

Determinants of Acute Watery Diarrhea in Children Under Five Years: A Comprehensive Analysis

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DOI: <https://doi.org/10.36348/sjm.2024.v09i10.006>

| Received: 14.09.2024 | Accepted: 25.10.2024 | Published: 28.10.2024

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Abstract

Background: Acute watery diarrhea (AWD), which has a sudden onset and is associated with a risk of severe dehydration, is primarily spread through unsafe water, poor sanitation, and inadequate hygiene. Socioeconomic factors, like low parental education and poverty, further increase risks. WHO-recommended interventions, including oral rehydration therapy, zinc supplementation, and rotavirus vaccinations, have reduced diarrhea-related deaths globally. **Aim of the study:** This study aims to explore the socio-demographic, environmental, and behavioral factors associated with childhood watery diarrhea, particularly in high-risk regions. **Methods:** This prospective observational study was conducted at the Department of Pediatric, 250 Bedded General Hospital, Khulna, Bangladesh, with 210 children aged 0–60 months presenting acute watery diarrhea, enrolled over one year July 2023 to June 2024. Eligible children met specific inclusion criteria, while exclusion was applied to cases of chronic diarrhea or unrelated pre-existing conditions. Data confidentiality was maintained, with ethical approval granted. The analysis involved descriptive statistics in SPSS (version 26) for comprehensive result interpretation. **Result:** The study included 210 children under five, with a mean age of 14.51 ± 5.34 months; most were aged 7–12 months (38.10%), and 54.29% were male. Caregivers were predominantly aged 28.39 ± 4.11 years, with 73.81% having completed primary education. Key findings included high MMR vaccination rates (62.38%), significant exclusive breastfeeding for six months (58.57%), and recent diarrhea reports among 20.95% of caregivers. In terms of WASH practices, 60.48% used piped water, 57.62% stored drinking water separately, and 95.71% had toilet facilities. Notably, 67.14% used water only for handwashing, and 45.24% washed hands with soap post-toilet use. **Conclusion:** Safe water, sanitation, and handwashing practices are essential to reducing acute watery diarrhea in children under five. Children in households with untreated water and inconsistent caregiver handwashing face higher risks. Targeted public health initiatives to improve water treatment and hygiene could greatly reduce diarrhea incidence and improve child health outcomes.

Keywords: Determinants, Acute Watery Diarrhea, and Children.

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INTRODUCTION

Childhood diarrhea remains a significant global health concern, with approximately 1.7 billion cases and over 525,000 child deaths annually due to diarrheal diseases [1]. Children in low- and middle-income countries (LMICs) are disproportionately affected, particularly in sub-Saharan Africa and South Asia, where the highest incidence and mortality rates are recorded [2]. In these regions alone, diarrhea claims nearly 78% young lives each year, underscoring the urgent need to address this preventable cause of child mortality [3]. Despite progress in reducing diarrhea-related deaths, it continues to rank as the second leading cause of mortality among children under five years, surpassed

only by neonatal complications [4]. Diarrhea, defined as three or more loose stools in a 24-hour period, can result from infections caused by bacteria, viruses, protozoa, or parasites [5,6]. In both developed and developing countries, rotavirus and Escherichia coli remain primary causative agents [7]. Acute watery diarrhea (AWD), a sudden onset of loose stools lasting up to two weeks, is especially dangerous due to the risk of severe dehydration [8]. Major factors contributing to the spread of watery diarrheal diseases include unsafe drinking water, poor sanitation, and inadequate hygiene practices [9]. In communities where access to clean water and proper sanitation is limited, diarrhea outbreaks are common, and child mortality rates are markedly higher [10]. Environmental, socio-economic, and behavioral

factors significantly influence the incidence of acute watery diarrhea among children [11]. In areas without reliable access to improved sanitation facilities, children are at higher risk for diarrhea. Studies indicate that children in households with inadequate sanitation are more vulnerable, particularly during periods of increased rainfall or flooding, which can lead to water contamination [12]. Poor hygiene practices, including lack of regular handwashing and improper food handling, further exacerbate the risk. Socio-economic conditions, such as poverty and low parental education, also play crucial roles [13]. Children from low-income families often lack access to adequate healthcare and nutritious food, factors that can contribute to weakened immunity and a higher likelihood of diarrheal infections [14]. Maternal education is especially impactful, as mothers' knowledge of preventive practices, such as breastfeeding, has been linked to reduced diarrhea incidence [15]. Global public health initiatives have made strides in controlling diarrheal disease through measures like oral rehydration therapy (ORT), zinc supplementation, rotavirus vaccinations, and promotion of exclusive breastfeeding [16]. These interventions, recommended by the World Health Organization (WHO), have significantly lowered diarrhea-related child deaths in many countries [16]. However, disparities persist, with the burden of disease remaining highest in areas with limited access to healthcare and sanitation. Identifying and addressing the multifactorial contributors to acute watery diarrhea among children is essential for effective intervention. This study aims to explore the socio-demographic, environmental, and behavioral factors associated with childhood watery diarrhea, particularly in high-risk regions.

METHODOLOGY & MATERIALS

This prospective observational study was carried out at the Department of Pediatric, 250 Bedded General Hospital, Khulna, Bangladesh. The target population consists of children aged 0–60 months with watery diarrhea who were seeking healthcare services. A total of 210 children whose caregiver's consent to participate in the study and provide relevant information were selected during one year from July 2023 to June 2024. The study population was selected based on specific inclusion and exclusion criteria.

Inclusion Criteria

- Children aged 0–60 months who present with acute watery diarrhea (defined as ≥ 3 watery stools in the last 24 hours).

Exclusion Criteria

- Children with chronic diarrhea or persistent diarrhea lasting more than 14 days.
- Children with known pre-existing conditions unrelated to diarrhea (e.g., congenital disorders) that may interfere with the study outcomes.

Caregivers or parents of eligible children were interviewed as respondents. Interviews were conducted using a validated questionnaire with the mothers or primary caregivers of the selected cases. The variables for this study were selected following a comprehensive literature review and included a wide range of factors thought to influence the occurrence of acute watery diarrhea (AWD) in children [17,18,25]. These variables encompassed the child's sociodemographic background, such as age, gender, and socioeconomic status, as well as healthcare-related factors like the child's immunization history, specifically receipt of the MMR vaccines, and vitamin A supplementation. In terms of environmental and behavioral factors, the study included questions about household water sources, sanitation facilities, and hygiene practices both at the household and individual levels. Specifically, we assessed the type and regularity of water treatment, access to safe drinking water, latrine availability, and handwashing behaviors among family members. Other variables included the child's health conditions, with a focus on the presence of undernutrition, and overall nutritional status, as these have been identified in previous studies as potential contributing factors to diarrhea in young children. This comprehensive set of variables allowed us to capture a wide array of possible influences on AWD occurrence in the study population. Information about the child's MMR vaccination history was obtained from child health cards. All caregivers or parents of the patients provided informed consent prior to their participation in the study. Data confidentiality was strictly maintained, and participants could withdraw from the study at any point without consequences. Ethical approval for the study was granted by the institution's Ethical Review Committee.

Data Analysis:

Data were systematically organized into tables and figures, accompanied by detailed explanatory notes to ensure clarity and comprehensive understanding. Statistical analysis was performed using SPSS software (version 26) on a Windows platform. Continuous variables were expressed as mean \pm standard deviation (SD), while categorical variables were presented as frequencies and percentages.

RESULT

The study included a total of 210 children aged between 0 and 60 months, with a mean age of 14.51 ± 5.34 months. The majority of the children were aged between 7 and 12 months (38.10%), while only 1.43% were aged 37 to 48 months. Males represented a higher proportion of the participants at 54.29%, compared to 45.71% females. Additionally, the caregivers had a mean age of 28.39 ± 4.11 years, and most (73.81%) had completed primary education; however, only 3.33% had a university degree. Notably, a significant portion of the children were either first-born (43.81%) or second-born (31.90%) (Table 1). Regarding childcare practices, it was found that a significant number of children had received the Measles, Mumps, and Rubella (MMR) vaccine, with

62.38% reporting vaccination. Notably, 94.66% had received one dose of the vaccine, whereas only 5.34% had received two doses. Additionally, 70.95% of the children had received vitamins in the previous six months. Furthermore, 58.57% were exclusively breastfed for at least six months, while 41.43% were breastfed for less than six months. A total of 20.95% of caregivers reported suffering from diarrhea recently, while 42.86% of family members experienced similar issues (Table 2). In Table 3, water, sanitation, and hygiene (WASH) practices were assessed, revealing that the primary source of water for most households was piped water (60.48%), while 39.52% relied on boreholes. A significant majority (68.10%) reported that the distance to fetch water was within five minutes. However, only 31.43% treated their water at home. Most respondents (57.62%) utilized separate containers for drinking water, and a substantial 95.71% had toilet facilities at home. Handwashing practices revealed that a

significant number of respondents used water only for handwashing 67.14%, while 11.90% used water and soap, and 20.95% reported not washing their hands at all. When asked about handwashing after specific activities, 45.24% washed their hands with soap after using the toilet, while 54.76% did not. Furthermore, the majority, 84.29%, washed their hands before feeding their child, and 75.24% did so after cleaning the child's buttocks. Handwashing after the disposal of child stool or urine was practiced by 78.10%, and 77.62% washed their hands before preparing food. Regarding handwashing facilities, 60.00% of respondents had a handwashing facility at home, with 53.81% reporting that it was located within 2 meters of the toilet. Concerning child stool disposal, 85.24% used the toilet, while 8.57% covered the stool with soil, and 6.19% disposed of it in open spaces. A majority, 84.29%, reported that child stool was not left in the compound, and 64.76% indicated that they did not leave refuse in the compound.

Table 1: Demographic profile of study participants (N=210)

Variables	Frequency (n)	Percentage (%)
Age (months)		
0–6	27	12.86
7–12	80	38.10
13–24	62	29.52
25–36	29	13.81
37–48	3	1.43
49–60	9	4.29
Mean±SD	14.51±5.34	
Gender		
Male	114	54.29
Female	96	45.71
Caregiver age (years)		
Mean±SD	28.39±4.11	
Highest education level caregiver		
No formal education	27	12.86
Primary	155	73.81
Secondary/Higher Secondary	21	10.00
University	7	3.33
Child's birth order		
1st born	92	43.81
2nd born	67	31.90
≥3rd born	51	24.29

Table 2: Childcare practices among respondents (N=210)

Variables	Frequency (n)	Percentage (%)
Received MMR vaccine		
Yes	131	62.38
No	79	37.62
Doses of MMR vaccine		
One	124	94.66
≥Two	7	5.34
Vitamin in previous 6 months		
Yes	149	70.95
No	61	29.05

Variables	Frequency (n)	Percentage (%)
Duration of exclusive breastfeeding		
<6 months	87	41.43
≥6 months	123	58.57
Age at start of weaning		
<6 months	87	41.43
At 6 months	50	23.81
>6 months	73	34.76
Age stopped breastfeeding completely (months)		
0–6	96	45.71
7–18	41	19.52
≥18	73	34.76
Caregiver suffered from diarrhea recently		
Yes	44	20.95
No	166	79.05
Family members suffered from diarrhea recently		
Yes	90	42.86
No	120	57.14
Child had a comorbidity recently		
Yes	33	15.71
No	177	84.29
Child had malnutrition		
Yes	32	15.24
No	178	84.76

MMR: Measles, Mumps, and Rubella

Table 3: Water, sanitation, and hygiene profile of study respondents (N=210)

Variables	Frequency (n)	Percentage (%)
Main source of water		
Piped	127	60.48
Borehole	83	39.52
Distance to fetch water		
≤5 min	143	68.10
>5 min	67	31.90
Home water treatment		
Yes	66	31.43
No	144	68.57
Separate container for drinking water		
Yes	121	57.62
No	89	42.38
Toilet facility at home		
Yes	201	95.71
No	9	4.29
Method of handwashing		
Water only	141	67.14
Water and soap	25	11.90
Don't wash hands	44	20.95
Wash hands with soap after visiting the toilet		
Yes	95	45.24
No	115	54.76
Wash hands before feeding the child		
Yes	177	84.29
No	33	15.71
Wash hands after cleaning child's buttock		
Yes	158	75.24
No	52	24.76

Variables	Frequency (n)	Percentage (%)
Wash hands after disposal of child's stool/urine		
Yes	164	78.10
No	46	21.90
Wash hands before preparing food		
Yes	163	77.62
No	47	22.38
Hand washing facility at home		
Yes	126	60.00
No	84	40.00
Hand washing facility near toilet (<2 m away)		
Yes	113	53.81
No	97	46.19
Child stool disposal method		
Toilet	179	85.24
Covered by soil	18	8.57
Open space	13	6.19
Child stool in compound		
Yes	33	15.71
No	177	84.29
Refuse in compound		
Yes	74	35.24
No	136	64.76

DISCUSSION

Acute watery diarrhea (AWD) remains a leading cause of morbidity and mortality among children aged 0–60 months. This study aimed to identify factors linked with AWD among children in this age group. Research from Ethiopia and Zambia has shown that factors such as the use of unprotected water sources, younger caregiver age, timing of child weaning, larger family size, low maternal education, inadequate sanitation, contaminated water sources, shorter breastfeeding duration, poor hand hygiene, absence of rotavirus vaccination, improper feces disposal, and inadequate food hygiene are significant predictors of AWD among children aged 0–59 months [17-19]. Additionally, other studies have associated child-specific factors such as age, gender, and malnutrition with childhood diarrhea [12,20,21]. In this study, factors including the use of borehole water, handwashing methods, household water treatment practices, and caregivers' handwashing habits after using the toilet were identified as key determinants of AWD among children 0–60 months. Specifically, children whose caregivers did not wash their hands with clean water and soap after using the toilet faced higher odds of contracting AWD compared to those whose caregivers practiced hand hygiene. This association is expected, as washing hands with clean water and soap effectively removes diarrhea-causing organisms, reducing their transmission [22]. Unwashed hands serve as vectors, transferring pathogens to children's food and thereby increasing the risk of exposure to diarrhea-causing agents [22]. Similar findings in studies from Ethiopia, Zambia, Uganda, and Nepal highlight that caregivers' handwashing practices at critical times, particularly after toilet use, serve as protective measures against AWD

among children 0–59 months [11,19,23,24]. Conversely, a study in Ethiopia among children aged 0–59 months found no significant link between handwashing at critical times and AWD, possibly due to the relatively stable socioeconomic background of the population studied, which contrasts with the predominantly low socioeconomic background of refugees in this study [25]. This study also revealed that children from households using borehole water had increased odds of AWD compared to those using chlorinated piped water. Chlorination in piped water disinfects and neutralizes diarrhea-causing pathogens, making it safer for household use [26]. Basamba *et al.*, (2013) reported borehole water contamination in Tanzania, attributing it to fecal contamination from sewage infiltration into groundwater, and recommended treatment or boiling of borehole water before consumption [27]. Although boreholes and other groundwater sources are considered "improved" and safe [28], microbiological assessments of these sources, including boreholes, frequently report high levels of *Escherichia coli*, indicating fecal contamination [29,30]. High population densities around these boreholes likely increase contamination risk, particularly if children touch water outlets during water collection. A Zimbabwean study also noted that while boreholes generally provide 'safe' water, contamination at the collection point can occur [31]. Similarly, a study in Nigeria found that protected groundwater sources, including boreholes, were associated with an elevated diarrhea risk [32]. However, findings from Uganda by Ssenyonga *et al.*, (2009) differed, indicating that children in households using borehole water had a reduced AWD risk compared to those relying on piped water [33]. These findings underscore the importance of safe water sources, rigorous handwashing practices, and tailored

public health initiatives to reduce AWD incidence among young children, especially in economically vulnerable populations. This investigation had some limitations. The reliance on caregiver-reported data, which may introduce recall bias, especially concerning past health and hygiene practices. Certain potential confounding factors, such as seasonal variations or detailed microbiological analysis of diarrhea pathogens, were not within the study's scope, which may influence the interpretation of determinants for acute watery diarrhea in this population.

CONCLUSION

This study underscores the critical role of safe water sources, proper sanitation, and rigorous handwashing practices in reducing acute watery diarrhea (AWD) among children under five. Children from households relying on untreated borehole water and those whose caregivers lacked consistent handwashing with soap after toilet use were at higher risk of AWD. The findings highlight the urgent need for targeted public health initiatives to improve water treatment and hygiene practices, especially in economically disadvantaged settings. By addressing these modifiable risk factors, such interventions could significantly decrease the prevalence of AWD and improve child health outcomes in vulnerable populations.

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