Original Research Article

Nutritional Knowledge, WASH Practices of Mothers and Their Impact on the Nutritional Status of Children Aged 6–59 Months in Cumilla District, Bangladesh

Abstract

Introduction: Child malnutrition is a pressing global public health issue, impacting both immediate health and future development. Adequate nutrition is a crucial aspect of public health, with maternal nutritional knowledge playing a vital role in ensuring optimal growth for children. Insufficient awareness about nutrition, even in households with sufficient resources, can result in poor outcomes for children.

Aim: This study aimed to explore the relationship between maternal nutrition knowledge and Water, Sanitation and Hygiene (WASH) practices and its effect on the nutritional status of children 6–59 months in the Cumilla district, Bangladesh.

Methods: A community-based cross-sectional study was carried out on 386 mother-child (6-59 months) pairs from 7 villages of the Cumilla district, Bangladesh.The study was designed to assess nutritional knowledge, WASH practices of mothers and nutritional status of their children using structured questionnaire and anthropometric measures.Chi square test was performed to investigate the association between maternal nutritional knowledge, WASH practices, and the nutritional status of children.

Results: The study revealed, the level of nutritional knowledge was average (72.3%) among mothers.The prevalence of stunting, underweight, wasting and overweightwere 38.6%, 16.9%, 11.9%, and 7.8% respectively. A strong relationship was found between nutritional knowledge, WASH practices of mothers and child's stunting ($p<0.05$) respectively. Maternal nutritional knowledge also had a strong association with underweight where female child was more prone to underweight than its male counterpart ($p<0.05$). There was no significant association between maternal nutritional knowledge, WASH practices and wasting ($p = 0.224$, $p = 0.328$) respectively.

Conclusion: The study revealed elevated rates of stunting and overweight in children compared to the national average, while underweight prevalence was lower and wasting prevalence was similar.Therefore, it is crucial to tackle social and cultural issues and implement effective strategies to enhance maternal nutritional knowledge and WASH practices to mitigate malnutrition in the rural areas of Bangladesh.

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1. Introduction

Nutritional status is a measure of an individual's nutrition, determined by both the quality of nutrients they ingest and their body's capacity to effectively utilize these nutrients for metabolic requirements(1). The nutritional status of children is crucial for community

nutrition because it serves as a proxy indicator for determining the health of the population(2).A country's degree of development can be clearly seen in the health and nutrition of young children(3). From conception through adulthood, proper nutrition is essential for optimal growth, physical development, high levels of reproduction, and the ability of the body's immune system to function properly(4). In contrast, malnutrition comprises undernutrition (wasting, stunting, and underweight), vitamin and mineral deficiencies, obesity, and resultant non-communicable diseases linked to diet(5). Child malnutrition is a major global public health issue. In 2020, around 149 million children globally faced stunted growth, 40 million grappled with overweight problems, and 49 million suffered from wasting(6).Malnutrition is also a major health concern in low-income countries like Bangladesh. About 24% of children under 5 in Bangladesh are stunted, 11% are wasted, 22% are underweight, and 2.20% are overweight, reflecting a dual burden of malnutrition(7).A slight disparity exists in the rate of stunting among children in urban (22%) and rural (24%) areas(7). Malnutrition has severe impacts on the health and growth of children, resulting in a greater chance of sickness and death, hindered physicaland cognitive development, and decreased productivity in adulthood(8).Child malnutrition is affected by various factors, such as demographics, environment, and socioeconomic conditions(9). Maternal knowledge on infant and young child feeding (IYCF) and water, sanitation, and hygiene (WASH) practices plays a crucial role in ensuring optimal nutrition for young children, given that mothers are primary caregivers(9). In low-income countries, many mothers lack adequate knowledge and employ suboptimal IYCF practices, contributing to high malnutrition rates(9).The lack of sufficient knowledge about nutrition among women is a fundamental reason for the widespread occurrence of undernourishment and deficiencies in essential nutrients, as women's knowledge about nutrition directly influences their attitudes and eating habits(10–13). Mothers with a good grasp of nutrition and feeding methods were less likely to have malnourished children, while those with negative attitudes toward these practices were more prone to having malnourished children(14).Therefore, if a mother or caregiver enhances their knowledge, attitude, and practices related to child nutrition, it will lead to a substantial improvement in the child's nutritional well-being (15). In addition, a substantial body of evidence suggests that malnutrition is closely associated with poor WASH (water, sanitation, and hygiene) practices(16–18). However, it is concerning to note that the majority of individuals in developing countries continue to adhere to inadequate WASH practices(19,20).Notably, a study emphasized that children who dwell in dirty and unhealthy surroundings may develop malnutrition, even when they don't have diarrhea or intestinal worms (21). There is also a projection indicating that the enhancement of water, sanitation, and hygiene (WASH) practices could potentially save approximately 45% of child fatalities worldwide annually, which are directly linked to undernutrition(8,22). So, mothers who had more education, a higher income, and the ability to access healthcare services were more prone to having children with improvednutritional well-being(23).

While previous studies have investigated the impact of maternal nutritional knowledgeand Water, Sanitation, and Hygiene (WASH) behaviors on children's nutritional status in a general context, there is a notable gap in research regarding the rural population of the Cumilla district,which is located in the eastern part of Bangladesh and has a high prevalence of poverty and malnutrition(2,24). Therefore, it is crucial to conduct a study on the maternal nutritional knowledge and WASH practices of the rural residents of Cumilla district and

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understand how their knowledge and practices impact the nutritional well-being of their children.

The primary aim of this research is to assess the nutritional knowledge, child feeding practices, WASH behaviors of mothers and the nutritional status of children aged 6 to 59 months in the rural areas of Cumilla district. Additionally, the study intends to establish a connection between maternal nutritional knowledge, WASH practices, and the nutritional status of children in the 6-59 months age group.

The outcomes of this investigation could provide valuable insights into these two crucial factors that contribute to child malnutrition in Cumilla district. This study's significance lies in its potential to address the persistent issue of child malnutrition in rural Bangladesh, particularly within the Cumilla district. The results could be used to inform policymakers, public health professionals, and other stakeholders, enabling them to develop policies, strategies, effective interventions, and programs aimed at enhancing maternal knowledge, attitudes, and practices related to child nutrition, ultimately leading to improved child health and nutritional outcomes

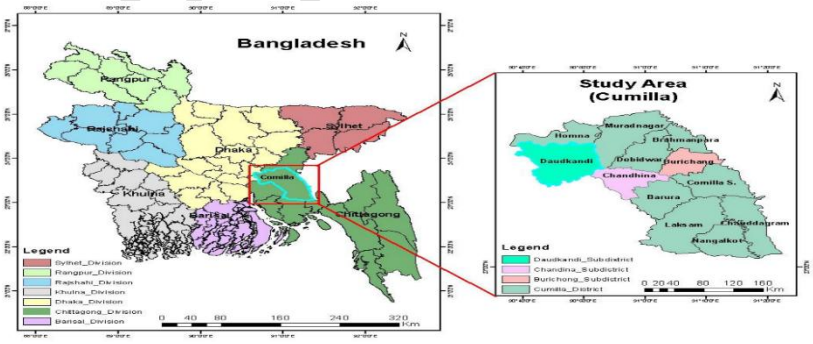
2. Methodology

2.1 Study design

The research adopted an analytical cross-sectional approach to gather data encompassing the anthropometric measurements of children, dietary habits, and sociodemographic profiles of households. Additionally, it explored the nutritional knowledge as well as the adherence to water, sanitation, and hygiene (WASH) practices among mothers residing in the rural regions of the Cumilla district.

2.2 Study area

Map 1 : Study area



The survey was conducted in Cumilla, a south-eastern district of Bangladesh. The study was carried out in only seven villages: Hatigara, Raicho, Kalir Basar, Anandopur, Bakhrabad, Joshpur, and Kumarpushkurini. The villages were chosen at random from a pool of rural villages, and the households were likewise chosen at random from the villages. However, it's important to note that the sample cannot be considered fully representative of the entire population

2.3 Study population

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The sample population selected for the study was women of childbearing age and their children (6-59 months) residing in study area. A total of 386 households were chosen randomly with mother and children pairs from 7 selected villages, who willingly agreed to participate in the study. The number of mothers and under 5 children were equal to household number. The study includes children aged six months to 59 months. Mothers from each household provided information and answered related questions.

2.4 Determination of Sample size

The sample size was determined using an estimated prevalence (p) of child malnutrition in Cumilla among children in Cumilla district(2), with a margin of error of 5%, and a confidence interval of 95% for which z = 1.96.

The minimum sample size was calculated using Cochran formula (25):

$N = z^2pq \div d^2$

Now, Sample size,

$$N = z^2pq \div d^2$$

$$= (1.96)^2 \times 0.4664 \times 0.5336 \div (0.05)^2$$

$$= 382.42$$

The estimated sample size was 382.42. However, 386 people in total were included in the study. In order to make up for the incomplete data, 4 additional respondents were recruited.

2.5 Data collection:

For data collection purposes, a validated structured questionnaire was used. The questionnaire was designed to gather information about anthropometry, nutritional knowledge, WASH practices and food frequency. The questionnaire was used in one-on-one interviews with participants to gather data.

2.7 Data Collection period

The survey was conducted from 10th December to 13th December, 2022

2.8 Anthropometry

Weighing scales were used to take the children's weights.Weight was measured down to the nearest 0.1kg when the subject was wearing minimal clothing.An infantometre was used to measure the recumbent lengths of children under the age of two. To the nearest 0.1 cm, measurements of length and height were taken.All anthropometric measures were carried out in accordance with the World Health Organization's best guidelines (26).

2.9 Anthropometric data processing

The child's anthropometric measurements were obtained by assessing their weight and height, which were then converted into nutritional status indicators known as z-scores. These indicators included weight-for-height (WHZ), weight-for-age (WAZ), and height-for-age

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(HAZ). The z-scores were determined based on a standard reference measurement using the ENA for SMART software. Specifically, the Height-for-Age z score (HAZ), Weight-for-Age z score (WAZ), and Weight-for-Height z score (WHZ) were calculated to evaluate the nutritional status of children under the age of five. The values of HAZ, WAZ, and WHZ were computed in accordance with the World Health Organization's 2006 growth standard(27). A child was considered underweight, stunted, or wasting if their weight-for-age, height-for-age, and weight-of-height Z-scores were all less than -2 standard deviations from the median value of reference(27,28). Children were categorized asunderweight (WAZ <-2 z-score), severely underweight (WAZ <-3 z-score); wasted (WHZ<-2 z score), severely wasted (WHZ <-3 z-score); stunted (HAZ <-2 z score), severely stunted (HAZ <-2 z-score)(27,28).

2.10 Measurements of WASH Parameters

A method comprised of 23 multiple-choice questions has been created by the researcher to evaluate women's nutritional knowledge. Every right answer was scored one, while every incorrect answer was received a score of zero.The score of WASH practices was arbitrarily divided into three categories: good WASH practices (17–23), average WASH practices (10–16), and poor WASH practices (0–10). WASH score was computed as the sum of the four individual indicators: drinking water score (0–6 points), sanitation score (0–3 points), hygiene score (0–5 points), and hand washing score (0–12 points), with a maximum obtainable score of 26 points (29)

2.11 Measurements of Nutritional Knowledge Parameters

Maternal knowledge about child health and nutrition was evaluated using a structured questionnaire adapted from the Food and Agriculture Organization (FAO) [6]. The questionnaire covered topics such as breastfeeding, colostrum, and the nutritional functions of specific foods.Their responses were rated on a scale from low, average, and high. A mother was asked 32 questions in all, with scores of 0–10, 11–21, 22–32 designating poor, average, and high nutritional awareness, respectively.

2.12 Data analysis

The collected data was appropriately coded and entered into a data entry software system. Data was then analyzed using the Statistical Package for the Social Sciences (SPSS) software (version 26.0 SPSS Inc. Chicago, II, USA). Descriptive analysis provided mean and standard deviation for continuous variables and frequency for categorical variables.

Z-scores were calculated using the ENA for SMART software and then transferred to an SPSS spreadsheet (version 26) for further analysis. Both descriptive and inferential statistics, such as independent sample t-tests, were performed. The association between selected independent and dependent variables was evaluated using a Chi-square test. Furthermore, the association between different levels of maternal nutritional knowledge (poor, average, and high) and the nutritional status of children was assessed through Chi-square tests, with a significance level set at α less than 0.05. Similarly, the association between different levels of WASH practices of mothers (poor, average, and good) and nutritional status was analyzed using Chi-square tests with the same significance level of α less than 0.05.

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2.13 Ethical approval/ informed consent

Before conducting the interviews, the informed consent of the participants was secured. The survey's participants voluntarily answered the questions.

3. Result

Table 1. Sociodemographic characteristics of mothers and children

Variables	Frequency	Percentage
Age of mothers (years)		
<20	59	15.3
20-33	309	80.1
>33	18	4.7
Mean ± SD	25.03 ± 4.42	
Age of children (months)		
6-11	101	26.2
12-24	103	26.7
25-35	59	15.3
>35	123	31.9
Mean ± SD	26.43 ± 15.06	
Sex of children		
Male	184	47.7
Female	202	52.3
Occupation of mother		
Housewife	328	85.0
Service holder	17	4.4
Student	15	3.9
Others	26	6.7
Mother’s education level		
Upto primary	46	11.9
Upto secondary	251	65.0
Higher secondary	61	15.8
Graduation	24	6.2
Illiterate	4	1.0
Household income (Thousands)		
<20	143	37.0

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20-50	181	46.9
>50	62	16.1
Mean ± SD	31917.10 ± 24036	
Household food expenditure (Thousands)		
<10	221	57.3
>10	165	42.7
Mean ± SD	11885 ± 6338	

3.1. Sociodemographic characteristics of mothers and children

As shown in Table 1, 80.1 % of mothers were within the age group of 20–33 years. About 32 of the children were within the age group of 35-59 months and 26% were within 12-24 months. Nearly half of the children were male and remaining were female. The majority of the respondents, nearly two-thirds of the total population (65%), had attended secondary education. More than four-fifths (85%) of the mothers were housewives, and nearly half of the households had an average monthly income of BDT 20–50,000. While more than half of the households (57.3%) had a food expenditure of less than 10,000 BDT

Table-2: Nutritional Knowledge of mothers

	Frequency	Percent
Low	61	15.8
Average	279	72.3
High	46	11.9
Total	386	100.0

3.2. Nutritional knowledge of mothers

The study findings revealed that 72.3% of interviewed mothers possessed average nutritional knowledge. Additionally, less than a quarter (11.9%) demonstrated high nutritional knowledge, while 15.8% of the surveyed mothers exhibited a low level of understanding of nutrition (Table 2).

Table-3: WASH practice scores of mothers

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	Frequency	Percent
Poor	12	3.1
Average	151	39.1
Good	223	57.8
Total	386	100.0

3.3 WASH practice scores of mothers

Table 3 presents an overview of WASH (Water, Sanitation, and Hygiene) practice scores among mothers. It revealed that a significant majority of mothers, approximately 57.8%, exhibited good washing practices. On the other hand, 39.1% had average WASH practices, while only a small proportion, 3.1%, had poor WASH practices.

Table-4: Nutritional status of children

	Frequency	Percent
Weight for age (WAZ)		
Severely underweight	20	5.2
Moderately underweight	45	11.7
Normal	291	75.4
Overweight	30	7.8
Height for age (HAZ)		
Severely stunted	72	18.7
Moderately stunted	77	19.9
Normal	237	61.4
Weight for height (WHZ)		
Severely wasted	21	5.4
Moderately wasted	25	6.5
Normal	340	88.1

3.4 Nutritional status of under-five children

A total 386 of under 5 children (male 184, female 202) were found in selected 386 households. Around 38.6% of children were identified as stunted. While the prevalence of wasting, underweight, and overweight was 11.9%, 16.9%, and 7.8% respectively. While 18.7% of the children were severely stunted, 5.4% were severely wasted and 5.2% were severely underweight. Mean (SD) age, height, and weight were 26.43 (5.06) months, 82.19 (12.96) centimeter, and 11.72 (3.68) kg respectively whereas mean anthropometry (weight,

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height) was greater among boys as compared to girls but not significantly. The stunting rate was very high than other forms of malnutrition. The prevalence of underweight and wasting were comparatively higher among female children (17.9% vs 15.7%) and (13.9% vs 10.3%). In contrast, prevalence of overweight and stunting were higher in male children (8.7% vs 6.9%) and (42.9% vs 34.7%).

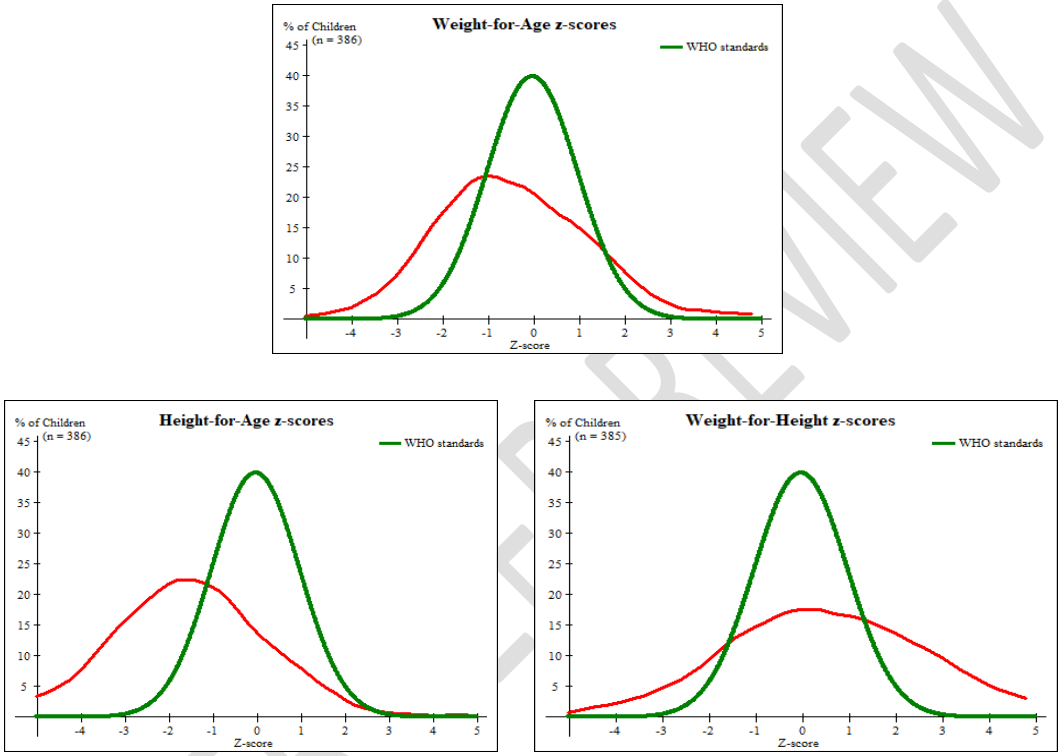

Figure 1: WAZ, HAZ and WHZ of the children compare to WHO standards

Table-5: Association between maternal nutritional knowledge and child nutritional status

Variable /Category	Underweight status		F/x2 (p-value)
Maternal nutritional knowledge	**Normal**	**Underweight**	
Low	47 (77)	14 (23)	8.9250 (0.012)
Average	229 (82)	50 (18)	
High	45(97.8)	1 (2.2)	
Stunting status			
Maternal nutritional knowledge	**Normal**	**Stunted**	
Low	21 (34.4)	40 (65.6)	26.654 (0.001)

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Average	179 (64)	100 (36)	
High	37 (80.4)	9 (19.6)	
Wasting status			
Maternal nutritional knowledge	**Normal**	**Wasted**	
Low	53 (86.8)	8 (13.2)	2.294 (0.224)
Average	242 (86.7)	37 (13.3)	
High	44 (95.6)	2 (4.4)	

3.5. Association between maternal nutritional knowledge and nutritional status of the children

A chi-square analysis was conducted to examine the relationship between maternal nutritional knowledge and the nutritional status of their children. Statistically significant associations were found between maternal nutritional knowledge and stunting (p = 0.001) as well as between maternal nutritional knowledge andunderweight (p = 0.012). These p-values are considered acceptable in the context of health-related research. However, no significant association was observed between maternal nutritional knowledge and wasting (p = 0.224).

Table-6: Association between maternal wash score and child nutritional status

Variable /Category	Underweight status		F/x2 (p-value)
Maternal wash score	**Normal**	**Underweight**	
Poor	8 (66.6)	4 (33.4)	3.922 (0.141)
Average	122 (80.8)	29 (19.2)	
Good	191 (85.6)	32 (14.4)	
Stunting status			
Maternal wash score	**Normal**	**Stunted**	
Poor	7 (58.3)	5 (41.7)	9.053 (0.011)
Average	79 (52.3)	72 (47.7)	
Good	151 (67.7)	72 (22.3)	
Wasting status			
Maternal wash score	**Normal**	**Wasted**	
Poor	9 (75)	3 (25)	2.228 (0.328)
Average	135 (89.4)	16 (10.6)	
Good	195 (87.4)	28 (12.6)	

3.6 Association between maternal WASH score and nutritional status of the children

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A chi-square analysis revealed a statistically significant relationship between maternal WASH score and stunting ($p = 0.011$). However, no significant associations were found between maternal WASH score and underweight ($p = 0.141$) or between maternal WASH score and wasting ($p = 0.328$).

4. Discussion

The results of the current study revealed critical insights into the complex interplay between maternal factors and child health outcomes, indicating a noteworthy connection between the nutritional status of children, specifically in terms of underweight and stunting, and both maternal nutritional knowledge and WASH practices. However, it was observed that wasting did not exhibit a significant association with either of these factors.

The mean age of the mothers in this study was 25.03 ± 4.42 years, with 80.1% falling within the 20–33 years age range. This finding aligns with a study conducted in Nigeria, where they found a mean maternal age of 25.6 ± 4.16 years, with the majority (93.0%) falling within the reproductive age range(30).Mean age of the children were 26.43 ± 5.06 months in this study that is similar to a study conducted in Lahor, Pakistan(31).

The study revealed that 65% of mothers had a secondary education, slightly higher than a study in Ghana (50%), and surpassing results in Egypt(32,33). Geographic variations might account for these differences. Bangladesh's functional literacy rate for females aged 11-45 in 2023 is 73.25%(34). While our study didn't find a significant correlation, other research in diverse settings has consistently shown the impact of parental education on the nutritional status of children under five(35,36).The study reveals that 72.3% of surveyed mothers possess average nutritional knowledge, while 11.9% have high knowledge and 15.8% exhibit a low level of nutritional understanding. This distribution contrasts with a different study reporting 40% with average knowledge, 17% with high knowledge, and 43% with low knowledge(31). Conversely, a separate study found 61.5% of caregivers demonstrating average nutritional knowledge, aligning closely with our findings (37). Notably, our study indicates a positive association between education and nutritional knowledge, with 65% of mothers having secondary education and 72% possessing average nutritional knowledge(38,39). Recognizing the pivotal role of nutrition awareness, especially in children, emphasizes the need to enhance caregiver or maternal nutritional knowledge in programs aimed at promoting nutrition(40,41).In our study, around 58% of mothers demonstrated good WASH practices, resembling findings from Nepal where 60% had similar practices (42). Another study in Nepal's Jhapa district reported 76.92% of respondents possessing good WASH knowledge (43). Recognizing the global impact, poor WASH practices, linked to diarrhea-associated infections, contribute significantly to undernutrition in children under five, accounting for 50% of cases worldwide (44). Our study revealed stunting, underweight, and wasting prevalence of 38.6%, 16.9%, and 11.9%, respectively. These rates were somewhat lower than reported in Afghanistan but higher than those in Ghana(37,45). Stunting prevalence notably exceeded the Bangladesh Demographic and Health Survey

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(BDHS) rate of 24%, while wasting aligned closely, and underweight was lower(7). A local Cumilla study reported rates of 40% for stunting, 31.2% for underweight, and 18.9% for wasting, with stunting resembling our findings. Another study in Hidabu Abote District reported 47.6% for stunting, 30.9% for underweight, and 16.8% for wasting, with wasting similar to our study(2).Compared to Gumbrit and Gambia studies, our stunting rates were higher(46). Additionally, male children in our study exhibited higher rates of severe underweight (5.4%), severe stunting (22.3%), and severe wasting (6%) compared to females, differing from a study in Nigeria where female children had a higher rate of wasting(30). This study reveals significant associations between maternal nutritional knowledge and key child health indicators—underweight and stunting. Consistent with previous research, a correlation exists between a child's nutritional status and their mother's knowledge(31). Another study found a positive association between children's stunting and maternal nutritional knowledge and practices (47). In Indonesia, a separate study confirmed a significant correlation between mothers' understanding of balanced nutrition and the well-being of elementary school children (48). These collective findings emphasize the crucial role of maternal nutrition knowledge in empowering mothers to adopt effective measures against child malnutrition (49).The study revealed a significant association between maternal Water, Sanitation, and Hygiene (WASH) practices and stunting ($p = 0.011$). However, no significant associations were found between maternal WASH practices and underweight ($p = 0.141$) or wasting ($p = 0.328$). This aligns with other studies, indicating a significant association between children's stunting status and mothers' WASH knowledge and practices, with p-values below 0.05 in both cases(47,50).According to a UNICEF report, inadequate hygiene practices contribute to 50% of underweight cases in both mothers and children, primarily due to the link between diarrhea and malnutrition(50). In the developing world, preventable illnesses and deaths often result from insufficient sanitation, lack of clean water access, and poor hygiene practices, leading to 1.9 million annual deaths in children under five due to diarrheal diseases related to WASH conditions(51). While it's widely acknowledged that malnourished children often experience frequent diarrhea, the intricate connection between diarrhea and malnutrition is complex. Research from various nations suggests that five or more episodes of diarrhea in the first two years of life may contribute to 25% of stunting in infants under 24 months of age(52–54). The link between open defecation and child stunting is evident in 112 districts of India (18). Increased access to clean water and improved sanitation is consistently associated with a reduction in stunting (55). Mothers or caregivers practicing handwashing with soap before meals or after using the toilet correlated with a 15% decrease in the risk of stunting (56). Global analysis of 171 Demographic and Health Surveys revealed a 27% reduced risk of stunted growth in children with access to improved sanitation facilities (57). An observational study in rural Bangladesh found that children in improved sanitation and hygiene environments were taller and had lower levels of stunting compared to those in unsanitary conditions (58). Optimal handwashing practices in India were linked to a reduced risk of stunted growth (56). Comparing children in West Bengal, India, and Bangladesh of similar socio-economic status, where open defecation was less common, showed that Bangladeshi children were taller (59). Improved access to clean water was associated with a lower risk of diarrhea and reduced mild or severe stunted growth (57).

5. Conclusion

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The study revealed that most of the participants had attended secondary school. However, the majority of them had only average levels of nutritional knowledge. The study found a notably higher prevalence of stunting compared to the Bangladesh Demographic and Health Survey (BDHS), indicating a pressing issue of chronic malnutrition among the children studied. Wasting rates were similar to BDHS findings, while underweight rates were lower. Additionally, gender disparities were evident, with higher rates of underweight and wasting among female children and increased rates of overweight and stunting among male children. The research identified significant associations between maternal nutritional knowledge and child malnutrition, emphasizing the importance of maternal understanding of nutrition for child well-being. Furthermore, it highlighted a significant link between maternal WASH (Water, Sanitation, and Hygiene) scores and child stunting, underscoring the role of proper WASH practices in child health and nutrition. These findings have the potential to address child malnutrition in rural Bangladesh, offering valuable insights for policymakers and public health professionals to develop effective strategies and interventions improving child health and nutrition in the Cumilla district.

References

1. Amosu AM, Degun AM, Atulomah NOS, Olanrewju MF. A Study of the Nutritional Status of Under-5 Children of Low-Income Earners in a South-Western Nigerian Community. 2011;3(6):578–85.
2. Jubayer A. Prevalence and Determinants of Child Health and Nutritional Status in Selected Areas of Cumilla District in Bangladesh Prevalence and Determinants of Child Health and Nutritional Status in Selected Areas of Cumilla District in Bangladesh Introduction : 2022.
3. authorPerson:Molina H. The Review of health and nutrition indicators in early childhood. 2012.Available from: https://unesdoc.unesco.org/ark:/48223/pf0000215737
4. To N. I NTRODUCTION TO N UTRITION Senior Lecturer in Biochemistry. Vol. 3rd Editio, Taylor & Francis. 2002. 450 p. Available from: https://www.taylorfrancis.com/books/mono/10.1201/9781420055962/introduction-nutrition-metabolism-david-bender-david-bender
5. Fact sheets - Malnutrition. Available from: https://www.who.int/news-room/fact-sheets/detail/malnutrition
6. 2020 Global Nutrition Report: Action on equity to end malnutrition - World | ReliefWeb. Available from: https://reliefweb.int/report/world/2020-global-nutrition-report-action-equity-end malnutrition?gclid=Cj0KCQiAjMKqBhCgARIsAPDgWlw696fV4Hg5UgyVR4LjFgrH_EMyXbr3z9kLV31kOo1wMdR9ZgB8uBoaAqobEALw_wcB
7. NIPORT and ICF. Bangladesh Demographic Health Survey 2022: Key Indicator Report. 2023;84.
8. Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, Onis M De, et al. Maternal and Child Nutrition 1 Maternal and child undernutrition and overweight in low-income and middle-income countries. 2011;

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9. Menon P, Rawat R, Ruel M. Bringing rigor to evaluations of large-scale programs to improve infant and young child feeding and nutrition : The evaluation designs for the Alive & Thrive initiative. 2014;34(3):195–211.

10. De Silva DPM, Ekanayake EMN, Gurusinghe MI, Perera PPR. Assessment of Nutritional Status and Nutritional Knowledge in Female Undergraduates Residing in Hostels of University of Sri Jayewardenepura, Sri Lanka. 2015;2015. Available from: http://dr.lib.sjp.ac.lk/handle/123456789/4535

11. Nelson H. Factors influencing household nutritional status in relation to increasing food prices in Kandy, Sri Lanka. 2011;

12. Rathnayake I, Weerahewa J. An Assessment of Intra-household Allocation of Food: A Case Study of the Urban Poor in Kandy. Sri Lankan J Agric Econ. 2011;4(0):95.

13. Gracey D, Stanley N, Burke V, Corti B, Beilin LJ. Nutritional knowledge , beliefs and behaviours in teenage school students. 1996;(December 2013).

14. Haque S, Al Rafi DA, Zaman N, Salman M, Al Noman MA, Nazmul Hoque M, et al. Nutritional status of under-five aged children of ready-made garment workers in Bangladesh: A cross-sectional study. PLoS One. 2023 Apr 1;18(4). Available from: /pmc/articles/PMC10101446/

15. Angeles-Agdeppa I, Monville-Oro E, Gonsalves JF, Capanzana M V. Integrated school based nutrition programme improved the knowledge of mother and schoolchildren. Matern Child Nutr. 2019;15(S3).

16. Prüss-Üstün A, Bos R, Gore F, Bartram J. Safer Water, Better Health: Costs, benefits and sustainability of interventions to protect and promote health. 2008;(January 2008). Available from: http://whqlibdoc.who.int/publications/2008/9789241596435_eng.pdf

17. Langford R, Lunn P, Panter-Brick C. Hand-washing, subclinical infections, and growth: a longitudinal evaluation of an intervention in Nepali slums. Am J Hum Biol. 2011 Sep [cited 2023 Nov 13];23(5):621–9.

Available from: https://pubmed.ncbi.nlm.nih.gov/21630368/

18. Spears D. How Much International Variation in Child Height Can Sanitation Explain? [Internet]. Policy Research Working Papers. The World Bank; 2013. 55 p. Available from: https://doi.org/10.1596/1813-9450-6351

19. Lomazzi M, Borisch B, Laaser U. The Millennium Development Goals: experiences, achievements and what's next. 2014;9716.

20. Progress on Sanitation and Drinking Water: 2015 Update and MDG Assessment - World | ReliefWeb. Available from: https://reliefweb.int/report/world/progress-sanitation-and-drinking-water-2015-update-and-mdg-assessment?gclid=Cj0KCQiAjMKqBhCgARIsAPDgWlxJ9YR-TwURh1LDVUPd4A7LTCHMMQErwliFz6-6OaLUlEEUZLp5T84aAlh0EALw_wcB

21. Humphrey JH. Child undernutrition , tropical enteropathy , toilets , and handwashing. Lancet. 2009;374(9694):1032–5. Available from: http://dx.doi.org/10.1016/S0140-6736(09)60950-8

22. Curtis V, Cairncross S. Reviews Effect of washing hands with soap on diarrhoea risk in the community : a systematic review. 44(0):275–81.

UNDER PEER REVIEW

23. Haque S, Al Rafi DA, Zaman N, Salman M, Al Noman MA, Hoque MN, et al. Nutritional status of under-five aged children of ready-made garment workers in Bangladesh: A cross-sectional study. PLoS One. 2023;18(4):1–18. Available from: https://doi.org/10.1371/journal.pone.0284325

24. Malnutrition in Bangladesh in context to District Comilla | The Lawyers & Jurists. Available from: https://www.lawyersnjurists.com/article/malnutrition-bangladesh-context-district-comilla/

25. Israel, G.D. (1992) Determining Sample Size. University of Florida Cooperative Extension Service, Institute of Food and Agriculture Sciences, EDIS, Florida. - References - Scientific Research Publishing. Available from: https://www.scirp.org/(S(czeh2tfqyw2orz553k1w0r45))/reference/ReferencesPapers.aspx?ReferenceID=1888298

26. WHO child growth standards: training course on child growth assessment. Available from: https://www.who.int/publications/i/item/9789241595070

27. WHO child growth standards: length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: methods and development. Available from: https://www.who.int/publications/i/item/924154693X

28. WHO Multicentre Growth Reference Study (MGRS). Available from: https://www.who.int/tools/child-growth-standards/who-multicentre-growth-reference-study

29. Reddy VB, Kusuma YS, Pandav CS, Goswami AK, Krishnan A. Water and Sanitation Hygiene Practices for Under-Five Children among Households of Sugali Tribe of Chittoor District, Andhra Pradesh, India. J Environ Public Health;2017. Available from: https://pubmed.ncbi.nlm.nih.gov/28642797/

30. Jemide JO, Nkechi Ene-Obong H, Effiong Edet E, Emmanuel Udoh E, Julie Omaghomi Jemide C. Association of Maternal Nutrition Knowledge and Child Feeding Practices with Nutritional Status of Children in Calabar South Local Government Area, Cross River State, Nigeria. Int J Home Sci. 2016;2(1):293–8. Available from: https://www.researchgate.net/publication/326207982

31. Kerr D, Devine W. Nutritional status. Dial Transplant. 1994;23(5):226.

32. Sackitey GL. Knowledge, Attitude and Perception on Prevention of Home Accidents among Mothers who Came to the Pediatrics Department of the Korle-Bu Teaching Hospital. J Heal Educ Res Dev. 2018;06(01):1–10.

33. Ibrahem ALR, Mohamed AM, Nora AK, Reham SED. Knowledge, attitude and practice of rural mothers towards home injuries among children under 5 years of age in Menouf District- Menoufia Governorate, Egypt. Menoufia Med J 29. 2016;29:1033–9. Available from: http://www.mmj.eg.net

34. BBS: Functional literacy rate (7+above years) in Bangladesh 62.92%. Available from: https://www.dhakatribune.com/bangladesh/education/319301/bbs-functional-literacy-rate-7-above-years-in

35. Mshida HA, Kassim N, Mpolya E, Kimanya M. Water, sanitation, and hygiene practices associated with nutritional status of under-five children in semi-pastoral communities Tanzania. Am J Trop Med Hyg. 2018;98(5):1242–9.

UNDER PEER REVIEW

36. van Cooten MH, Bilal SM, Gebremedhin S, Spigt M. The association between acute malnutrition and water, sanitation, and hygiene among children aged 6–59 months in rural Ethiopia. Matern Child Nutr. 2019;15(1):1–8.

37. Forh G, Apprey C, Frimpomaa Agyapong NA. Nutritional knowledge and practices of mothers/caregivers and its impact on the nutritional status of children 6–59 months in Sefwi Wiawso Municipality, Western-North Region, Ghana. Heliyon. 2022;8(12):e12330. Available from: https://doi.org/10.1016/j.heliyon.2022.e12330

38. Debela BL, Demmler KM, Rischke R, Qaim M. Maternal nutrition knowledge and child nutritional outcomes in urban Kenya. Appetite. 2017;116:518–26. Available from: http://dx.doi.org/10.1016/j.appet.2017.05.042

39. Fadare O, Amare M, Mavrotas G, Akerele D, Ogunniyi A. Mother's nutrition-related knowledge and child nutrition outcomes: Empirical evidence from Nigeria. PLoS One. 2019;14(2):1–17.

40. Ongosi A. Nutrient Intake and Nutrition Knowledge of Lactating Women (0-6 months postpartum) in a Low Socio-Economic Area in Nairobi, Kenya by ANITA NYABOKE ONGOSI Submitted in partial fulfilment for the requirement of MASTER OF SCIENCE DEGREE IN HUMAN NUTRITION in. Univ Prectoria. 2010;(December):1–198. Available from: https://repository.up.ac.za/bitstream/handle/2263/25935/dissertation.pdf?sequence=1

41. Joanna Minkiewicz, Jody Evans, Kerrie Bridson dan FM. Deakin Research Online Online. 2007, Interrelat between Innov Mark Orientat SMEs, Manag Res news, vol 30, no 12, pp 878-891. 2007;30(12):878–91.

42. Sah J, Kumar Shah S, Kumari Sah R, Kumar Sah P, Kumar Sah J, chiluwal S. Assessment of the Knowledge, Attitude and Practice Regarding Water, Sanitation and Hygiene among Mothers of Under-five Children in Rural Households of Saptari District, Nepal. Am J Public Heal Res. 2017;5(5):163–9. Available from: http://pubs.sciepub.com/ajphr/5/5/5

43. Sah R, Baral D, Ghimire A, Pokharel P. Study on knowledge and practice of water and sanitation application in Chandragadhi VDC of Jhapa District. Heal Renaiss. 2014;11(3):241–5.

44. Tarnoff C. U.S. Agency for International Development (USAID): Background, Operations, and Issues. 2015;63.

45. To KG, Lee JK, Nam YS, Trinh OTH, Do D Van. Hand washing behavior and associated factors in Vietnam based on the Multiple Indicator Cluster Survey, 2010–2011. Glob Health Action. 2016 [cited 2023 Oct 15];9(1):29207. Available from: https://www.tandfonline.com/doi/abs/10.3402/gha.v9.29207%40zgha20.2016.9.issue-s1

46. Akmatov MK. Child abuse in 28 developing and transitional countries—results from the Multiple Indicator Cluster Surveys. Int J Epidemiol. 2011 Feb 1 [cited 2023 Oct 15];40(1):219–27. Available from: https://dx.doi.org/10.1093/ije/dyq168

47. Kuddus MA, Sunny AR, Sazzad SA, Hossain M, Rahman M, Mithun MH, et al. Sense and Manner of WASH and Their Coalition With Disease and Nutritional Status of Under-five Children in Rural Bangladesh: A Cross-Sectional Study. Front Public Heal. 2022;10(May):1–12.

UNDER PEER REVIEW

48. Prasetya G, Khomsan A. The Knowledge, Attitude and Practice of Mothers and Children on the Indonesian Dietary Guidelines and the Relationship with Children's Nutritional Status. J Gizi Dan Pangan. 2021;16(1):55–64.

49. Indris A, Shaleka D, Ashenafi M. Child nutritional status , mothers ' nutritional knowledge and practice and Household food security status in Tehuledere Woreda , South Wollo , Ethiopia. 2021;44(2):161–71.

50. Improving Child Nutrition: The achievable imperative for global progress - UNICEF DATA. Available from: https://data.unicef.org/resources/improving-child-nutrition-the-achievable-imperative-for-global-progress/

51. UNICEF. UNICEF East Asia and Pacific Regional Office (EAPRO) Guide for Practical Joint Actions Nutrition -WASH Toolkit. 2016. 1–88 p. Available from: https://www.unicef.org/eapro/WASH_Nutrition_Toolkit_EAPRO_Final_w_ISBN_web_version_7Nov2016.pdf

52. Cairncross S, Hunt C, Boisson S, Bostoen K, Curtis V, Fung ICH, et al. Water, sanitation and hygiene for the prevention of diarrhoea. Int J Epidemiol. 2010 Apr 1;39(suppl_1):i193–205. Available from: https://dx.doi.org/10.1093/ije/dyq035

53. Bado AR, Susuman AS, Nebie EI. Trends and risk factors for childhood diarrhea in sub-Saharan countries (1990-2013): Assessing the neighborhood inequalities. Glob Health Action. 2016;9(1).

54. Nuhu S, Mpambije CJ. Water and Sanitation Services in Informal Urban Settlements and their Implications to Peoples Health in Tandale, Dar es Salaam Tanzania. Int J Res Humanit Soc Stud. 2016;3(7):64–74.

55. Nutrition-WASH Toolkit – Guide for Practical Joint Actions | UNICEF East Asia and Pacific. Available from: https://www.unicef.org/eap/reports/nutrition-wash-toolkit-guide-practical-joint-actions

56. Rah JH, Cronin AA, Badgaiyan B, Aguayo V, Coates S, Ahmed S. Household sanitation and personal hygiene practices are associated with child stunting in rural India: A cross-sectional analysis of surveys. BMJ Open. 2015;5(2).

57. Fink G, Günther I, Hill K. The effect of water and sanitation on child health: evidence from the demographic and health surveys 1986-2007. [cited 2023 Oct 15]; Available from: https://academic.oup.com/ije/article/40/5/1196/658066

58. Lin A, Arnold BF, Afreen S, Goto R, Huda TMN, Haque R, et al. Household environmental conditions are associated with enteropathy and impaired growth in rural bangladesh. Am J Trop Med Hyg. 2013;89(1):130–7.

59. Ghosh A, Gupta A, Spears D. Are Children in West Bengal. 2014;49(8):21–4.

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