

ORIGINAL ARTICLE

Determinants of Nutritional Status of Reproductive Age Women in Semi-Urban Bangladesh: A Community-Based Cross-Sectional Study

Md. Jarif Mahbub^{1,2*}, Sanjida Nur-A Afrin¹, Hasin Rahman¹

1. Institute of Nutrition and Food Science (INFS), University of Dhaka, Dhaka-1000, Bangladesh

2. Department of Nutrition and Food Engineering, Faculty of Health and Life Sciences, Daffodil International University, Daffodil Smart City (DSC), Birulia, Savar, Dhaka-1216, Bangladesh

ARTICLE INFO

Keywords:

Malnutrition
Nutrition
Obesity
BMI
Bangladesh

ABSTRACT

Background: Women aged 15-49 years are vulnerable to malnutrition, including undernutrition and overnutrition. This age group is crucial for maternal health and child development. The study aimed to assess the nutritional status of women aged 15-49 years in semi-urban Bangladesh and to identify its determinants.

Methods: In a cross-sectional survey of 391 women, data on demographics, socioeconomic status, anthropometry, water, sanitation, and hygiene practices were collected. Nutritional status was categorized using body mass index (BMI) classification.

Results: The mean BMI of the participants was 24.5 ± 3.8 . Only 5.9% were underweight and 49.4% were normal weight. However, 35.3% were overweight and 9.5% were obese. Regression analysis showed that formal education up to the secondary level and handwashing with only water or water with ash or soil were determinants of maternal nutritional status. Women with secondary education were 4.2 times more likely to be adequately nourished than women with no education. Women who practiced handwashing with only water or water with ash or soil were 78% and 63% more likely to be malnourished, respectively, than women who used soap along with water.

Conclusion: This study highlighted the shifting nutritional landscape among women in semi-urban Bangladesh, with increasing rates of overweight and obesity. Formal education and handwashing practices are important determinants of maternal nutritional status. Multifaceted interventions are needed to address these challenges and improve maternal health in this population.

*Corresponding author:

Md. Jarif Mahbub, MSc;
Rafiq-302, Amar Ekushey Hall,
University of Dhaka,
Dhaka-1000, Bangladesh.
Tel: +8801521416218

Email: jarifmahbub@gmail.com

Received: October 19, 2023

Revised: January 20, 2024

Accepted: February 1, 2024

Please cite this article as: Mahbub MJ, Afrin SNA, Rahman H. Determinants of Nutritional Status of Reproductive Age Women in Semi-Urban Bangladesh: A Community-Based Cross-Sectional Study. Int J Nutr Sci. 2024;9(1):30-38. doi: 10.30476/IJNS.2024.100304.1270.

Introduction

Malnutrition is a pressing public health issue associated with a heightened risk of morbidity and mortality (1). Particularly in South Asian

developing countries, undernutrition among women of reproductive age is a cause for concern (2). Women play a pivotal role as child-bearers and caregivers, making their health status paramount

for the well-being of household members (3-5). While Bangladesh has seen progress in addressing undernutrition, the pace still remains slow. Moreover, a double burden of malnutrition, characterized by a decline in underweight, but a rise in overweight and obesity, poses a significant nutritional and health challenge. Recent data from the Bangladesh Demographic and Health Survey (BDHS) illustrated this shift, with underweight rates decreasing from 33% in 2004 to 12% in 2018, while the percentage of overweight or obese individuals increased from 17% in 2004 to 49% in 2018 (6).

Despite economic growth and improvements in socioeconomic and healthcare aspects, Bangladesh continues to grapple with high malnutrition rates (6). Existing nutrition programs have not yielded substantial improvements in nutritional outcomes, underscoring the need for a more strategically structured nutrition policy (7). Among those most vulnerable to malnutrition are women of reproductive age, influenced by various social and biological factors (8). Identifying the geographical and socioeconomic determinants of maternal nutrition can be a crucial initial step in addressing malnutrition (9). While some studies have explored the prevalence, patterns, and contributing factors of women's malnutrition in a broader context, there remains a dearth of research on the determinants of women's nutritional status in semi-urban areas in Bangladesh (10-14).

Factors influencing women's nutritional status, as revealed in numerous studies, include education, family income, rural residence, age at marriage, age at first delivery, inter-birth interval, nutritional knowledge, working hours, gender disparities, hygiene and sanitation practices, dietary habits, family size, and nutrient intake (1-3, 5, 9-14, 15-20).

In this study, we endeavor to explore the geographical and socioeconomic determinants of women's nutritional status in a semi-urban area of Bangladesh. Our research aimed to bridge knowledge gaps by predicting the determinants regarding undernourishment and nourishment of the women (15-49 years) of the semi-urban area based on socioeconomic, demographic, and health factors. This endeavor is anticipated to inform policymakers in crafting effective health policies and strategies, ultimately contributing to a substantial reduction in malnutrition and an enhancement in the nutritional well-being of women of reproductive age.

Materials and Methods

We designed a community-based cross-sectional survey to assess women's nutritional status in Cumilla, a southeastern district of Bangladesh,

aligning with the study's objectives. The research was conducted across five villages in Cumilla Sadar South Upazilla including Kalir Bazar, Ujirpur, Joshpur, Gohinkhali, and Joypur. Households were randomly selected based on specific inclusion criteria. Each selected household met the following criteria as having ever married woman of reproductive age (15-49 years) and providing consent to participate in the survey. The households that did not meet the aforementioned criteria were excluded from the study. A total of 391 households were enrolled, corresponding to the number of women surveyed, as one married female (15-49 years) was selected from each household for anthropometric measurements. The minimum sample size was calculated using the following widely used formula of

$$n = \frac{t^2 \times p(1 - p)}{m^2};$$

where n is the required sample size, t is the statistical uncertainty chosen=1.96 at a confidence level (CI) of 95%, p is the estimated proportion of malnourished women in the rural area of Bangladesh=58.8% (6) and m is the margin of error at 5% (standard value of 0.05). This calculation yielded a minimum required sample size of 372.

A team of thirty-three final-year undergraduate students from the Institute of Nutrition and Food Science (INFS), University of Dhaka, diligently collected the data for this study. Before commencing data collection, they underwent rigorous training over seven days, led by an experienced professor from the INFS. Throughout the four-day data collection period, each student conducted interviews with only three respondents per day, ensuring the highest possible data quality. Consequently, each student recorded a total of 12 interviews over the four days, resulting in a combined 396 interviews. To maintain the accuracy and reliability of the collected data, a dedicated team of three members supervised and inspected the enumerators throughout the entire data collection process. The data collection occurred from February 24 to 27, 2020. In the final analysis, this study incorporated data from 391 interviews, as 5 interviews were excluded due to missing data.

Body Mass Index (BMI) is a very simple index of weight-for-height that is commonly applied to classify the state of being underweight, overweight, and obese in adults. BMI was used to ascertain the nutritional status of the women belonging to the study population. The term indicates the ratio of the body weight in kilograms to the square of the height in meters (kg/m²). The classification of nutritional status based on BMI was as follows: (i) Underweight (BMI<18.50), (ii) Normal (BMI ranging from 18.50

to 24.99), (iii) Overweight (BMI ranging from 25 to 29.99), and (iv) Obese ($BMI \geq 30.00$) (21). In this study, two categories, “malnourished” ($BMI < 18.50$) and “nourished” ($BMI \geq 18.50$) were used to categorize the nutritional status of the study population (14). Women’s weight was determined using electronic scales (TANITA KD 182) with a precision of approximately 0.1 kg. Height measurements were taken using a non-extensible, inflexible measuring tape with an accuracy of 0.1 cm.

This study aimed to investigate the factors associated with the nutritional status of women. In this context, nutritional status served as the outcome variable (dependent variable). The nutritional status was categorized as “malnourished” and “nourished” based on BMI measurements. To identify potential determinants of women’s nutritional status (independent variables), a comprehensive literature review was conducted. Some of the potential factors were self-selected. Subsequently, the following variables were selected from the dataset for examination as possible determinants of maternal nutritional status including age, religion, level of formal education, total monthly household income, monthly household expenditure on food, family size, age at first marriage, and the method of handwashing after defecation.

The analysis for this study was conducted using IBM SPSS Statistics software (Version 26, Chicago, IL, USA). Initially, descriptive analyses, including frequency distribution and percentage calculations were performed to provide insights into the socio-economic, demographic, and water, sanitation, and hygiene (WASH) practices of women aged 15-49 years. As all explanatory variables were categorical, contingency tables were constructed to examine the relationship between different categories of these variables and the outcome variable. To evaluate the

statistical significance of the univariate associations, the χ^2 test was employed. All tests were two-tailed, and a p value of < 0.25 was considered statistically significant. To comprehensively assess the impact of multiple independent variables on the categorical dependent variable, a multivariate logistic regression model was employed. Explanatory variables that exhibited no association with the outcome ($p \geq 0.25$) were excluded from the multivariate logistic regression model. The analysis provided estimates for the crude odds ratio (cOR), adjusted odds ratio (aOR), and their respective 95% confidence intervals (CI). A p value of < 0.05 was deemed statistically significant in this context. The flow diagram of the study has been depicted in Figure 1.

Results

Table 1 demonstrates demographic and socioeconomic characteristics of the respondent women of this study, while a total of 391 women were selected from individual households. The majority of the participants were identified as Muslim (96.9%), with a smaller percentage being Hindus (3.1%). The women in the study varied in age, but for this research, only women within the reproductive age range of 15 to 49 years were included. Among the 391 respondents, the average age was 28.4 years with a standard deviation of 6.1 years. The largest proportion of women fell within the 20 to 29 years age group (57.8%), while the smallest group comprised those aged 15 to 19 years (3.3%). Regarding household leadership, only 16 households (4.1%) had a female head of the family, whereas the majority (95.9%) were led by males. On average, each household consisted of 4.9 members, with 41.2% of households having four or fewer members, and 58.8% having more than four

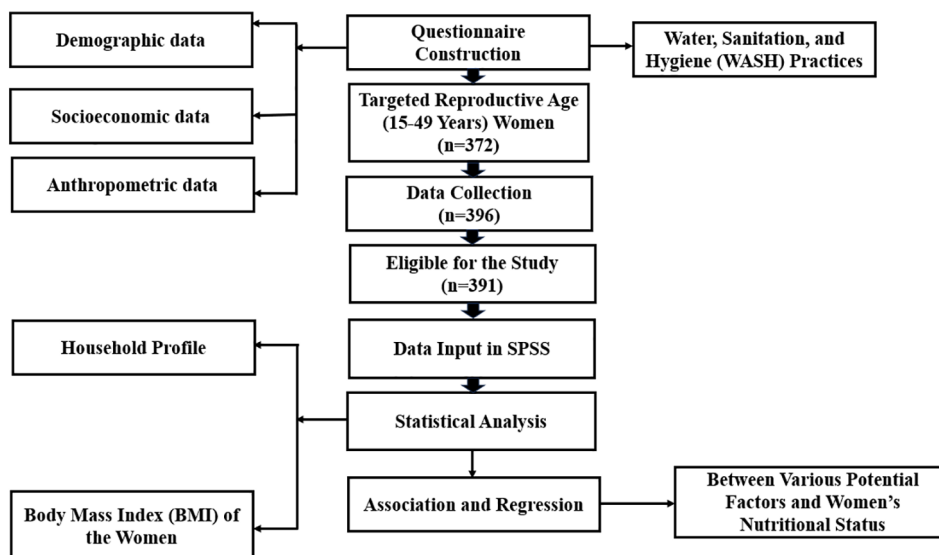


Figure 1: Flow diagram of the study.

members. Educational levels were categorized as 0 years of schooling (uneducated), 1-5 years (primary level), 6-10 years (secondary level), 11 years (higher secondary), and more than 11 years (graduation level). The mean year of schooling among the women was 7.1 years with a standard deviation (SD) of

Table 1: Demographic and socioeconomic characteristics of the respondent women in the study.

Characteristics	Frequency (%)
Religion	
Muslim	379 (96.9)
Hindu	12 (3.1)
Age group (years)	
15-19	13 (3.3)
20-29	226 (57.8)
30-39	127 (32.5)
40-49	25 (6.4)
Family members	
4 or less	161 (41.2)
More than 4	230 (58.8)
Formal educational level	
Uneducated	51 (13)
Up to primary level	56 (14.3)
Up to secondary level	245 (62.7)
Up to higher secondary and graduation level	39 (10)
Monthly household income (BDT)	
Less than 10,000	37 (9.5)
10,000-20,000	238 (60.9)
20,001-30,000	74 (18.9)
Higher than 30,000	42 (10.7)
Household monthly expenditure on food (BDT)	
Less than 5,000	87 (22.2)
5,000-10,000	254 (65)
Higher than 10,000	50 (12.8%)
Age at first marriage (years)	
15 or less	97 (24.8)
Higher than 15	294 (75.2)

3.6. Approximately, 13% of the women had no formal education, while 14.3%, 62.7%, and 10% had completed primary, secondary, and higher secondary education, respectively.

The average monthly household income was 19,521 Bangladeshi Taka (BDT) with an SD of 11,291 BDT. A majority of households (60.9%) reported a total monthly income ranging from 10,000 to 20,000 BDT. Only 9.5% of households had a monthly income of less than BDT 10,000, while 18.9% earned between 20,001 and 30,000 BDT, and 10.7% had a higher monthly income exceeding 30,000 BDT. Regarding monthly food expenditures, the mean was 7,214 BDT with a standard deviation of 3,743 BDT. Approximately 22.2% of households spent less than 5,000 BDT on monthly food, while 12.8% spent more than 10,000 BDT. The majority (65%) of households had monthly food expenditures ranging from 5,000 to 10,000 BDT. The average age of women at their first marriage was 17 years with a standard deviation of 2.2 years. Most women in the study area were married after the age of 15, accounting for 75.2% of the total women studied, while the remaining 24.8% were married at 15 years of age or younger.

The mean weight of the respondents was found to be 56.5 ± 9.5 kg. The mean BMI of the respondents was 24.5 ± 3.8 . Among 391 women, only 5.9% were found as underweight, and 49.4% were found as normal. But the percentage of overweight and obese was found much higher, 35.3% and 9.5% respectively (Figure 2). In this study, all the women under examination exclusively relied on tube well water for their drinking needs. Additionally, a substantial majority, 95.7%, used tube well water for both cooking and washing utensils. Only a minimal fraction, 0.5% and 3.8% resorted to well and pond water supplies for these purposes, respectively (Table 2). Out of the 391

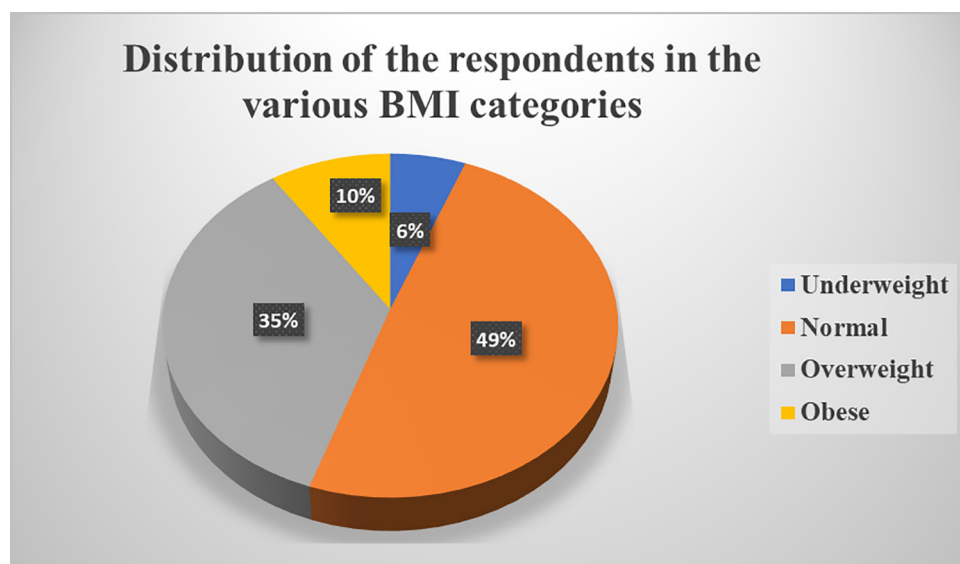


Figure 2: Distribution of the women in the study according to their nutritional status based on BMI.

Table 2: Distribution of the women in the study according to various water, sanitation, and hygiene (WASH) practices.

WASH practices	Frequency	%
Source of water for purposes other than drinking		
Tube well	374	95.7
Well	2	0.5
Pond	15	3.8
Place of defecation		
Open place	20	5.1
Unsanitary toilet	41	10.5
Sanitary toilet	330	84.4
Method of handwashing after defecation		
Only water	56	14.3
Water with ash or soil	45	11.5
Water with soap	290	74.2

Table 3: Chi-Square test to determine the association of variables with the nutritional status of the women in the study.

Variable	N	Nutritional status		Test	
		Malnourished	Nourished		
Age (Years)	15-19	13	3 (23.1)	10 (76.9)	$\chi^2=10.352$ $p=0.016^*$
	20-29	226	13 (5.8)	213 (94.2)	
	30-39	127	4 (3.1)	123 (96.9)	
	40-49	25	3 (12.0)	22 (88.0)	
Religion	Islam	379	21 (5.5)	358 (94.5)	$\chi^2=2.601$ $p=0.107^*$
	Hinduism	12	2 (16.7)	10 (83.3)	
Formal education level	Uneducated	51	5 (9.8)	46 (90.2)	$\chi^2=4.360$ $p=0.225^*$
	Up to primary level	56	4 (7.1)	52 (92.9)	
	Up to secondary level	245	10 (4.1)	235 (95.9)	
	Up to higher secondary and graduation level	39	4 (10.3)	35 (89.7)	
Family size	4 or less	161	9 (5.6)	152 (94.4)	$\chi^2=0.042$ $p=0.837$
	Higher than 4	230	14 (6.1)	216 (93.9)	
Total Monthly Income (BDT)	Less than 10,000	37	3 (8.1)	34 (91.9)	$\chi^2=1.367$ $p=0.713$
	10,000-20,000	238	15 (6.3)	223 (93.7)	
	20,001-30,000	74	4 (5.4)	70 (94.6)	
	Higher than 30,000	42	1 (2.4)	41 (97.6)	
Total monthly expenditure on food (BDT)	Less than 5,000	87	7 (8.0)	80 (92.0)	$\chi^2=1.005$ $p=0.605$
	5,000-10,000	254	13 (5.1)	241 (94.9)	
	Higher than 10,000	50	3 (6.0)	47 (94.0)	
Method of handwashing after defecation	Only water	56	5 (8.9)	51 (91.1)	$\chi^2=7.045$ $p=0.030^*$
	Water with ash or soil	45	6 (13.3)	39 (86.7)	
	Water with soap	290	12 (4.1)	278 (95.9)	
Age at first marriage (years)	15 or less	97	5 (5.2)	92 (94.8)	$\chi^2=0.123$ $p=0.725$
	Higher than 15	294	18 (6.1)	276 (93.9)	

BDT: Bangladeshi Taka, *Significant at $p<0.25$.

women surveyed, the majority, which accounts for 330 individuals (84.4%), had access to sanitary toilets. A small percentage, specifically 20 women (5.1%), practiced open defecation, while 41 women (10.5%) were utilizing unsanitary toilet facilities (Table 2). Table 2 shows that approximately 74.2% of the women followed the hygiene practice of using water and soap after defecation. Conversely, 11.5% of them employed water with ash or oil for this purpose, while 14.3% relied solely on water.

Before analysis, potential determinants of maternal nutritional status were identified through

a combination of literature review (10, 13, 14, 17) and self-selection. Subsequently, a χ^2 test was conducted to assess the associations between these determinants and the nutritional status of women, as described in Table 3. Variables with a significance level of $p<0.25$ were initially considered indicative of an association with nutritional status. Specifically, religion ($\chi^2=2.601$, $p=0.10$), formal education level ($\chi^2=4.360$, $p=0.22$), age ($\chi^2=10.352$, $p=0.01$), and handwashing method after defecation ($\chi^2=7.045$, $p=0.03$) met this criterion and were subsequently included in the multivariate logistic regression model.

Table 4: Multivariate logistic regression analysis on the possible determinants of nutritional status of the women in the study.

Variable	Unadjusted			Adjusted		
	cOR	95% CI	P value	aOR	95% CI	P value
Religion						
Islam	3.41	0.70, 16.56	0.128	2.65	0.48, 14.82	0.266
Hinduism	1.00	Ref.	-	1.00	Ref.	-
Age						
15-19	1.05	0.263, 4.206	0.943	0.30	0.039, 2.28	0.245
20-29	1.49	0.35, 6.34	0.593	1.93	0.42, 8.85	0.399
30-39	2.69	0.80, 9.03	0.110	3.89	0.73, 20.60	0.111
40-49	1.00	Ref.	-	1.00	Ref.	-
Formal education level						
Uneducated	0.46	0.08, 2.66	0.382	1.84	0.36, 9.40	0.463
Up to primary level	2.23	0.59, 8.45	0.236	2.85	0.51, 15.85	0.231
Up to secondary level	4.19	0.88, 20.04	0.72	4.22	1.11, 15.99	0.034*
Up to higher secondary and graduation level	1.00	Ref.	-	1.00	Ref.	-
Method of handwashing after defecation						
Only water	0.44	0.15, 1.30	0.138	0.22	0.07, 0.71	0.089
Water with ash or soil	0.28	0.10, 0.79	0.016*	0.37	0.11, 1.17	0.011*
Water with soap	1.00	Ref.	-	1.00	Ref.	-

BDT: Bangladeshi Taka, *Significant at $p < 0.05$, aOR: Adjusted Odds Ratio, cOR: Crude Odds Ratio, CI: Confidence interval, Ref: Reference.

The results of the regression analysis indicated that women's nutritional status was significantly affected by formal education up to the secondary level, as well as the method of handwashing after defecation (Table 4). Specifically, women who had completed formal education up to the secondary level were 4.2 times more likely to exhibit adequate nutrition (adjusted odds ratio [aOR] of 4.22, 1.11, and 15.99, 95% CI). Conversely, women who practiced handwashing solely with water and those who used water with ash or soil were 78% (aOR 0.22, 95% CI, 0.07, 0.71) and 63% (aOR of 0.37, 95% CI, 0.11, 1.17) more likely to experience malnutrition, respectively.

Discussion

In our study, the average weight of the participants was found to be 56.5 ± 9.5 kg, with a mean BMI of 24.5 ± 3.8 . Among the 391 women included in the study, a mere 5.9% were classified as underweight, while 49.4% fell within the normal weight range. Strikingly, the percentages of overweight and obese individuals were significantly higher, at 35.3% and 9.5%, respectively. To provide context, data from 17-18 BDHS revealed that in rural settings, 10.8% of women were underweight, 51.4% were of normal weight, 23.2% were overweight, and 4.9% were obese (6). This comparison underscores a noticeable shift in the prevalence of malnutrition among rural and semi-urban women in our study area. Specifically, there has been a substantial decrease in the percentage of underweight and normal-weight women, while the percentage of overweight

and obese women had a significant increase. This shift towards higher rates of overweight and obesity in rural and semi-urban areas is a matter of growing concern for women's health. Multiple empirical studies support this trend in Bangladesh, emphasizing the need for targeted interventions to address the emerging challenge of overweight and obesity (10, 11, 22).

Within 391 households of this study, a substantial majority of 330 families (84.4%) reported using sanitary toilets, indicating a significant improvement in sanitation facilities compared to the findings of 17-18 BDHS, where only 62% of households reported using sanitary toilets (6). This positive shift signifies progress in sanitation practices among the studied population. The handwashing practices observed after defecation were notably positive in our study. Approximately, 74.2% of women reported using water and soap for handwashing, surpassing the percentage reported in 17-18 BDHS, which stood at 58% (6). However, it is worth noting that there is room for improvement, as 11.5% of respondents reported using water with ash or soil, and 14.3% reported using only water for handwashing. Encouragingly, promoting better handwashing practices, particularly among those using alternative methods, could further enhance hygiene standards in the community.

Within our study, a significant association was observed between the level of formal education and the nutritional status of the women. Specifically, women who had completed formal educational level

up to the secondary level were 4.2 times more likely to demonstrate adequate nutrition compared to those who had not received any formal education. This finding aligns with the results of previous researches. A study involving married women reported a nearly seven fold higher risk of being underweight among women with no formal education in comparison to those with higher levels of education (17). Similarly, a study conducted in rural Bangladesh identified an inverse relationship between women's education and underweight status (12). Also, a study conducted in Nepal stated that a low level of education is a key contributor to the poor nutritional status of reproductive-age women (18). Education empowers women with knowledge, economic resources, and decision-making abilities that collectively influence their nutritional choices and overall health (23). These factors, in turn, can lead to improved nutrition for both themselves and their families. These findings collectively underscore the critical role of education in promoting maternal nutritional well-being.

Within our study, an important association was emerged between handwashing practices and women's nutritional status. Specifically, women who practiced handwashing solely with water and those who used water with ash or soil were found to be 78% and 63% more likely to experience malnutrition, respectively, in comparison to those who utilized soap in combination with water. This underscores the vital role of effective handwashing practices in preserving women's nutritional well-being. These findings resonate with studies conducted in India, where poor WASH practices have been linked to adverse nutritional outcomes. A study in India identified significant associations between poor WASH practices, such as having water facilities outside the household premises, unimproved sanitation facilities, and non-use of soap after defecation, with poor nutritional status among adolescent girls (24). Additionally, another Indian study revealed a higher prevalence of severe maternal wasting among households with inadequate WASH practices, particularly concerning handwashing and toilet use (16). The association of handwashing with improved nutritional status is largely due to its role in reducing the risk of infectious diseases and promoting safe food handling and caregiving practices. By preventing illness and the related negative impacts on appetite, digestion, and nutrient absorption, hand washing indirectly contributes to better nutritional outcomes (25, 26). These collective findings underscore the importance of promoting proper WASH behaviors to improve maternal nutritional health.

Studies conducted in countries other than

Bangladesh have reported a wide range of determinants of the nutritional status of reproductive-age women. A study conducted in Kenya revealed that maternal nutritional status had a negative association with breast feeding, recent severe illness, and having multiple children below 2 years of age. Conversely, higher maternal age, socio-economic status, and household food security exhibited positive associations with maternal nutritional status (3). In an Indian study, it was determined that the factors contributing to malnutrition among reproductive-age women were poverty, food insecurity, poor WASH practices, particularly related to hand washing and toilet use, and the gender-based violence (16). Food inadequacy, insufficient information/knowledge, low educational levels, caste, income, and family size emerged as primary contributors to the poor nutritional status of reproductive-age women in Nepal (18). In Tanzania, age and the family's wealth index were identified as independent and significant risk factors for undernutrition among reproductive-age women (19). A study conducted in Nigeria found a significant relationship between family size and the BMI of reproductive-age women (20).

This study has several limitations. Its cross-sectional design prevented the establishment of causal relationships between variables and limits temporal inferences. Despite efforts to ensure random sampling, potential sampling bias may exist, affecting the generalizability of findings. Reliance on self-reported data, including dietary habits and hygiene practices, introduced recall and reporting bias. The assessment of nutritional status relies solely on BMI categories, overlooking nuances in body composition and micronutrient deficiencies. Social desirability bias may have influenced responses. Acknowledging these limitations is crucial for a nuanced interpretation of the study's results and for guiding future research in addressing women's malnutrition.

Conclusion

The study has shed light on critical aspects of women's health and well-being in a semi-urban setting in Bangladesh. The study has observed significant shifts in the nutritional status, sanitation practices, education, and handwashing behaviors of women within this population. Notably, the prevalence of underweight and normal-weight women has decreased substantially compared to national data, while the prevalence of overweight and obese women has increased significantly. This shift towards higher rates of overweight and obesity among rural and semi-urban women is a cause for concern, necessitating targeted interventions

to address this emerging health challenge. In terms of sanitation practices, there has been a commendable improvement, with a substantial majority of households now using sanitary toilets. This progress reflects positive changes in sanitation behaviors within the community. The association between formal education and maternal nutritional status underscores the pivotal role of education in promoting adequate nutrition among women. The critical link between handwashing practices and women's nutritional well-being emphasizes the need for effective WASH interventions. These results underscore the urgency of promoting proper WASH behaviors to enhance maternal nutritional health in the studied communities. This research underscores the evolving nutritional challenges faced by women in rural and semi-urban areas, emphasizing the need for multifaceted interventions encompassing education, improved WASH practices, and continued efforts to enhance sanitation facilities.

Acknowledgment

We are deeply grateful to the late Professor Dr. Md. Nazrul Islam Khan, Institute of Nutrition and Food Science, University of Dhaka, whose unwavering guidance, and mentorship were invaluable to the completion of this study. Special appreciation goes to Professor Dr. Md. Ruhul Amin, Institute of Nutrition and Food Science, University of Dhaka. We would like to express our sincere gratitude to the Bangladesh Academy for Rural Development (BARD) for their essential support. Lastly, our profound appreciation goes to all the respondents and participants whose willing participation greatly facilitated the research process.

Authors' Contribution

MJM: Conceptualization, Statistical analysis, Writing the first draft; SNA: Writing and editing the draft; and HR: Writing and editing the draft.

Conflict of Interest

None declared.

References

- 1 Waghmare H, Chauhan S, Sharma SK. Prevalence and determinants of nutritional status among women and children in Pakistan. *BMC Public Health*. 2022;22:1–13. DOI: 10.1186/s12889-022-13059-2. PMID: 35428254.
- 2 Waghmare H, Mondal NA, Prasad RD. Determinants of Nutritional Status among Women in South Asian Countries: A Cross-Sectional Study. *Demogr India*. 2022;51:100–110.
- 3 Gewa CA, Oguttu M, Yandell NS. Maternal nutrition in rural Kenya: health and socio-demographic determinants and its association with child nutrition. *Matern Child Nutr*. 2012;8:275–286. DOI: 10.1111/j.1740-8709.2011.00322.x. PMID: 21624050.
- 4 Rahman M, Roy SK, Ali M, et al. Maternal Nutritional Status as a Determinant of Child Health. *J Trop Pediatr*. 1993;39:86–88. DOI: 10.1093/tropej/39.2.86. PMID: 8492369.
- 5 Goudet S, Griffiths P, Bogin BA. Mother's body mass index as a predictor of infant's nutritional status in the post-emergency phase of a flood. *Disasters*. 2011;35:701–719. DOI: 10.1111/j.1467-7717.2011.01238.x. PMID: 21913932.
- 6 National Institute of Population Research and Training (NIPORT), and ICF. Bangladesh demographic and health survey 2017-18. Dhaka, Bangladesh, and Rockville, Maryland, USA; 2020.
- 7 Lentz EC, Barrett CB. The economics and nutritional impacts of food assistance policies and programs. *Food Policy*. 2013;42:151–163. DOI:10.1016/j.foodpol.2013.06.011.
- 8 Tinker A. Women's health: the unfinished agenda. *Int J Gynecol Obstet*. 2000;70:149–158. DOI: 10.1016/s0020-7292(00)00227-7. PMID: 10884543.
- 9 Akseer N, Bhatti Z, Mashal T, et al. Geospatial inequalities and determinants of nutritional status among women and children in Afghanistan: an observational study. *Lancet Glob Heal*. 2018;6:e447–459. DOI: 10.1016/S2214-109X(18)30025-1. PMID: 29454554.
- 10 Hossain MM, Islam MR, Sarkar ASR, et al. Prevalence and determinants risk factors of underweight and overweight among women in Bangladesh. *Obes Med*. 2018;11:1–5. DOI: 10.1016/j.obmed.2018.05.002.
- 11 Chowdhury MAB, Adnan MM, Hassan MZ. Trends, prevalence and risk factors of overweight and obesity among women of reproductive age in Bangladesh: a pooled analysis of five national cross-sectional surveys. *BMJ Open*. 2018;8:e018468. DOI: 10.1136/bmjopen-2017-018468. PMID: 30030307.
- 12 Khanam R, Lee ASC, Ram M, et al. Levels and correlates of nutritional status of women of childbearing age in rural Bangladesh. *Public Health Nutr*. 2018;21:3037–3047. DOI: 10.1017/S1368980018001970. PMID: 30107861.
- 13 Haseen F. Malnutrition among Bangladeshi women in ultra poor households: prevalence and determinants [dissertation]. Uppsala (SE): Uppsala University; 2005.

- 14 Hasnat Milton A, Smith W, Rahman B, et al. Prevalence and Determinants of Malnutrition Among Reproductive Aged Women of Rural Bangladesh. *Asia Pacific J Public Heal*. 2010;22:110–117. DOI: 10.1177/1010539509350913. PMID: 20032040.
- 15 Ene-Obong HN, Enugu GI, Uwaegbute AC. Determinants of health and nutritional status of rural Nigerian women. *J Heal Popul Nutr*. 2001;19:320–330. PMID: 11855355.
- 16 Sinha R, Raybardhan S, Barnwal N, et al. Assessment of nutritional status of mothers of children under 3 years of age and its determinants. *Indian J Community Med*. 2020;45:440–444. DOI: 10.4103/ijcm.IJCM_480_19. PMID: 33623197.
- 17 Mostafa Kamal SM, Islam MA. Socio-economic Correlates of Malnutrition among Married Women in Bangladesh. *Malays J Nutr*. 2010;16:349–359. PMID: 22691988.
- 18 Acharya SR, Bhatta J, Timilsina DP. Factors associated with nutritional status of women of reproductive age group in rural, Nepal. *Asian Pacific J Heal Sci*. 2017;4:19–24. DOI: 10.21276/apjhs.2017.4.4.6.
- 19 Mtumwa AH, Paul E, Vuai SAH. Determinants of undernutrition among women of reproductive age in Tanzania mainland. *South African J Clin Nutr*. 2016;29:75–81. DOI: 10.1080/16070658.2016.1216509.
- 20 Oyedapo HA, Ayeni O, Afolabi NB, et al. Quantile regression methods for determination of factors associated with nutritional status of women of reproductive age in Nigeria. *Sci African*. 2021;14:e00988. DOI: 10.1016/j.sciaf.2021.e00988.
- 21 World Health Organization. Global Database on Body Mass Index. 2006.
- 22 Biswas T, Uddin MJ, Mamun A Al, et al. Increasing prevalence of overweight and obesity in Bangladeshi women of reproductive age: Findings from 2004 to 2014. *PLoS One*. 2017;12:e0181080. DOI: 10.1371/journal.pone.0181080. PMID: 28510585.
- 23 Acharya DR, Bell JS, Simkhada P, et al. Women's autonomy in household decision-making: a demographic study in Nepal. *Reprod Health*. 2010;7:15. DOI: 10.1186/1742-4755-7-15. PMID: 20630107.
- 24 Chattopadhyay A, Sethi V, Nagargoje VP, et al. WASH practices and its association with nutritional status of adolescent girls in poverty pockets of eastern India. *BMC Womens Health*. 2019;19:89. DOI: 10.1186/s12905-019-0787-1.
- 25 Shrestha A, Kunwar BM, Meierhofer R. Water, sanitation, hygiene practices, health and nutritional status among children before and during the COVID-19 pandemic: longitudinal evidence from remote areas of Dailekh and Achham districts in Nepal. *BMC Public Health*. 2022;22:2035. DOI: 10.1186/s12889-022-14346-8.
- 26 Mbuya MNN, Humphrey JH. Preventing environmental enteric dysfunction through improved water, sanitation and hygiene: an opportunity for stunting reduction in developing countries. *Matern Child Nutr*. 2016;12:106–120. DOI: 10.1111/mcn.12220. PMID: 26542185.