subsequent 10 years (Mitra et al., 1998).

In Bangladesh, a large number of international agencies have flowed into health interventions directed to child survival beside government and non-government efforts. International Center for Diarrhoeal Research, Bangladesh (ICDDR,B) is the pioneer in developing community based health and family planning programs. Its Demographic Surveillance System (DSS) that fortnightly records birth, death, marriage and migration has provided unique opportunity to study the impact of the health and family planning program on various health outcomes including mortality. However, the health program alone is not sufficient to reduce mortality, improve health and well-being of the individual. In the recent years, the importance of economic and social factors in the context of health improvement has been emphasized (World Bank, 1993; Abed, 1996). In the field of development, BRAC is the most conversed credit-based development organization in the country. In 1992, BRAC-ICDDR, B Joint Research Project has studied how does MCH-FP and BRAC programs jointly and independently impact on various indicators of human well-being including health. In 2002, the Joint Research Project studied the impact of the BRAC's women-focused development interventions on child survival (Bhuiya & Chowdhury, 2002). This study revealed that there has been a substantial reduction in hazard of death during childhood (1-4 year age group) over the period, but the reduction was statistically similar for all groups of children irrespective of their mothers' participation in the development program. However, reduction was much greater for infants (0-1 year age group) whose mothers participated in the development program compared to infants of non-participant mothers from similar socio-economic background. At this stage, as neonatal death is a major public health concern in recent years, it would be interesting to know whether the development interventions influence the survival of neonates. This paper presents findings about how BRAC's Rural Development Program reduces neonatal mortality in rural Bangladesh.

Conceptualizing neonatal death

Causes of neonatal death

Neonate is the period of childhood commencing after birth to 28 days of life. Neonatal death is defined as death of a live-born infant during the neonatal period. In Bangladesh, very little is known about causes of neonatal death and relatively no information is available on early neonatal death. This is mainly due to the fact that most neonatal deaths are not registered and are unattended by health personnel (Talukder, et. al., 2001). A conceptual framework for neonatal mortality has therefore been drawn from the secondary data of other developing and developed countries. The framework outlines the relationship between various direct and indirect causes, and as it seems, neonatal death is caused by a complex interplay of factors e.g. newborn factors and maternal factors.

Newborn factors

Newborn factors are considered as immediate cause as it directly causes the neonatal death. One of the most weighty factors is congenital anomalies or birth defects which accounts for about 25% neonatal deaths in many parts of developed rather than the developing world (March of Dimes, 2003). Pre-maturity, newborn infection, birth asphyxia, poor perinatal and neonatal care, home delivery, unskilled birth attendants have identified as major causes of neonatal death in developing countries (March of Dimes, 2003; UNICEF, 1997). Pre-maturity and its complications cause about 20% of neonatal deaths. The causes identified for the newborn infection included tetanus, sepsis, pneumonia, and diarrhoea. The perinatal and neonatal care in most developing countries is commonly concentrated in clinics in larger cities and most births take place at home without the help of professional birth assistance. Even where birth can occur in a health unit, conditions are not much better since lack of expertise and instruments to provide optimal care for common neonatal problems.

Maternal factors

Maternal factors are considered as aggravating factors as they increase the risk of neonatal death by enhancing the newborn factors. Two important factors for newborn infection are if mothers have puerperal infection and if women do not obtain antenatal tetanus immunization (Vintzileos, et. al., 2002 & Asih, et. al., 1997).

Lifestyle of a mother may influence the risk of premature labor. Smoking and alcoholism, short birth interval, and poor weight gain during pregnancy enhance the risk of a low birth weight baby and subsequently premature delivery (Baby zone, 2003). Psychological stresses, poverty, low educational level of mothers and mothers' age are identified as pre-disposing factors for pre-maturity. Young teenagers often have poor eating habits, poor weight gain and don't get antenatal care. As women get older their chance of multiple gestation increases that often ends with pre-maturity and LBW babies. Older women are more prone to develop hypertension, diabetes, heart and kidney disease those can complicate a woman's pregnancy and make her more likely to have a pre-term delivery (Baby zone, 2003). It is evident that malnutrition, particularly certain vitamins and minerals deficiencies are linked to the high incidence maternal and neonatal mortality and morbidity in developing countries (UNICEF, 2003).

A genetic factor can be the sole cause of birth defect. Some inborn errors of metabolism due to a single defective gene inherited from each parents to their newborns causing birth defect (March of Dimes, 2003). Some maternal illnesses (e.g. diabetes) or infections (e.g. rubella or German measles), drugs, alcohol and chemical exposure may cause a wide range of birth defects, such as cleft lip or palate, spina bifida and congenital heart disease (March of Dimes, 2003).

In Bangladesh, three major causes, such as, sepsis, perinatal asphyxia and prematurity/low birth weight for neonatal mortality have been identified in hospital, but the methods of diagnosis may not be very stringent (Talukder et al., 2001). There might be categorization problems because these three causes seemed to be mutually exclusive when of course in reality there may be double reasons, e, g, the risk of dying of a premature baby is increased if the mother is adolescent. Moreover, community level studies of neonatal mortality are unsatisfactory as they have usually been a part of larger under-five mortality survey. It appears still we remain in the dark about the causes of death in the 150,000 newborns lost annually in this country.

METHODS AND POPULATION

Study design

In this case-control study, exposure was defined as the proportion of BRAC eligible population who were not getting BRAC intervention. **Cases** were neonates who born alive during the year 1999-March 2002 and died on or before 28 days of life. **Controls** were however, live children born during the same period and taken from the nearest household. Respondents were mothers of cases and controls. Mothers of both cases and controls were asked retrospectively to gather information on exposing risk factors for neonatal death.

The study also used qualitative methods including case studies in order to get an overall insight of existing factors in community responsible for the increased and reduced trend of neonatal death, and to complement quantitative data to understand the cultural meaning and extent of factors that exposed neonates at risk of death.

Study setting

The study was conducted in Matlab, a low-lying delta area, 40 miles South-East of Dhaka, the capital of Bangladesh. As in most rural Bangladesh, the majority of the Matlab population is poor. Typical dwellings are a household with one or two rooms, an earth floor, thatched or corrugated iron sheet roofs and five to six people are dwelling. Most people work in agriculture. Nearly half of the males and two-third of the females are illiterate. In Matlab, ICDDR, B has been operating the Demographic Surveillance System (DSS) since 1966. Half of the villages, with around 100,000 population, have been receiving ICDDR'B's maternal child health and family planning (MCH-FP) services since 1978, and the other half has been receiving government services (Fauveau, 1994). The major components of the MCH-FP services included immunization, community-based maternity care, control of acute respiratory infections, and provision of family planning methods through community health workers.

Since 1992, a number of villages in the MCH-FP and comparison areas have been receiving inputs from BRAC. BRAC is targeted at women from very poor household known as BRAC eligible household. The criteria for BRAC eligibility is that the household owns no more than half an acre of land including homestead land and at least one member of the household sells at least 100 days of manual labor in a year to earn a livelihood. After identifying the target groups, a small group with 25-30 members known as

village organization is formed and starts savings with BRAC on a weekly basis. Initially, members receive social awareness education and skill development training. After 6 months, they start to receive loan from BRAC to carry out income generating activities including cultivation, small trade, rural transportation, poultry, handicrafts, etc. The members repay the loans in weekly installments with 15% interest rates (BRAC, 1995). The process brings women into focus of social and economic development.

Study population and sampling

The study population included all under-5 children in the study area, and all births taken place during January 1999 to March 2002. Respondents were selected from the DSS registers of ICDDR, B. Once a dead neonate was identified, then 3 live children were selected from the same study base. The database maintained by the DSS provided the sampling frame. The unique household number identified respondents in the field.

The quantitative case-control study was done in 27 villages where BRAC is working. Sample size for the case-control study was 117 cases and 351 controls.

The qualitative interviews included case studies of 6 cases and 6 controls selected purposively from one village having BRAC intervention where the community health workers helped to select the appropriate interviewees. The main criteria for selecting respondents were their knowledge of area and the culture.

Data collection

Before launching the quantitative survey, pilot activities were carried out. The interviews focused on respondents' beliefs, perceptions, understandings, awareness, and interpretations of causes for neonatal death. From the qualitative findings, some indicators have been sorted out to develop a structured questionnaire. The questionnaire encompassed three types of variables, such as socio-economic (SES) background of the respondents, proximate variables and outcome variable. The questionnaire was thoroughly pre-tested, and then modified and edited on the basis of feedback received before finalization. Using this questionnaire, the quantitative survey was carried out. Data was collected by female interviewers recruited from the study area. All were educated and able to speak the local language. Experienced supervisor and researchers monitored field activities. Data collectors and supervisor were trained for one week on how to use the questionnaire. A series of discussion sessions and practical exercises including role-playing were held with them. During the survey, there was continuous feedback between

the data collectors and supervisors. The completed questionnaires were checked on a daily basis for completeness and sent back to the field immediately when necessary. Researchers were responsible for overall supervision of the survey on-site. Data collection was carried out from January to February 2002.

Definition of variables

The dependent variable is the neonatal death. The independent variables included SES and proximate variables. The SES variable included mothers' age at birth of the child, parents' education and occupation, BRAC membership and eligibility, and other NGO membership. Proximate variable incorporated information on neonates, such as place of birth, birth attendants, low birth weight (LBW), pre-maturity and congenital anomaly; and information on mothers included number of children, family planning history, antenatal check-up, physical and emotional violence during pregnancy, and number of children. Age of the mother at the time of birth of the child was measured in completed years and was grouped into two categories. Parents' literacy was defined as the ability to read and write regardless of educational level attained. Occupation was measured as wage and non-wage labour. BRAC membership status was grouped as whether or not ever been a member of BRAC. BRAC eligibility was classified as BRAC eligible or poor and BRAC non-eligible or non-poor. Birthing care is defined by two categories which were institutional delivery and labor conducted by the skilled attendants. Pre-maturity was defined if delivery was taken place 2 weeks before the expected date. LBW was considered if birth weight is less than 2.5 kg. If birth weight was not recorded, then mothers' perception of very small and very low weight was considered. Congenital anomaly was defined if the baby has any birth defect during birth. As only 7 dead neonate had this defect, it was not possible to do any further analysis with this variable. Antenatal care meant visiting a satellite clinic, a medical doctor, a hospital or a health provider for at least 3 times with the purpose of antenatal check-up. Family planning use rate was considered whether mothers used any contraceptives before the respected child being born. Psychological stress and physical violence was considered if mothers had constant worry and physical beating during pregnancy. Number of children was divided into two categories. All the independent variables were considered as categorical variables in the logistic regression analysis. BRAC non-membership, BRAC eligibility, parents illiteracy, mothers' age less than 24 years, fathers' wage labor, LBW, pre-maturity, not seeking ANC, not using family planning methods, home delivery, unskilled birth attendants, mothers having psychological stress,

mothers having physical violence, and mothers having more than 2 children was coded as 1.00 in the categorical variable coding scheme.

Data analysis

The quantitative data were stored and analyzed using SPSS version 10 statistical package. Analysis was done in three stages. Firstly, risk ratio was estimated to study whether BRAC membership reduces risk of neonatal death, and to see what proximate variables acted as potential risk factors for neonatal death and whether BRAC membership has any influence over these risk factors. Secondly, stratified analysis with regard to different SES variables was done to identify confounders that disturbed the interpretation of the association between BRAC membership and neonatal death. Thirdly, in order to estimate the net effect of variables on neonatal death, logistic regression was done in three steps. One with SES variables; another with the proximate variables; and finally a combined model with significant variables from both the groups which included BRAC membership, BRAC eligibility, antenatal check-up, family planning and physical violence. The causes of neonatal death as well as their health seeking behavior were analyzed by running frequencies.

The qualitative interviews were coded line by line, and categories were identified. The analysis tried to correlate causal factors with increased or reduced trend of neonatal death and tried to provide possible explanation of the quantitative findings.

RESULTS

Characteristics of respondents

A total of 468 mothers, 117 of dead neonates and 351 of live neonates were included in the case-control study. Most respondents (52%) belonged to the age group 25-34 years, 30% to 17-24 years, and 18% to 35-44 years of age. More husbands than women were literate. Most respondents (58.5%) were from BRAC eligible households. The majority of them were housewives. In contrast, almost all of their husbands were involved in some income generating activities. Their main occupation was farming and wage labour. One hundred and thirteen mothers were BRAC members. About 14% of BRAC members were also members of other organizations such as ASA, Grameen Bank, VARD0, etc.

Causes of neonatal death

The major causes of death mentioned by mothers were *ulga*, LBW and pre-maturity. About 27% neonates died from *ulga*, meaning an evil spirit. The incident of illness caused by spiritual being is known as *Ulga dhora*. According to the villagers, *ulga* comes through bad wind and attacks children in different form of illnesses. The second common causes were LBW (23%) and pre-maturity (22%). However, pneumonia (12%) was identified as the third common cause. Some least common causes identified in the study were malnutrition, prolonged labour, jaundice, manhandling of breech presentation, etc. However, most mothers (41%) did not receive any treatment for their newborns illness. Nevertheless, about 38 percent sought care from either traditional healers or homeo-doctors or pharmacists. However, findings revealed that healers were not able to get cure the acute and fatal cases, instead conditions became worsen. Only a few took medical care.

The association of BRAC intervention and neonatal death

Neonatal mortality showed a significant 1.9 fold increased risk (CL 1.09, 3.25) among women who were not BRAC members compared to women who were BRAC members. This association was explored in two steps; first, possible risk factors for neonatal death were identified; second, association of BRAC membership with these risk factors was analyzed.

First step: risk factors of neonatal death

Table 1 presents various risk factors for neonatal death and estimates the risk ratio for each of them.

Antenatal check-up

The risk of neonatal death was roughly twice as large in case of mother who did not seek antenatal care compared to a mother who did. Moreover, a similar significant risk was observed if the number of antenatal visits was less than three (OR=1.89; 95% CL 1.16, 3.07).

The qualitative data provided the villagers' perspectives of how antenatal care reduces the risk. One woman said, "If I did the regular antenatal check-up, I would then be able to know the growth rate of my foetus. If I knew that my foetus did not grow up properly and how more nutritious diet, perhaps the baby would not die from malnutrition / LBW." A BRAC member said, "While I was pregnant, I visited the *pushti ghar* (BRAC's nutrition program), checked my weight and took food from *pushti packet*. If mother takes adequate diet, the baby will be healthy and there is less chance of attack by disease and death." Women not seeking antenatal care did not have enough knowledge about its importance. For instance, one woman had been identified as high-risk mother while she was pregnant and the doctor advised her to undergo regular antenatal check-up, especially to check-up blood pressure and not to take salty diet. However, she did not follow doctor's advice and her child died three days after birth. The woman said, "If I knew that antenatal check-up is good for child's health, I must have done that whether or not I am able to have a meal."

Table 1: Crude odds ratio and confidence limits for six potential risk factors of neonatal death.

Risk factors	Category	Cases (%)	Control (%)	OR	95% CL	X ²
Antenatal care	Yes	85 (21.9)	303 (78.1)	1.0		
	No	32 (40.0)	48 (60.0)	2.38	1.43-3.95	P<0.001
Family planning	Yes	10 (13.3)	65 (86.7)	1.0		
	No	107 (27.2)	286 (72.8)	2.43	1.21-4.91	P<0.05
Physical violence	No	99 (23.4)	324 (76.6)	1.0		
	Yes	18 (40.0)	27 (60.0)	2.18	1.15-4.13	P<0.05
Mental abuse	No	55 (20.8)	209 (79.2)	1.0		
	Yes	62 (30.4)	142 (69.6)	1.66	1.09-2.53	P<0.05
Pre-maturity	No	68 (17.0)	331 (83.0)	1.0		
	Yes	49 ((73.1)	18 (26.9)	13.25	7.27-24.14	P<0.001
LBW	No	51 (36.2)	90 (63.8)	1.0		
	Yes	66 (20.2)	260 (79.8)	2.23	1.44-3.46	P<0.001

Family planning method

A 2.4-fold increase in neonatal mortality was observed if mothers did not use any family planning methods before the relevant child was conceived. Women perceived that family planning method delayed pregnancy and that birth spacing is necessary for good maternal as well as child health.

Domestic violence and emotional stress

Neonatal mortality showed a significant 1.7 – 2.2 fold increased risk in women having emotional stress and physical violence during pregnancy. Women found a strong association between neonatal death and domestic violence. "There are many husbands, fathers- and mothers-in-law who beat their wives or sons' wives while they were pregnant. A foetus might get injured at that time. Consequently, the baby may die at any time after birth." Another explanation was "If there is any persecution or harassment by a mother-in-law or a husband, or any other form of emotional stress, how a pregnant woman of that family can have adequate diet and rest! Therefore, the growth of the foetus will be hampered and the baby will be born with low birth weight, and will be affected by many diseases and complications and will die within 1 to 2 days of birth."

Pre-maturity and low birth weight (LBW)

Pre-maturity and LBW were associated with 13 and 2 times increased risk of neonatal mortality respectively. A woman explained the reasons and consequences of pre-maturity as "I had swollen face, foot, hand and abdomen (oedema) while I was 5 months pregnant. The baby, however, was delivered before the expected date of delivery. I tried to feed her breast milk. Initially, the baby was able to suck but after a while she had convulsion. On the second day, frequency of convulsion increased and she could not suck breast milk. My husband called a *kabiraj* who treated her with sanctified water and herbs. Nevertheless, on third day, she died." Women perceived that if babies are born before term, usually they are malnourished and LBW. Mothers' explanation for the LBW was "I could not take enough food since 5th month of pregnancy. As a result, the foetus did not get enough nutrition to grow-up and became very small. Consequently, she got generalized infections. One day after her birth, she also had ulceration inside her mouth and could not drink milk at all. Even, it was not possible to feed her any medicine to cure."

Mothers having physical illnesses and any pregnancy related complications (OR=1.55; 95% CL 0.98, 2.46), home delivery (OR=1.6; 95% CL 0.65, 3.98), and

unskilled birth attendants (OR=1.29; 95% CL 0.63, 2.70) had increased risk of neonatal mortality. However, the associations were not statistically significant. Further, the risk was lower (OR=0.87; 95% CL 0.57, 1.33) if a mother has more than two children though the association was not significant.

Second step: association of BRAC membership and risk factors for neonatal death

Table 2 shows the association of the identified risk factors with BRAC membership. Of these, only antenatal care and use of family planning methods were found to be significantly higher among BRAC members compared to non-members.

Table 2: Distribution of risk factors with respect to exposure to BRAC membership.

Risk factors	Category	BRAC non-member (%)	BRAC member (%)	X ²
Antenatal care	Yes	287 (80.8)	101 (89.4)	P = 0.036
	No	68 (19.2)	12 (10.6)	
Family planning	Yes	49 (13.8)	26 (23.0)	P = 0.020
	No	306 (86.2)	87 (77.0)	
Physical violence	Yes	36 (10.1)	9 (8.0)	P = 0.494
	No	319 (89.9)	104 (92.0)	
Mental abuse	Yes	157 (44.2)	47 (41.6)	P = 0.623
	No	198 (55.8)	66 (58.4)	
Pre-maturity	Yes	51 (14.4)	16 (14.2)	P = 0.939
	No	302 (85.6)	97 (85.8)	
LBW	Yes	105 (29.6)	36 (32.1)	P = 0.606
	No	250 (70.4)	76 (67.9)	

Effect of confounding factors over the association of BRAC membership with neonatal death

Table 3 lays out the stratified analysis and identified confounders that disturbed the interpretation of the association between BRAC membership and neonatal death. Crude analysis gave OR=1.9 with confidence limits (1.09, 3.25).

Odds ratio has varied in different age groups. It was only for those mothers aged less than 25 years (17-24 yrs.) that the odds ratio deviates significantly from the unity. Age factor, therefore, has entered as a confounder. With regard to BRAC eligibility, it is evident that the trend is similar for both the categories as well as to the crude OR. Thus, the economic condition did not have any influence over the neonatal death.

Stratifying for literacy of both mother and father shows the odds ratio within literate and illiterate strata are almost the same (mother: 2.0, 1.7 and father: 1.8, 2.0) and similar to the crude odds ratio. It seemed that literacy doesn't have any influence over the association of BRAC membership and neonatal death. Conversely father's occupation have had an influence over the association. Strongest association had been found among

fathers who were wage labourer, meant neonates of BRAC non-members were more vulnerable to the effect of their fathers' occupation. Mother's occupation was not used mainly because most of the mothers were housewives.

Table 3: Association between BRAC membership and neonatal death. Stratification with regard to mother's age, BRAC eligibility and literacy, and father's literacy and occupation.

Variable	Category	Exposure		Relative risk estimate	
		BRAC non-member	BRAC member	OR	95% CL
Age (yr)					
<25	Case	37	4		
	Control	73	27	3.42	1.11-10.51
25-34	Case	46	10		
	Control	135	51	1.74	0.82-3.70
35 and above	Case	15	5		
	Control	49	16	0.98	0.31-3.12
BRAC eligibility					
Eligible	Case	60	15		
	Control	132	67	2.03	1.07-3.84
Non-eligible	Case	38	4		
	Control	125	27	2.05	0.68-6.23
Mother's literacy					
Illiterate	Case	41	12		
	Control	121	60	1.69	0.83-3.46
Literate	Case	57	7		
	Control	136	34	2.04	0.85-4.86
Father's literacy					
Illiterate	Case	44	10		
	Control	112	51	2.00	0.94-4.29
Literate	Case	54	9		
	Control	145	43	1.78	0.81-3.90
Father's occupation					
Wage labour	Case	35	5		
	Control	79	39	3.46	1.26-9.51
Non-wage	Case	61	13		
	Control	172	53	1.45	0.74-2.84
Total	Case	98	19		
	Control	257	94	1.89	1.09-3.25

Mothers' BMI and other NGO membership did not have any influence over the association between BRAC membership and neonatal death. The pattern was rather similar within the two strata (if BMI is <18.5, OR is 2.08 and if BMI is > & = 18.5, OR is 1.73), (if a woman was member of both BRAC and other NGO, OR is 2.2 and if a woman was only a member of BRAC, OR is 1.9) and to the crude odds ratio.

Net effect of variables on neonatal death

In table 4, the results of logistic regression analysis of neonatal death on selected socio-economic and proximate variables are presented. The model I imparts the effect of socioeconomic variables over neonatal death. It finds BRAC membership to be the most influential predictor of neonatal death. The odds ratio for the BRAC non-members was 2.1 indicates that BRAC non-members have had twice risk compared to the BRAC members.

Table 4: Odds ratio and *P*-values for the multivariate logistic regression analysis of neonatal mortality with the selected socio-economic and proximate variables. (All independent variables are included in the analysis).

	Model I SES variable		Model II Proximate variables		Model III Combined variables	
	OR	<i>P</i> -value	OR	<i>P</i> -value	OR	<i>P</i> -value
SES variable						
BRAC membership						
No	2.06	<0.05	-	-	2.32	<0.05
Age						
<25 years	1.29	0.279	-	-	-	-
Economics status						
BRAC eligible	1.94	<0.05	-	-	1.62	0.066
Education						
Illiterate	0.726	0.225	-	-	-	-
Husband's education						
Illiterate	0.953	0.852	-	-	-	-
Occupation						
Wage labour	0.853	0.560	-	-	-	-
Proximate variable						
Seeking ANC						
No	-	-	2.61	<0.01	2.27	<0.01
Utilizing FP						
No	-	-	1.94	0.096	-	-
Place of birth						
Home	-	-	2.71	0.259	-	-
Birth assistance						
Unskilled	-	-	0.82	0.781	-	-
Mental abuse						
Yes	-	-	1.53	0.094	-	-
Physical violence						
Yes	-	-	2.38	<0.05	2.49	<0.05
No. of children						
>2	-	-	1.12	0.655	-	-
Pre-maturity						
Yes	-	-	18.89	<0.001	15.04	<0.001
LBW						
Yes	-	-	0.70	0.265	-	-

The model indicates that there is a positive association between higher risk of neonatal death and poor socio-economic condition. Mother's age had an influence over neonatal death. Young mothers (age is less than 25 years) had higher risk of their children's death

during neonatal period though it is not significant statistically. Parents literacy and fathers' non-wage labour, however, was found to be negative and insignificant predictors of neonatal death.

Model II reveals the net effect of proximate variables on neonatal death. Pre-maturity, not seeking antenatal care and physical violence had become the influential predictors of neonatal death when only all proximate variables were adjusted for. Among them the strongest significant predictor was pre-maturity where the odds ratio was 18.9. Not seeking antenatal care and physical violence during antenatal period were the next strongest predictors. In this model, not utilizing family planning, psychological stress and LBW had become insignificant predictors that were found to be significant in univariate analysis in table 2.

The model III shows the combined effect of socio-economic and proximate variable on neonatal death. In this model, mothers' age, parents' education, fathers' occupation, contraception, place of birth, birth assistance, psychological stress, number of children mothers have and LBW were excluded because they were found to be insignificant in first and second model. When all identified risk factors from both the model act together, the final model shows that one of the risk factors of socio-economic condition i.e. BRAC eligibility has become weaken and insignificant. However, pre-maturity and not seeking antenatal care reduces, and BRAC non-membership enhances the risk of neonatal death compared to the first and second model. However, with regard to physical violence, the model gave the similar result as of the second model. This model finds the most influential predictors for the neonatal death were BRAC non-membership, not seeking antenatal care, physical violence and pre-maturity. Among them the strongest predictor was pre-maturity.

DISCUSSION

This study contributes to an understanding of the particular element of development interventions responsible for neonatal survival and the mechanisms. The study was conducted in Matlab. Though Matlab manifests the typical rural characteristics of Bangladesh, it is somewhat different from other rural areas. Because since 1960s, various interventions and research works have been going on in this area which may have some influence on peoples' knowledge, beliefs, attitude and behavior. That is why, it may not be possible to claim that the study site accurately reflects the country's overall situation.

Methodological lessons

Studying neonatal death in a rural setting surrounded by various cultural and traditional beliefs was a complex task. However, using both qualitative and quantitative design helped to see the issues from a different angle and facilitate better understanding of newborn health. In an attempt to apply questionnaires to large samples and keep procedure simple, some questions received restricted answers. This deficiency was compensated by the use of qualitative methods. The qualitative study has enabled a number of issues to come out clearly in the ways they are perceived by the women themselves. As it is a case control study, sometimes it was not possible to generate enough information to make a concrete conclusion which is discussed in the section of risk assessment urge to design a cohort study in future.

The reliability of the data has been studied by comparing the data to another community-based study done by Tobias Andersson in 2000 in Ethiopia. Both studies have longitudinal surveillance data-base and cases have identified from the registry. However, methodological differences exist, for example, Tobias followed the cases prospectively in the registry. Therefore, some important determinants for the neonatal death were not recorded as surveillance data was not collected for this purpose. This study overcomes this limitation as data was collected by interviewing mothers about their past events according to the purpose of the study. But the study may have suffered from recall bias. In order to reduce this bias, the follow-up period had been shortened and the study area was widened to get sufficient number of cases. Moreover, the patterns of relationship between the socio-demographic variables and neonatal mortality as observed in this study were somewhat consistent with findings of another study which found that mortality reduction was greater for those infants whose mothers participated in the development programs

compared to those of non-participants mothers of similar socio-economic background (Bhuiya & Chowdhury, 2002).

Major findings

The conceptual framework below presents how BRAC development interventions have contributed positively on neonate survival in Matlab (fig 1). The postulated causal web showed that the most potential risk factors for the neonatal death included not seeking antenatal care, not using any family planning method, physical violence, psychological stress, pre-maturity and LBW.

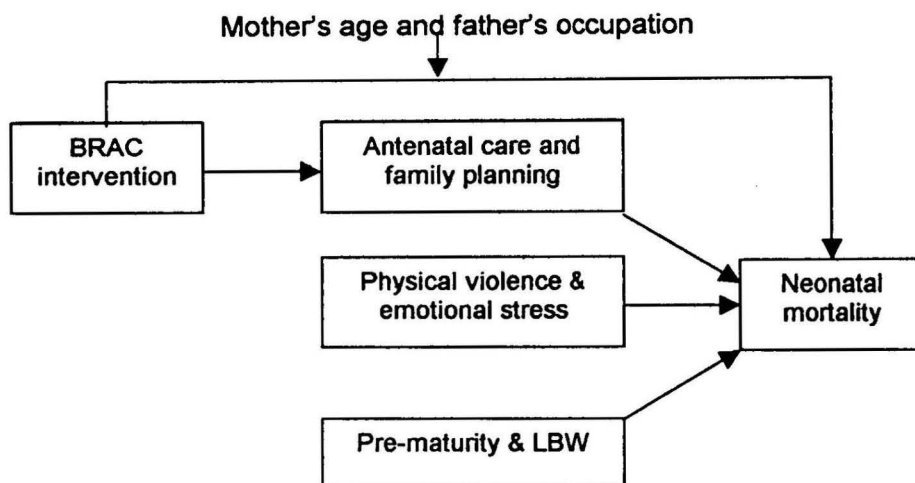


Figure 1: Factors postulated to determine neonatal mortality

One of the influential predictor of neonatal death identified in the study is antenatal care. The number of antenatal visits should be at least three in order to reduce the risk. This finding is somewhat consistent with findings from other studies in Indonesia, Turkey and United States (Asih et. al., 1997; UNICEF, 2003; & Vintzileos et. al., 2002). The Ministry of Health, Turkey has taken a good antenatal care policy for pregnant women with the aim to identify maternal danger signs vis-à-vis the antenatal care, and thus to be taken adequate measures prior to birth to prevent fatalities and disabilities of both mother and newborn (UNICEF, 2003). Another risk indicator for neonatal death is if a mother doesn't use family planning method before the child being born though the association has become insignificant in the multivariate logistic regression. It is evident that women

who spaced birth less than 24 months apart were more likely to experience a neonatal death (Asih, et. al., 1997). More than two years birth spacing is necessary for a mother's nutritional and health recovery.

The conceptual framework has shown that BRAC development programs have contributed to the enhanced survival of neonate of its member women through inputs of antenatal care and family planning services. One may raise a question – how it happens? Member women of BRAC development programs are getting inputs of micro-credit contribute directly to raise household income and savings. Women's participation in village organization meetings and social awareness program can contribute to change their worldview, self-confidence and mobility. The health awareness part of the program helped women to seek antenatal care services and to use family planning methods. However, it is interesting to know how effective the ANC service is in addressing clients' needs. As the immunization campaign is intense in Bangladesh, perhaps pregnant mothers go to the ANC center or any physician or pharmacist only for the tetanus toxoid injection. Possibly there is a problem with the definition of antenatal care as it only counts number of visits by pregnant women to satellite clinics, physicians, hospitals or community health workers rather than considering adequate antenatal care and counseling. A study may therefore be needed to explore how tetanus toxoid immunization of a mother affects a newborn's health? Although Bangladesh has evolved a success story in contraceptive prevalence rate, the discontinuation rate is very high (Nasreen, et. al., 1996). In order to achieve at least two-year birth spacing, the program should pay greater attention toward discontinuation rate rather than only contraceptive prevalence rate.

The association of BRAC membership and neonatal death is confounded by mother's age and fathers' occupation. Greater risk was found if mothers were less than 24 years and fathers' were wage labourer, indicating that BRAC is providing less/no attention to adolescents and poorer households that might have important policy implications.

Pre-maturity has identified in the study as the most potential risk factor for neonatal death. This finding is consistent with another study in Bangladesh where about 75% of deaths occurred in babies born pre-prematurely (Yasmin, et. al., 2001). Though LBW has become insignificant in the multivariate logistic regression, we do consider it as risk factor since another study in Bangladesh identified it as the same (Yasmin, et. al., 2001). BRAC development program however does not have any effect on these two proximate variables. Considering the propensity of pre-maturity on enhancing neonatal death, program should take all possible measures to reduce the trend of pre-mature labor.

In order to do that program needs to know what factors are responsible for the pre-term delivery urge to conduct a further study.

Gender-based violence usually continues during pregnancy and is significantly associated with increased neonatal mortality rate. Psychological stress has become insignificant in the multivariate logistic regression analysis, we consider it as a risk factor of neonatal death as some studies in African countries found it as the same (Jewkes, et. al., 1999). Domestic violence is associated with foetal distress and foetal death at all stages of development including stillbirth, perinatal and neonatal mortality (Dey, at. al., 1995). If a woman is abused physically and /or psychologically, she might not take adequate rest and diet due to fear or psychological disturbance that may lead to LBW and pre-mature labour. Abusive spouses often prevent women from using family planning methods as well as antenatal care (IPPF, 2003). Many organizations including BRAC in Bangladesh have addressed the issue of women empowerment by introducing micro-credit as well as social awareness raising program. However, it was observed that domestic violence has been increased after becoming a BRAC member (Ahmed, et. al., 2002) though the violence against women is gradually decreasing as the length of association of women with micro-credit programs increases. The reason behind the higher rate of physical violence against the beneficiaries of micro-credit program is believed to be due to the tension that comes with a woman suddenly becoming worthy of credit and responsible for money, which is in conflict with men's role in society. Therefore, program should take this issue into account, as it is hazardous for the health of both mothers and newborns.

Findings revealed that parental socio-economic factors do not have any effect over neonatal mortality. Studies in the Philippines and Indonesia have also shown that neonatal mortality is independent of the level of bio-demographic, socio-economic and health-related factors (Asih, et. al., 1997; Cabigon, 1997). Conversely, these factors are important predictors of mortality differentials after first month of life (Asih, et. al., 1997).

Improving newborn health

As the mother and the newborn are inseparable units, most problems affecting the women before and during pregnancy have a strong negative impact on the neonatal health. Thus, interventions to reduce neonatal mortality should be closely linked to improve the health of women and making motherhood safe (Koblinsky, 1995; Save the Children, 2002). As some of the causes are deeply rooted in upbringing girls and the status of women in the

society, it is extremely important to pay attention to women's health throughout the life cycle and not merely during pregnancy. Intervention should have two components: one, care of mothers and two, care of newborns.

Mothers' care should include :

1. Antenatal care: Care during pregnancy is vital by means of regular antenatal check-up with at least 3 visits. BRAC can give extensive training to family welfare visitors and *shasthya shebikas* on different antenatal care issues including diet, TT injection, iron tablets, regular check-up, hygiene delivery practices, and early and exclusive breastfeeding. FWVs and SSs can work together to identify pregnant women, maintain register and arrange satellite clinic for all services as a package.
2. Enforce family planning methods: In order to reduce neonatal death it is necessary to increase the age at first birth, limits number of children, space births more than two years. Therefore, efforts should have to be made at the appropriate age of marriage and use of family planning. In order to achieve a desired level of contraceptive prevalence and to lower the discontinuation rate, program should give emphasis on raising clients' effective knowledge, informed choice, side-effect management and counseling.
3. The micro-credit program should set off a new wing on preventing violence against women both in and outside home. Men's forum and / or couple education can be arranged to sensitize men and to raise their awareness. The program should incorporate reproductive right issues that may help women in decision-making of marriage at appropriate age, using contraceptives, and seeking antenatal care.
4. In order to reduce neonatal death by LBW and pre-maturity, program should pay attention on maternal nutrition in both pregnant and non-pregnant state (Koblinsky, 1995). Nutrition for pregnant mothers is an old motto. BRAC's integrated nutrition program should include both adults and adolescents. Attention has to be made toward gender inequality of intra-household food distribution.

Newborns care should include

1. Care for low birth weight and pre-mature baby: Immediate and exclusive breast-feeding is very important for caring malnourished, LBW and pre-mature baby as it provides much-needed immune defense, nutrients and warmth – things needs to be very important for their survive and thrive. Despite the proven benefits of immediate and exclusive breastfeeding, some cultures discourage early

breastfeeding because colostrum is thought to be unclean. Education on breastfeeding thus should be regularly included as part of reproductive health education and services, emphasized in community-based behavioral change strategies, and supported by advocacy at national and regional levels.

2. **Identify sick newborn:** Appropriate care at appropriate time is necessary in order to avert the situation, as many deaths were untreated or treated by traditional healers. BRAC development program should provide training to the community health workers, parents and other care givers on some danger signs to identify the sick newborns in the early stage including unable to suck breast milk, not taking milk for a long time, lethargic, loss of muscle tone, convulsion, respiratory distress, and body temperature (<95° F and >99° F). Program can include indigenous practitioners as counselor and mobilizer.
3. **Referral and treatment of sick newborn:** If a case is identified by a family care giver, he/she have to contact to community health workers, they then would take the cases to a BRAC health centre or a thana health complex.

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