

REVIEW ARTICLE

The Importance of Breastfeeding in Minimizing Mortality and Morbidity from Diarrhoeal Diseases: the Bangladesh Perspective

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ABSTRACT

Despite world-wide promotion of breastfeeding, there is a declining trend in breastfeeding practice in many developed as well as developing countries. In these countries, health planners are faced with the difficult task of re-educating women on the value of breastfeeding. In this context, it is useful to review the role of breastfeeding in combating infectious diseases, especially childhood diarrhoea, and in preventing deaths. Studies have shown that the duration of benefits of breastfeeding in diarrhoea can range from a few months to several years. However, breastfeeding is not consistently protective in all types of diarrhoea. For example, there is evidence of increased risk of rotavirus diarrhoea in breastfed children compared to non-breastfed children after certain age. Impairment of child growth is another controversial issue associated with prolonged breastfeeding. Is this growth-faltering, or do breastfed children follow a normal growth pattern which is below the reference growth curve? How long should mothers be advised to continue breastfeeding? This review focuses on answers to these questions and discusses benefits of breastfeeding and its controversial issues. The reasons for choosing the case study in Bangladesh are: (i) the prevalence of breastfeeding in Bangladesh is often cited as one of the highest in the world; (ii) diarrhoeal diseases are hyper endemic in this country; and (iii) issues of breastfeeding in several diarrhoeal diseases have been well documented here.

Key words: Breastfeeding; Diarrhoea; Diarrhoea, Infantile; Morbidity; Mortality

INTRODUCTION

Diarrhoeal diseases account for about one billion illness episodes annually among children aged less than 5 years, and of these, about 3.3 million deaths occur in the developing world (1). In rural Bangladesh, the average episodes of diarrhoea range from 3 to 5 per child per year, each episode lasting for 3-5 days, with a total of 9-25 days of morbidity from diarrhoea per child annually (2). The major determinants of deaths in diarrhoea are

dehydration and malnutrition (3,4). Malnourished children with diarrhoea often die of serious conditions like pneumonia, septicaemia, meningitis and other infections even when dehydration has been corrected (4). Nutritional management is, therefore, an important strategy in diarrhoeal treatment since malnutrition is a serious consequence of diarrhoea, and children with diarrhoea are often malnourished prior to the onset of diarrhoea (5).

The Diarrhoeal Diseases Control (CDD) Programme of the World Health Organization (WHO) has recommended that national efforts to control diarrhoeal diseases

focus on improved case management practices (6). Other efforts to prevent diarrhoeal diseases primarily focus on long-term interventions, such as clean water, improved water use, improved sanitation, and improved hygiene behaviours. The beneficial effects of these interventions have been well-documented (7). However, in some poor societies, where people depend on sources of surface water for many purposes other than drinking, provision of safe drinking water alone might not prevent diarrhoeal diseases (8). Therefore, depending on the culture, economy and ecological characteristics of the country, it might be useful to explore additional low-cost methods in preventing diarrhoeal diseases (9).

One of the inexpensive and effective strategies in combating and preventing illness, especially diarrhoea in young infants, is the promotion of breastfeeding. The WHO is looking at ways to prevent diarrhoea and has identified breastfeeding as an important strategy (10). WHO estimates that if all infants were breastfed exclusively for the first four months of life, mortality during the first 5 years of life would be reduced by nearly 10% (9). Young children and infants with diarrhoea are often advised to drink an extra amount of water in between taking oral rehydration solution to prevent possible electrolyte imbalances (11). However, breastmilk alone, without addition of water, is adequate during some episodes of diarrhoea, alleviating the risk of administering contaminated fluids (12). In Bangladesh, breastfeeding is a social norm, and literally all mothers begin breastfeeding at birth of the child and continue it partially or completely for a few months, and in some cases, till the third year of child's life (13). Unfortunately, in many developing countries, including Bangladesh, breastfeeding is often discontinued during diarrhoea (14), and food withdrawal is a social practice (15,16). The cessation of breastfeeding during an episode of diarrhoea can double a child's risk of subsequent severe illness or death (14). This paper discusses some of the scientific data concerning the role of breastfeeding in preventing or minimizing the effects of diarrhoea, and proposes actions to be taken by child survival programmes that will help enhance programme effectiveness in reducing diarrhoea and its negative effects on child health.

MATERIALS AND METHODS

Literature published since 1975 was identified by a MEDLINE search, using a number of key words, including breastfeeding, breastmilk, diarrhoea or diarrhea, morbidity, and mortality. Studies were also identified by scanning Current Contents and by reading the reference lists of related articles. For specific purpose of this review, the search was narrowed to focus on developing countries, with appropriate references to the case in Bangladesh.

Health benefits of breastfeeding

Many studies have convincingly demonstrated the beneficial effects of breastfeeding on the overall health of an infant (6,17,18,21-25,32-39). The benefits of breastfeeding that appear less clear are: impact on different aetiologies of diarrhoea, impact on mortality, the mechanisms through which benefits are achieved, the duration of benefits, the extent of protection offered, the impact of breastfeeding on a child's growth, and the quantity and quality of milk produced by malnourished mothers.

Impact on acute diarrhoea

Considerable evidence exists on the protective effects of breastfeeding on infectious diseases among infants (17,21,22,24,28,35,38,39). Most notable among these infectious diseases are diarrhoea and respiratory infections. In Bangladesh, studies have focused on protective effects of breastfeeding on the vast majority of causal agents of diarrhoea (17,18,21,38,41). The most convincing effects of breastfeeding have been found in case of cholera and shigellosis. Breastfeeding was significantly associated (18) with less severe shigellosis (odds ratio 0.49; 95% confidence interval 0.28 to 0.86). The protective effect of breastfeeding on rotavirus diarrhoea is unclear. In Bangladesh, where breastfeeding is prolonged, the incidence of rotavirus diarrhoea in the community is the same as in the industrialized countries where breastfeeding is relatively of short duration (19). Exclusive breastfeeding of infants in Bangladesh was associated with significant protection against severe rotavirus diarrhoea (20) compared to other feeding modes (relative risk 0.10; 95% confidence interval 0.03 to 0.34). However, during the second year of life, the risk of this disease was higher in breastfed than in non-breastfed children, and no overall protection was associated with breastfeeding *per se* during the first two years of life.

In case of *Giardia lamblia*, a significantly lower rate of infection was observed in Bangladeshi infants of less than 6 months of age, who were exclusively breastfed compared to infants older than 6 months, who were supposedly either non-breastfed or partially breastfed (21). However, it was not clear whether the lower incidence rate in breastfed infants was attributable to the lack of exposure to the disease or actual protection by breastmilk. In a poor area of Mexico City, non-breastfed infants had five times increased risk (95% CI 1.5 to 9.9; $p=0.009$) of *Giardia* infection, compared to completely breastfed infants (22). In another prospective study on 98 Mexican children, breastfeeding offered protection from diarrhoea due to *Campylobacter jejuni* (24). Protection against *Giardia* and *Campylobacter* diarrhoea was associated with the concentration of specific antibody in human milk (23,24). Protective efficacy of breastfeeding in these children did not last beyond 6 months of age. In

acute diarrhoea, continued breastfeeding can decrease stool output (25). In a case-control study in Bangladesh, withdrawal of breastfeeding during acute diarrhoea was associated with a five-time higher risk of dehydration compared to continuation of breastfeeding during diarrhoea at home (26).

It should be noted, however, that while the anti-infective properties of human milk have been documented in both developed and developing countries, some studies in industrialized countries showed either no protective effect or a minimal protective effect of breastfeeding against diarrhoea (27,28).

Impact on persistent diarrhoea

Persistent diarrhoea is one that starts acutely and continues for two weeks or more. Lack of breastfeeding and consumption of cow's milk sometime during the episode were found positively associated with persistence of diarrhoea in both hospital- and community-based studies in Bangladesh (29,30). Analysis of a systematic sample (3,690) of children less than 3 years, who attended a diarrhoeal disease hospital in Bangladesh, showed lack of breastfeeding as one of the prognostic indicators for increased duration of diarrhoea (29). Feeding breastmilk also had a protective role against persistence of diarrhoeal episodes in a community-based study in Northern India (31). After adjusting for confounders, exclusive breastfeeding was associated with an odds ratio of 0.06 (95% CI 0.002 to 2.1), a 16.5-time lower odds of developing persistent diarrhoea.

Impact on mortality

Breastfeeding protects children from dying. Prolonged breastfeeding beyond one year in a cohort of 1,087 Bangladeshi children was associated with a 6-fold increase in survival compared to non-breastfed children (32). A prospective study in India (33) showed that breastfed children hospitalized with diarrhoea were 3 times more protected against death compared to non-breastfed children (95% CI 2.1 to 3.6). The protective efficacy was maximum in infants up to 6 months of age and declined gradually with increase of age. Further, a greater benefit was observed in children who were severely wasted, severely stunted, had protracted illness, or had diarrhoea as the sole illness.

In a population-based case-control study in Southern Brazil (34), the type of milk in an infant's diet was found as a risk factor for death from diarrhoea. After adjusting for confounding variables, infants who received powdered milk or cow's milk, in addition to breastmilk, were at 4.2 times (95% CI 1.7 to 10.1) the risk of death from diarrhoea compared to infants who did not receive artificial milk, while the risk for infants who did not receive any breastmilk was 14.2 times higher (95% CI 5.9 to 34.1). Each additional daily breastfeed reduced the risk of diarrhoeal death by 20% (95% CI 2% to 34%).

Mechanism of protection

While the unique protective effect of breastfeeding has long been documented, only more recently attempts have been made to identify the specific mechanisms of protection. Some of the mechanisms of protection are listed:

- a. A primary method of protection is the hygienic factor, i.e., avoiding contamination of milk, bottles, or food from unsanitary conditions (34-37). Studies in Peru, the Philippines, and Brazil on breastfeeding in infants younger than six months, concluded that supplementing breastmilk with water or tea at least doubled the risk of diarrhoea ((37).
- b. Breastfeeding is also thought to offer protection mediated by non-specific factors, such as lactoferrin, lysozyme and lactoperoxidase. Lactoferrin has strong bacteriostatic effect in presence of antibody and bicarbonate. Lysozyme can act in concert with IgA and peroxide to lyse Gram-negative bacteria (35).
- c. The protection of breastmilk by specific anti-microbial factors is well-documented. One study from Bangladesh demonstrated that the protection of the breastfed infants against cholera is related to the level of the IgA antibodies in the mothers' milk against *Vibrio cholerae* lipopolysaccharide and enterotoxin (38). The mechanism of protection by breastfeeding against shigellosis has not yet been documented. Presence of anti-*Giardia* sIgA in human milk can prevent symptoms of diarrhoea due to *Giardia*, but not acquisition of the organism (23).
- d. Breastfed infants may have a better nutritional status. This improved nutritional status ultimately reduces the risk of death from diarrhoea (35).
- e. Another mechanism of protection is the so-called "bifidus factor" (35). This stimulates growth of bifidobacteria, and antagonizes the survival of enterobacteria, thus reducing morbidity from diarrhoea.

Duration of benefits

Since this study was restricted to evaluate the contribution of breastfeeding in case of diarrhoea, the duration of benefit from breastfeeding should not be generalized in other infectious and non-infectious diseases. Attempts to define the duration of benefit from breastfeeding in diarrhoea are hampered by a methodological problem: the majority of studies on the effect of breastfeeding have been conducted only in infants aged less than six months. Despite this fact, sufficient data exist to suggest a pattern in the duration of benefit. It is agreed that infants receive maximum benefits from breastfeeding in early life, with protection against diarrhoeal diseases declining as age increases (17,33,41).

The greatest degree of protection attributed to breastfeeding exists during the first three months of life (17). A lower level of protection extends to six months (24), with some continued protection remaining through the first year of life (39,40). One study among Bangladeshi children concluded that breastfeeding confers protection against shigellosis till three years of age (18). Conflicting reports exist regarding the persistence of protective effect following discontinuation of breastfeeding. A literature review of 35 studies from 14 countries stated that the protective effects of breastfeeding do not continue after cessation of breastfeeding (36). A prospective observational study performed in England concluded that breastfeeding during the first 13 weeks of life confers protection against gastrointestinal illnesses, and that the protective effect persists beyond the period of breastfeeding itself (39).

Quantity of protection

Several studies have attempted to quantify the protection offered by breastfeeding in an infant. A study performed in 1990 in Mexico concluded that non-breastfed infants (up to six months of age) had 2.3 times greater risk of developing diarrhoea than breastfed infants (24). In an Indian study mentioned earlier (33), the magnitude of risk of death was three times in non-breastfed children compared to that in breastfed children hospitalized with diarrhoea. Similar risk of death from diarrhoea was observed among non-breastfed infants compared to breastfed infants in Southern Brazil (34).

Breastfeeding is not only associated with a decreased incidence of diarrhoea, but also with less severity of diarrhoea and fewer fatalities from diarrhoea (35,36). The estimated benefit from breastfeeding is a decrease in diarrhoeal morbidity by 8-20%, and a decrease in diarrhoeal mortality rate by 24-27% in the first 6 months of life (36).

Does breastfeeding impair child growth

Exclusive breastfeeding is widely considered the preferred method of infant feeding during the initial months of life, especially in less developed countries where nutritionally adequate, hygienic substitutes for human milk are neither widely available nor affordable. It is recommended that babies be breastfed exclusively for the first 4 to 5 months of life, after which weaning should begin with the introduction of solid foods. Some evidence suggests that children who are solely breastfed beyond their first birthday are more likely to be malnourished than are children completely weaned before this time (42). This issue of growth faltering was studied by Briend and Bari (32), who prospectively followed 1,087 Bangladeshi children (69 of them died) from their first to their third birthdays, weighing them monthly. Mean weight-for-age (% National Center for Health Statistics

standard) of partially or fully breastfed children was 69.6 ± 9.3 percent compared to 70.6 ± 10.7 percent ($p < 0.001$) for children who were fully weaned. This difference in nutritional status of the two groups, although statistically significant, was very small in absolute terms. Additionally, it would be important to determine the body composition of such children to see what constitutes the difference (fat or fat-free mass).

The apparent deviation of growth of exclusively breastfed infants in less developed countries from current recommendations can be considered a normal pattern with no observed deleterious consequences (40). In case of Bangladesh, the average weight-for-age and length-for-age indices of infants parallel the 50th centile of National Center for Health Statistics (NCHS) during the first four months of life (43). The decline in the average nutritional indices that was observed for Bangladeshi infants older than 4 months may have been related to insufficient nutrient intake from breastmilk or to incomplete utilization of nutrients because of illness such as infectious diseases (44). However, another reason could be that the standards used to assess growth are not appropriate. The Davis Area Research on Lactation, Infant Nutrition and Growth (DARLING Study) showed that weight pattern of breastfed infants, even in a population of high socioeconomic status, differed from current reference data (45). The NCHS standards used in assessing growth of infants are based on data collected from 1929 to 1975 from white middle-class infants. These data were collected at a time when bottle feeding was the norm, and when early supplementation with other foods in addition to milk was emphasised (46).

Several programmatic implications of these findings merit further discussion. If it is assumed that it would be desirable to prevent the relative decline in anthropometric indices of nutritional status, it would be necessary to promote increased dietary intake of the infants by earlier introduction of energy-dense appropriately-prepared weaning foods, enhanced production of their mothers' milk, or better protection from infections. It also suggests the need for new growth charts for exclusively breastfed infants.

Quantity and quality of milk produced

Studies throughout the developing world have illustrated that under normal conditions, women are able to produce quantities of breastmilk similar to those in developed countries. For example, in Bangladesh, Brown *et al.* (47) found that milk production peaked at an average of 750 g per day when the infants were 5-7 months. The quality of milk of malnourished mothers is in general not different from that of well-nourished mothers in terms of protein and lactose content. However, fat contents may vary by maternal dietary intakes (47).

The efficacy of intervention to improve lactational capacity of mothers (volume and duration) merits further study. An 18-month follow-up study suggested that both early initiation (49) and increased frequency (56) of breastfeeding extended the nursing period, the former having a greater impact. Previous attempts to improve lactation by maternal dietary supplementation have met with mixed results. Prentice (48) reviewed the available evidence and concluded that supplementation during lactation is most unlikely to increase breastmilk output or significantly improve its composition except perhaps in extremely malnourished women. However, these studies did not focus on prepregnancy nutritional status of the mother or on the effectiveness of supplements before and during pregnancy on subsequent lactational capacity.

Lessons learned and recommendations

Huffman and colleagues (13) reported in 1980 that 98% of Bangladeshi mothers were breastfeeding their infants at age one, and 91% were still breastfeeding children at two years of age. This figure is encouraging and probably one of the highest in the world. However, in this study, 41% of the Bangladeshi mothers began breastfeeding by the third post-partum day, when colostrum (rich in immune components) is replaced by the production of milk. There is a growing concern regarding the decline in breastfeeding practice in many developed as well as developing countries including Bangladesh. The decline is more in urban, better-educated and affluent groups than in their rural, uneducated and poor counterparts in developing countries (50,51). Given the general positive association of breastfeeding with infant health in the papers reviewed here, there is a crucial need for research targeting this decline. Specific research needs could be as follows:

- a. In Bangladesh, there is a growing urban slum population who are living with poverty and poor sanitation. The mothers often work outside their homes. We do not know the breastfeeding practices of these subgroups in Bangladeshi communities. Also we need to know the changing attitude, if any, of the upper-class urban Bangladeshi women who are likely to be influenced by western culture;
- b. There is evidence that mothers discontinue breastfeeding during illnesses of their children (14,52). More anthropological studies are needed to find out why mothers change their feeding behaviour when the child is sick;
- c. Some studies suggest that breastfed infants need additional micronutrients (53,54). We do not have enough information on the nutritional requirement of malnourished nursing mothers and malnourished breastfed children who are already compromised with nutrition and are vulnerable to repeated infections;

- d. Since most data are consistent that breastfed and non-breastfed children do not grow equally at least after a certain age, separate growth charts for the breastfed children could be developed;
- e. Comparative studies on the body composition of breastfed and non-breastfed children would be a useful adjunct to studies of overall growth in the two groups;
- f. Large-scale effectiveness and cost-benefit trials are required to resolve the issue of maternal supplementation in terms of lactational performance;
- g. Reasons for lack of effect of breastfeeding against certain diarrhoeal pathogens should be further studied.

Mass media promotion of infant formula has a tremendous influence on a mother's decisions related to the feeding of her child. Community health workers, family welfare workers, midwives, nurses and doctors may hold unfavourable attitudes, fostered by lack of information or misinformation on issues of breastfeeding. Several measures can be undertaken to enhance breastfeeding programme effectiveness in Bangladesh and some other developing countries (55):

- a. It may be appropriate to enact legislation regarding special leave and benefits of nursing mothers at their work;
- b. Health centres and hospitals may need mandated rooming-in facilities;
- c. Working places should have creche facility; mothers should be allowed time between work for nursing their babies;
- d. In large hospitals, milk banks can be established to support newborn babies having lost their mothers or having mothers incapable of breastfeeding;
- e. Some restrictions might be placed on the promotion of commercial formula;
- f. Health personnel should be given intensive training on lactation management along with other nutrition education; lactation management includes proper positioning of the infant, support in cases where infants do not want to suck or suck inadequately, advice on how to prevent engorgement of breasts, counselling on other lactational problems, etc. (56);
- g. The fathers should be involved in educational sessions because in most cases they influence the mothers' decisions about infant feeding in poor communities;
- h. Issues of breastfeeding should be incorporated in the nutrition education curricula for both graduate and under-graduate training of physicians and nurses, and in the residents' training programmes in obstetrics and paediatrics;

- i. More effective community educational approaches are needed, perhaps starting in schools, and concentrated in antenatal clinics, to prepare expectant mothers to make informed decisions regarding breastfeeding and lactation management;
- j. Duration of benefit from breastfeeding in diarrhoea till one year of age is consistent in most studies; breastfeeding beyond one year particularly in underprivileged groups should perhaps be encouraged to protect children from some types of diarrhoea (e.g. shigellosis) and possibly other diseases, to prevent deaths, and to facilitate birth spacing (57). In any case weaning should be started after 4 or 5 months of age.

Therefore, policy makers, professional organizations dealing with health care, Health Ministries and related government bodies should initiate and continue comprehensive efforts and commitments for promotion of breastfeeding and lactation management in Bangladesh and other developing countries. It is possible that with adequate foresight, Bangladesh and other developing countries can retain the advantages of breastfeeding as the process of modernization continues.

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