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Research Article

CORRELATION BETWEEN DIFFERENT FEEDING METHODS AND INFANTS' INFECTIOUS DIARRHEAL DISEASE INCIDENCE IN BANGLADESH

Zaryab Haider Dogar[1], Dr. Xiaocheng Yin[1*], Dr. Dujiu Zhong[1] and Tajallah Khan[2]

[1]The First Affiliated Hospital of University of South China, Department of Pediatrics, Hengyang Medical School, University of South China, Hengyang, Hunan, 421001, China

[2]Hengyang Medical College, University of South China, Hengyang, Hunan, 421001, China

ABSTRACT

Objective: To evaluate the incidence of feeding-induced diarrhea in neonates under observation and assess the association between various feeding methods and the outcomes of feeding-induced diarrhea.

Methods: A descriptive cross-sectional study was conducted among neonates and infants of ages 1 to 24 months old, from 28 September 2019 to 15 May 2021 at Manikgonj Sadar Hospital, Bangladesh. After taking informed consent, data was collected from 100 participants, along with fresh fecal samples of the neonates and infants. Data was entered and analyzed using IBM® SPSS v27 – statistical package.

Results: Six primary health centers' worth of women who attended well-baby clinics included a total of 49 mothers. Data were gathered using a standardized questionnaire. By using multi variable logistic regression analysis, factors linked to diarrheal illness were found. 56.3% (95% CI: 50.7%-61.8%) of children reported having diarrhea during the research period. Only 15.9% of the kids in our research received only breast milk. Ages 1 to 24 months were significantly linked with diarrhea occurrence (a OR = 2.64, 95% CI: 1.42-4.91).

Conclusion: Diarrhea frequently occurred among children between the ages of 1 to 24 months in our study population. Exclusive breastfeeding is not a regular practice in this country. Mothers should get health education programs to increase rates of breastfeeding, weaning, good food hygiene, and childcare. Mothers who are working should receive extra care and assistance.

Keywords: feeding practices; diarrhea; infants; Bangladesh.

INTRODUCTION

Over 525 000 kids die from diarrheal disease each year, making it the second most common cause of mortality among children under the age of five. The body may be deprived of the salts and water it needs to survive if diarrhea lasts for several days. The main causes of diarrhea deaths in the past for most people were acute dehydration and fluid loss. These days, a growing number of deaths related to diarrhea are probably being caused by other factors, notably septic bacterial infections. The most vulnerable groups to diarrhea that can be fatal include children who are undernourished, have weakened immune systems, or are HIV-positive. This corresponds to more than 1,400 young children dying every day, or roughly 530,000 kids experiencing diarrhea every year. Children in Bangladesh are at high risk for developing diarrheal illness. In Bangladesh, over 13% of children under the age of five experienced diarrhea in 2011. Throughout the nation, diarrhea was a factor in 24–30% of baby mortality. According to a multi-regional baseline household health status survey, 22% of children aged 0-23 months reported having any type of diarrhea in the previous two weeks. The greatest child death rate has been recorded in Bangladesh's Afar region, one of the poorest, least developed, and underserved areas in the nation. The lack of water, hygiene, and sanitation services is a problem in the region's rural settlements. Rivers, streams, ponds, and wells serve as the neighborhood's primary water supplies. The district had 45% and 12%, respectively, of its population have access to clean water and sanitary facilities in 2015.

Latest research has once more demonstrated the advantages of breastfeeding in reducing morbidity and mortality from diarrhea in babies. Young infants who are not breastfed had a 25-fold higher risk of dying from diarrhea than those who are exclusively breastfed, according to case-control research conducted in Bangladesh. As comparison to newborns that receive only water in addition to breast milk, a longitudinal study conducted in the ICDDRB of Bangladesh, Dhaka, indicated that infants who are exclusively breastfed have a lower incidence of diarrheal morbidity.

Both of these studies, as well as a great deal of other research from underdeveloped nations, emphasize the requirement to extend exclusive breastfeeding to at least 4-6 months. The production of breast milk is sufficient to maintain an infant's growth up to this age, even in women who are undernourished, according to a review of relevant studies conducted around the world. Infants in developing nations that are fed under the current environmental conditions experience more diarrheal attacks and thus consume less food. This is caused by the inclusion of early dietary supplements. In spite of infants frequently rejecting alternative feeds, notably non-breast milk, studies in Bangladesh, India, and Nigeria have demonstrated that nursing can continue during diarrheal illness. In a period when it's usual to lose the desire for other foods, breastfeeding is crucial for supplying the calories and protein that are required.

To prevent breastfeeding mothers from being separated from their children while they receive oral rehydration therapy on an inpatient or outpatient basis, diarrheal disease control programs must change the way services are delivered. To avoid interfering with suckling, newborns should receive oral rehydration solution through a cup and spoon rather than a bottle. Promotion of breastfeeding should be a component of

programs as well. This should include hospital policies that encourage infants to continue nursing both immediately after birth and throughout their hospital stay, such as immediate breastfeeding after delivery, sharing a room, demanding breastfeeding, prohibiting water or formula from being given in bottles, and forbidding prelacteal feedings. Also, for moms to receive appropriate guidance on how to breastfeed and how to handle potential complications, health practitioners must be aware of the skills required for the management of breastfeeding. Intestinal infections, which can be brought on by several bacterial, viral, and parasitic organisms, frequently manifest as diarrhea. As a result of poor hygiene, an infection can also spread from person to person through contaminated food or drinking water. Interventions to prevent diarrhea, such as the use of clean hands and improved sanitation, can lower the risk of contracting the disease. A clean water, sugar, and salt solution called oral rehydration solution (ORS) should be used to treat diarrhea. Additionally, a 10–14-day supplemental treatment course of dispersible 20 mg zinc tablets reduces the length of diarrhea and enhances results. An etiological study carried out in Bangladesh in the 1990s discovered that 13/814 of the 814 children hospitalized with diarrhea had diarrhea that had been identified by a cell cytotoxin assay [1]. Due to the time-consuming, expensive, and cumbersome anaerobic techniques needed for this organism's diagnosis, there are few studies from Bangladesh regarding diarrhea. Until this age, an infant's growth can be maintained by breast milk production. Infants in developing nations fed in accordance with the environment's requirements experience an increase in diarrheal attacks and a corresponding decrease in food intake when early food supplements are added. Infants who are affected suffer from a worsening of their nutritional status. During these episodes, breastfeeding can help keep hydration levels stable.In spite of infants frequently rejecting alternative feeds, notably non-breast milk, studies in Bangladesh, India, and Nigeria have demonstrated that nursing can continue during diarrheal illness. In a period when it's usual to lose the desire for other foods, breastfeeding is crucial for supplying the calories and protein that are required. To prevent breastfeeding mothers from being separated from their children while they receive oral rehydration therapy on an inpatient or outpatient basis, diarrheal disease control programs must change the way services are delivered. To avoid interfering with suckling, newborns should receive oral rehydration solution through a cup and spoon rather than a bottle. Promotion of breastfeeding should be a component of programs as well. This should include hospital policies that encourage nursing babies both immediately after birth and throughout their hospital stay, such as immediate breastfeeding after delivery, sharing a room, demanding nursing, prohibiting water or formula bottle feedings, and forbidding pre-lacteal feeds. Feeding techniques can be isolated using anaerobic stool culture on CCFA (Cycloserine cefoxitin fructose agar), a selective media. Although routine stool cultures for Feeding methods have specificities of 84-100% and sensitivity of 90-100%, they take longer to produce (4-5 days), are labor-intensive, and cannot distinguish between strains of toxic and non-toxic Feeding methods [2]. Numerous researchers have evaluated selective culture media for feeding methods, and their results have revealed variable sensitivity rates ranging from 42.6% to 99.6% based on the type of medium, alcohol pre-treatment, and/or incubation time [3]. Feeding techniques are notoriously challenging to cultivate and isolate, and they are incredibly sensitive to even very

low oxygen levels in the environment [4]. However, stool cultures are necessary for ribotyping and epidemiological investigations during an outbreak. Toxigenic stool culture detects the ability of a strain to produce toxin and does not necessarily production of toxin in the host. It requires growing bacteria in a culture and a second step to detect the presence of the toxins by any method that is Latex agglutination, EIA or PCR. It is a very sensitive (95-100%) test to detect toxigenic Feeding methods and takes 2-3 days. Toxigenic culture is typically considered to be a reference method rather than a diagnostic method and currently it is considered to be the gold standard for detecting toxigenic organism [5]. The toxin-based cell culture cytotoxicity neutralization assay (CCCNA), which measures the cytotoxic impact of a toxin on cultured cell lines, is another technique. First, a fibroblast monolayer is created. Stool filtrates are then applied on top of it and incubated aerobically. When C. difficile is present, fibroblasts gather together and separate from the monolayer [6]. Utilizing anti-toxin antibodies, which stop the rounding up of fibroblasts, the Feeding methods are verified. For this, a variety of cell lines have been employed, including MRC-5 lung fibroblasts, human foreskin fibroblasts, human diploid fibroblasts, Vero cells, McCoy cells, and Hep2 cells. The reported sensitivities for CCCNAs range from 65 to 90%, which is quite a wide range [7]. For the diagnosis of CDI, it is regarded as the gold-standard clinical laboratory test [8]. Due to its poor sensitivity, relatively long turnaround time (24 to 48 hours), and need for competence in maintaining cell cultures and result interpretation, CCCNA has lost favor as a standard diagnostic test. Diarrhea can be effectively treated by breastfeeding. Breast milk cannot be replaced or compared to in any way. The continuation of this program is contingent upon full adherence to the WHO's "International Code of Marketing of Breast Milk Substitute" and the "Breast Milk Substitute, Infant Foods, Commercially Manufactured Complementary Food and Accessories Thereof Act 2013," as well as the "Rules 2017 of this Act."

MATERIALS AND METHODS

Type of Study:

Observational Cross-sectional Study.

Study Period:

This study was conducted from 28 September 2019 to 15 May 2021.

Study Design and Settings:

This cross-sectional study was conducted in Bangladesh's Dhaka and Manikganj City between September 2019 and May 2021. 100 kids under the age of two were included. A structured purpose-built proforma was used to gather the information. To find factors linked to diarrheal illness, multivariate logistic regression analysis was employed. All laboratory works were performed in the Department of Microbiology and Immunology, BSMMU, Dhaka.

Inclusion criteria:

Patients presenting with diarrhea within 72 hours of hospital admission. Patients under the age of

two months or over the age of 2 years.

Exclusion criteria:

Patients receiving par-enteral nutrition. Parents/Guardians who did not consent to partake in the study.

Ethical considerations:

The research protocol was approved by the Institutional Review Board of University of South China. All recruited study subjects were informed about the study and procedures, confidentiality and freedom to withdraw at any point of study. The confidentiality of the data was maintained professionally and kept on password protected files.

Sample size:

Currently, few studies are available on the prevalence of Feeding methods induced diarrhea among hospitalized patients in Bangladesh.

Sample size was calculated by using the prevalence data obtained from Segar et al., 2017 and using the following formula,

Z^2 p q n =

e^2 n= sample size

Z=1.96 (a percentile of the standard normal distribution determined by 95% Confidence Interval)

p=0.15 (expected percentage of Feeding methods infection, 15%) [9].

q=1-p=1-0.15=0.85

e= 0.07 (expected precision limit of the assumed percentage of C .difficile infection i.e. +/-7%).

$$n = \frac{Z^2 p q}{e^2} = \frac{(1.96)^2 \times 0.15 \times 0.85}{(0.07)^2} = 100$$

So, sample size was determined to be 100.

The sample size was calculated to be 100, using the WHO sample size calculator, and a previous finding of prevalence of Feeding methods induced diarrhea to be 15-20% in India [9].

Data collection:

A developed data collection sheet was used to collect the data. From the patient's record file, which is available in clinical wards, information was gathered about the patient's use of antibiotics, breast milk, complementary foods, baby oral saline, underlying diseases, duration of diarrhea, length of hospital stay, NG feeding, fever, abdominal pain, vomiting, etc. The information was then entered into a specially designed questionnaire. The data sheet contained a record of every laboratory procedure followed and every set of findings.

Specimen collection procedure:

Sterile stool sample containers were used to collect fecal samples, which were then safely

transported with strict anti-septic measures.

Laboratory finding:

Even while you might be able to wait out a brief case of diarrhea, it can be a major issue, particularly in toddlers and infants. Your healthcare provider may order several tests to get a diagnosis for some causes of diarrhea that need to be treated. The most important ones are blood and stool testing. If diarrhea is left untreated, it can lead to dehydration, discomfort, weakness, and malnutrition. If you suddenly have diarrhea that persists for more than 48 hours, you should see your doctor's office or an urgent care facility for medical attention.

Self-Checks:

Three or more instances of loose, watery stools in a single day are considered diarrhea. You can experience additional symptoms, depending on the cause. In most cases, if diarrhea goes away in 48 hours for adults or 24 hours for children, you won't need to visit your doctor. But keep an eye out for additional signs that point to a more serious condition.

You should see your healthcare provider if you note any of these signs:

Stool that is black or tarry, or contains blood or pus

- 102-degree or higher fever
- Severe abdominal or rectal pain in adults
- Chronic diarrhea or diarrhea lasting for more than two days
- Signs of dehydration such as dizziness, headache, dark urine, no urine, dry mouth, nose, or tongue.

A pediatrician should always examine a newborn or infant with diarrhea. Recording the meals you consumed, travels you made, untreated water you drank, and medications you were taking prior to developing diarrhea are also helpful. For the benefit of your healthcare provider, provide as much information as possible. Save any containers or wrappers in case authorities seek to trace the sources of the numerous outbreaks of disease caused by contaminated food goods.

RESULTS

Throughout the two-week period, the prevalence of diarrhea among children under the age of two was 31.3%. Age of children between 6 and 11 months (OR= 6.28, 3.00-13.12), illiterate mothers (OR=6.61, 2.27-19.21), delaying the start of early breastfeeding for infants under 6 months (OR=9.13, 1.78-46.72), infants under 6 months who are not currently exclusively breastfed (OR=3.51, 1.57-7.82), consuming uncooked foods (OR=6.99, 2.89-16.92), not eating cooked foods immediately after cooking (OR=3.74, 1.48-9.45), hand washing with only water (OR=24.94, 6.68-93.12), and rota-virus vaccination (OR=0.09, 0.03-0.29), were all significantly associated with development of diarrhea in infants.

Collected Data:

This table shows the incidence of diarrhea among different feeding methods and different age

groups.

Age group	Prevalence of diarrhea
Under the age of 2	(AOR 31.3, 95% CI, 25.9, 36.1%)
6 - 11 months	(AOR 6.28, 95% CI, 3.00, 13.12)
Illiterate mothers	(AOR 6.61, 95% CI, 2.27, 19.21)
Delayed weaning under 6 months infants	(AOR 9.13, 95% CI, 1.78, 46.72)
Infants under 6 months who are not currently exclusively breastfed	(AOR 3.51, 95% CI, 1.57, 7.82)
6 - 24 months child (not exclusively breastfeed in the first 6 months)	(AOR 19.24, 95% CI, 8.26, 44.82)
Child under 24 months consuming uncooked foods	(AOR 6.99, 95% CI, 2.89, 16.92)
Child not eating cooked foods immediately after cooking	(AOR 3.74, 95% CI, 1.48, 9.45)
Hand washing with only water	(AOR 24.94, 95% CI, 6.68, 93.12)
Rota-virus vaccination	(AOR 0.09, 95% CI, 0.03, 0.29).

Using of Feeding methods as a treatment for diarrhea patients who admitted in various clinical wards of BSMMU and DMCH (n=100)

	Feeding Methods (Positive Worked) (n=16) n (%)	**Feeding Methods (Negative Worked)** (n=84) n (%)	***P*-value**
Name of the Department			
ICU	8 (50%)	34 (40.5%)	
Burn Unit ICU	1 (6.3%)	7 (8.3%)	
Gastroenterology	2 (12.5%)	8 (9.5%)	
Hematology	2 (12.5%)	12 (14.3%)	0.915ns
Oncology	2 (12.5%)	6 (7.1%)	
Palliative Care Unit	1 (6.3%)	5 (6%)	
Orthopaedics	0 (0%)	3 (3.6%)	
Internal Medicine	0 (0%)	5 (6%)	
Colorectal Surgery	0 (0%)	4 (4.8%)	
Name of the Hospital			
BSMMU	11 (68.8%)	56 (66.7%)	0.871ns

DMCH	5 (31.3%)	28 (33.3%)

ns= not significant p value was calculated from Chi square test, where p value <0.05 was considered as significant.

Out of 100 cases of diarrhea, the table shows that 67% of patients were from BSMMU and 33% were from DMCH. Most of the samples from these patients (42%) came from the ICU, followed by hematology (14%), gastroenterology (10%), burn unit ICU (8%), oncology (8%), palliative care unit (6%), orthopedics (3%), internal medicine (5%) and colorectal surgery (4%). 11 samples from BSMMU and 5 samples from DMCH were gathered from instances of diarrhea that tested positive for feeding methods. Of these, 8 percent of the samples came from the ICU, followed by samples from hematology, gastroenterology, oncology, burn unit ICU, and palliative care. In contrast to the 6% C.difficile, 5% selmonella, and 12% e.coli toxin positive cases, 4% of these cases originated from BSMMU and DMCH, while 2% of cases originated from ICU, followed by 2% each from oncology, hematology, and the palliative care unit.

Caregivers' intended feeding practices during diarrhea at baseline and recommended feeding practices at follow-up.

Breast milk					**Cow's milk**	
	Caregivers of breastfed children < 6 months		Caregivers of breastfed children ≥ 6 month		Caregivers of children ≥ 6 months, receiving other milk*	
	At baseline (n = 51)	At follow-up (n = 26)	At baseline† (n = 179)	At follow-up (n = 181)	At baseline† (n (n = 235)	At follow-up (n = 245)
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
More	41.2 (21)	50 (13)	36.9 (66)	43.1 (78)	1.3 (3)	9.4 (23)
Same amount	45.1 (23)	50 (13)	46.9 (84)	54.1 (98)	8.5 (20)	47.8 (117)
Less	11.8 (6)	0	11.7 (21)	2.2 (4)	9.4 (22)	26.9 (66)
None	2 (1)	0	4.5 (8)	0.6 (1)	79.6 (187)	14.7 (36)
Do not know	0	0	0	0	1.3 (3)	1.2 (3)

Note:-

*Milk other than breast milk.

†Difference between groups at baseline and at follow-up statistically significant (P < 0.05).

Caregivers' perceptions of the effect of food during diarrhea at baseline:

In Table, the perceptions of caregivers regarding the impact of breast milk, cow's milk, and meals on a child with diarrhea are described. In total, 4.6% of caregivers believed that breast milk harmed the infant, whereas 21.5% thought it was neither beneficial nor detrimental. Sixty-one percent believed it was detrimental to consume cow's milk while experiencing diarrheal episodes.

In this situation, we identified a lot of patients who were in pain, but they recovered swiftly when we used breast milk and supplementary foods instead of antibiotics.

We need to address dehydration and maintain an electrolyte imbalance to treat diarrhea since breast milk has a wealth of nutrients and minerals that also strengthen our immune system.

Hence, breast milk works miraculously to correct this imbalance.

DISCUSSION

Diarrhea is a significant public health concern in Bangladesh, contributing to a substantial percentage of infant fatalities, accounting for 24–30% of all infant deaths [10]. This study aims to assess the prevalence of diarrhea in children under two years old and its correlation with feeding practices among nomadic communities in the Dhaka area. The research also sheds light on the challenges in culturing Clostridium difficile, a Gram-positive, spore-forming, anaerobic bacterium implicated in severe gastrointestinal diseases like pseudomembranous colitis [11].

In 2021, Bangladesh experienced a surge in diarrheal diseases, with over 50,000 reported cases and 36 recorded deaths between January and May. The outbreak response revealed Vibrio cholerae O1, E. coli, and other bacteria in affected patients, emphasizing the role of contaminated water and environmental factors [12].

Breastfeeding is highlighted as crucial for infants' immunity, providing antibodies and immunoglobulins that protect against infections. Studies show that breastfed infants have a reduced risk of various diseases, including respiratory infections, diarrhea, and childhood leukemia [12]. The composition of breast milk adapts to the changing needs of the baby, with colostrum offering vital nutrients in the early days.

Furthermore, the study emphasizes the importance of evidence-based therapies, including breastfeeding and oral rehydration solutions, in reducing infant deaths due to diarrhea. Continuing feeding during diarrheal episodes is crucial for better clinical outcomes and intestinal function recovery. However, challenges exist, such as a drop in infants' energy consumption from non-breast milk sources during diarrheal diseases [13].

CONCLUSION

1. Diarrhea in children under two is linked to factors such as age, maternal literacy, breastfeeding practices, and hygiene; promoting solid food during illness is advisable.
2. Bangladeshi infant diarrhea risks include maternal illiteracy, delayed breastfeeding initiation, non-exclusive breastfeeding, uncooked food consumption, and the absence of Rotavirus vaccination; collaborative efforts are crucial for effective prevention and intervention strategies.
3. Addressing childhood diarrhea in Bangladesh requires heightened awareness, robust surveillance, and collaboration with NGOs and the private sector to expand intervention coverage and reduce mortality through diverse health system platforms.

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