

Regional variations in the management of reusable menstrual material among women of reproductive age in Bangladesh

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SUMMARY

Menstruation is a natural biological process, yet menstrual hygiene management (MHM) remains inadequate in many low- and middle-income settings. This study assessed the prevalence, geographic distribution, and determinants of reusable menstrual product use among women in Bangladesh. A secondary analysis was conducted using the Bangladesh Multiple Indicator Cluster Survey (MICS) 2019, including 56,077 women aged 15–49 years. Bivariate associations were examined using chi-square tests, and multivariable relationships were assessed using weighted binomial logistic regression, with adjusted odds ratios (AORs) and 95% confidence intervals. District-wise spatial mapping and wealth-stratified subgroup analyses were also performed. Approximately two-thirds of women reported using reusable menstrual materials. The lowest prevalence was observed in Dhaka (45%), followed by Kushtia (47%) and Jhenaidah (49%), while higher use was seen in northern and southern regions. Higher odds of using reusable products were associated with rural residence, lower education, poorer household wealth, male-headed households, older age, current marriage, and limited mass media exposure. Substantial variation was observed across wealth quintiles, indicating socioeconomic heterogeneity in determinants. The findings highlight the need for targeted educational interventions and menstrual health awareness programs, particularly for socioeconomically disadvantaged groups, to promote safe and hygienic use of reusable menstrual products in Bangladesh.

Key words: Menstrual Hygiene Management (MHM), reusable menstrual materials, socioeconomic factors, spatial distribution, Bangladesh Multiple Indicator Cluster Survey (MICS), wealth quintile analysis

1. Introduction

Menstruation is a natural phenomenon that signifies the commencement of the reproductive stage in a woman's life, yet it has not received the attention it deserves and remains a topic often excluded from open discussion. Menstrual management remains an overlooked challenge for girls and women, especially in low- and middle-income nations (LMICs) (Sommer and Sahin, 2013). The concept of 'Menstrual Health' encompasses various aspects, including the physical needs during menstruation, concerns associated with privacy, access to water and restroom facilities, awareness about appropriate absorbent materials and their proper disposal, and addressing prevalent myths and misunderstandings. In 2014, the United Nations International Children's Emergency Fund (UNICEF) and World Health Organization (WHO) introduced the term Menstrual Hygiene Management (MHM) and shared an official definition of MHM (Phillips-Howard et al., 2016).

MHM advocates for the dignified and hygienic management of menstruation, which includes the safe collection or absorption of menstrual blood using various materials. Ensuring proper hygiene is vital during menstruation to prevent menstrual-related infections. Maintaining menstrual hygiene and health is essential for the welfare and empowerment of women and young girls. Every day, more than 300 million women worldwide are on their menstrual cycle. It's estimated that around 500 million women and girls worldwide do not have the opportunity to use necessary menstrual products or proper facilities for managing their menstrual hygiene (Anaba et al., 2022). Menstrual Management Materials (MMMs) fall into two categories: disposable (tampons, pads) and reusable (pads, cloth, menstrual cups). Disposables offer convenience but generate more waste, while reusables are eco-friendly and cost-effective, though they require regular cleaning. Both aim to provide women with comfortable and hygienic options for menstruation (UNICEF, 2024).

Women generally view disposable menstrual materials as clean. Like-

wise, reusable materials can be considered hygienic if they are thoroughly washed, adequately dried, and correctly stored (Alam et al., 2017). However, proper handling of reusable sanitary items, particularly cloth pads, continues to pose an obstacle for numerous women. Renewable pads or cloths frequently suffer from insufficient cleaning and are not always stored in hygienic conditions (Hennegan et al., 2016; Fatema and Basit, 2025). In most cases, influenced by cultural and social norms regarding menstruation, women often dry their products inside the house or store them in the bathroom (Shah et al., 2013). These obstacles could potentially deter users from upholding optimal hygiene practices, and the practice of using unsanitary items during their period can potentially harm women's health (World Bank, 2024).

Unhygienic menstrual practices can significantly impact women's health by leading to various infections and complications. Women who engage in such practices are at a heightened risk of gastrointestinal, genital, and perineal infections. These practices are linked to recurrent reproductive tract infections (RTIs) and may increase the likelihood of developing cervical cancer (Das et al., 2015; Meher and Sahoo, 2023). Research indicates that women using reusable absorbent pads are 2.3 times more likely to experience symptoms of urogenital infections than those using disposable pads. Furthermore, they face a 2.8 times greater risk of being diagnosed with at least one urogenital infection, such as Bacterial Vaginosis (BV) or Urinary Tract Infection (UTI) (Das et al., 2015). Poor menstrual hygiene can also cause prolonged reproductive issues, health-related concerns like infertility, and issues occurring during childbirth, such as low birth weight and preterm delivery (Krenz and Strulik, 2021).

However, some studies have illustrated that washable period management supplies are deemed safe, reliable, and well-received by individuals experiencing menstruation (Juma et al., 2017). Reusable period-related components offer a more eco-friendly and cost-effective alternative in comparison to single-use pads (Hennegan et al., 2016). Adolescents and women

from poorer nations favor reusable pads due to their cultural acceptance, user-friendly nature, affordability, cleanliness, effectiveness, and accessibility (Tilley et al., 2013; Sommer, 2012). Another study in Malawi revealed that young women expressed a preference for disposable sanitary products, with adolescent girls perceiving the use of reusable materials for collecting menstrual blood as old-fashioned (Kambala et al., 2020).

Limited research has been undertaken on menstrual hygiene practices, with a predominant focus on the adolescent group (Haque et al., 2014; Alam et al., 2017). In many LMICs, discourse on menstrual health and hygiene is commonly subject to social taboos (Afiaz and Biswas, 2021). A cross-sectional study was carried out to examine the connection between menstrual care routines and academic achievement among rural Bangladeshi teenage girls, and found that 43.4% of adolescent girls reported multiple uses of reusable cloths per menstrual cycle, with those who practiced ‘good’ MHM showing 5.7 times higher likelihood of achieving good academic performance (Ahmed et al., 2021; Ha and Alam, 2022). Another study was conducted to examine the menstrual hygiene condition of teenage school girls in Chittagong division, and the utilization of used cloths as menstrual absorbents was commonly observed in both urban and rural regions (Muhit and Chowdhury, 2013). Women with disabilities in Bangladesh face significant barriers to effective MHM. Addressing these issues requires targeted interventions, including disability-inclusive menstrual health education, improved access to menstrual products and sanitation facilities, and community initiatives to reduce stigma (Khan et al., 2024; Zaman et al., 2024). As of now, there has been a limited number of nationally representative studies conducted in Bangladesh to comprehensively assess menstrual hygiene management (MHM) practices, incorporating the application of reusable menstrual materials. However, a significant gap exists in relation to research incorporating subgroup analysis, particularly with the stratification of data based on a wealth index. Such an analysis would provide valuable insights into how socio-economic factors, such as wealth, influence menstrual ma-

terial usage across different demographic groups. This type of research is essential for tailoring interventions and policies that cater to the particular requirements of women in various socio-economic strata, ensuring equitable access to menstrual health products, and promoting better hygiene practices nationwide.

To the authors' knowledge, research in the area of the usage of washable menstrual products among females of reproductive age is notably scarce. Investigating this area is crucial for generating valuable insights that could inform menstrual health initiatives, shape reproductive health policies, and identify specific areas that require targeted attention. Therefore, this study aims to evaluate the extent of use of reusable menstrual management resources by women during their fertile years at national level in Bangladesh, employing a district-level distribution approach and further investigating the associated factors. It will then investigate the effect of different socio-demographic variables across different wealth indices. The findings of this study can offer a tangible pathway toward achieving Sustainable Development Goal (SDG) 3.7, aimed at universal access to sexual and reproductive healthcare services (United Nations Department of Economic and Social Affairs, 2024).

2. Data and variables

This section presents information regarding the data source and the processing of the data, as well as a brief explanation of the variables that were utilized in the analysis.

2.1. Source of data

The present study used secondary data from the 6th round of the nationally comprehensive Bangladesh Multiple Indicator Cluster Survey (MICS) conducted in 2019. The survey was structured to yield estimates for predefined indicators related to children and women on a national scale, as well as for urban and rural regions, across the eight administrative divisions and 64

districts of the country. The survey utilized a two-stage stratified cluster sampling approach, with enumeration areas (EAs) serving as the primary sampling units (PSUs). During the first stage, 3,220 EAs were selected from 64 districts (sampling strata) through probability proportional to size sampling. In the second stage, 20 households were randomly selected from each EA using systematic random sampling. This methodology yielded a total sample of 64,400 households, averaging about 1,000 households per district stratum (UNICEF, 2024). Following the exclusion of missing values and the necessary adjustments made to accommodate the survey's complex structure, we arrived at a weighted sample size of 56,077 women in an age bracket of 15–49 years, representing the target reproductive age group.

2.2. Ethical clearance

MICS datasets are publicly available. The Bangladesh MICS 2019 was conducted by the Bangladesh Bureau of Statistics (BBS) in partnership with UNICEF Bangladesh under the Global MICS Programme. Technical support was supplied by UNICEF, and funding for quality assurance visits throughout data collection was provided by UNFPA Bangladesh. This study employed data that was acquired from <https://mics.unicef.org/surveys>.

2.3. Variables of the study

In this study, the dependent variable was the use of reusable menstrual management materials, which was determined through a follow-up question regarding the materials used during the most recent menstruation (i.e., were the materials reusable?). Before the analysis, the outcome variable was recoded, with responses of 'Yes' being assigned a value of 1 and 'No' a value of 0. Any instances of 'don't know' responses or non-responses were subsequently excluded from the dataset. The analyses included the following socio-demographic variables: age of respondent in years (15–19, 20–24, 25–29, 30–34, 35–39, 40–44 and 45–49), educational status of respondent (pre-primary or none, primary, secondary, higher education), educational status

of household head, household wealth index (poor, middle, rich; derived using PCA based on ownership of household goods), marital status (currently married or not), type of place of residence (urban or rural), religion (Islam or others), division (Dhaka, Rajshahi, Chattogram, Rangpur, Sylhet, Barishal, Khulna and Mymensingh), disability status (has functional difficulties or not), and exposure to mass media (exposed or not) (Hasan et al., 2025; Roy et al., 2024).

3. Methodology

This section provides a short description of the theoretical basis of the study conducted here.

3.1. Chi-square test of independence

The chi-square test assesses the association between two categorical variables, employing a contingency table to display the counts of combined variable responses. This test is exclusive to categorical variables and cannot compare continuous variables or measure their association. Conditions for the test include unrelated categories, disconnected subjects in each group, anticipated cell values ≥ 1 , moderate expected frequencies for most cells, a large sample size for comparisons, and no matching of categorical variables. There are two valid approaches: one emphasizes the relationship, the other independence, yielding the same results. Assumptions are presented with a focus on connection for convenience. The hypotheses of the chi-square test are as follows:

H_0 : There is no association between the two variables.

H_1 : There is association between the two variables.

$$\chi^2 = \sum_{i=1}^n \sum_{j=1}^n \frac{(O_{ij} - E_{ij})^2}{E_{ij}},$$

where O_{ij} ($i=1, \dots, r$ and $j=1, \dots, k$) denotes the observed frequencies, and E_{ij} ($i = 1, \dots, r$ and $j = 1, \dots, k$) denote the expected frequencies. On the assumption that there is no significant difference between the two groups, the test statistic will have $(r - 1) \times (k - 1)$ degrees of freedom and follow a chi-square distribution. In the test statistic, O_{ij} is the observed frequency of the i^{th} row and j^{th} column and E_{ij} is the expected frequency of the i^{th} row and j^{th} column. The expected frequency E_{ij} is calculated as:

$$E_{ij} = \frac{(\text{total of } i^{th} \text{ row}) * (\text{total of } j^{th} \text{ column})}{\text{total number of observations}}.$$

Rejection of the null hypothesis occurs when the chi-square test statistic surpasses the critical value or when the p-value falls below the chosen significance level (e.g., 0.05), signaling a significant association between the variables (Hogg et al., 2005).

3.2. Cramér's V statistic

Cramér's V is a widely used measure of association for categorical variables, particularly when the variables are arranged in a contingency table. It is based on the chi-square statistic and is suitable for contingency tables of any dimension. The value of Cramér's V ranges between 0 and 1, where 0 indicates no association between the variables and 1 indicates a perfect association. Higher values of Cramér's V suggest a stronger relationship between the variables.

Cramér's V is calculated as follows:

$$V = \sqrt{\frac{\chi^2}{n \times \min(r - 1, c - 1)}} \quad (1)$$

where χ^2 denotes the chi-square test statistic, n represents the total sample size, r is the number of rows, and c is the number of columns in the contingency table (Agresti, 2013).

3.3. Binary logistic regression model

In general regression, predictions are made for continuous dependent variables based on covariates. However, when dealing with binary outcomes, binary logistic regression becomes pertinent. This modeling technique is especially suited for scenarios where the response variable is binary (1 for "yes" and 0 for "no"). In our study on the use of reusable menstrual materials, we employ binary logistic regression to model the binary response variable, indicating whether individuals use reusable menstrual materials or not.

Let the outcome variable Y_i denote the response of the i^{th} observation. Now the response variable Y_i is categorized into

$$Y_i = \begin{cases} 1, & \text{if the materials were reusable,} \\ 0, & \text{if the materials were not reusable.} \end{cases}$$

Let $X_{i1}, X_{i2}, \dots, X_{ip}$, denote the set of explanatory variables, which may be either quantitative variables or indicator variables presenting different categories of a variable, and let $x_{i1}, x_{i2}, \dots, x_{ip}$ represent the observed values of the variables $X_{i1}, X_{i2}, \dots, X_{ip}$. For the convenience of a given study, it might be necessary to convert the continuous random variables into categories using statistical software, and this conversion often leads to a suitable outcome.

As mentioned earlier, the response variable is a Bernoulli random variable, and so it is clear that this variable follows the Bernoulli distribution with parameter π_i . For the outcome, the probability of success is defined as:

$$P(Y_i = 1) = \pi_i = \frac{\exp(\beta_0 + \beta_1 x_{i1} + \dots + \beta_p x_{ip})}{1 + \exp(\beta_0 + \beta_1 x_{i1} + \dots + \beta_p x_{ip})}.$$

The above equation can be re-expressed using the logit function for a simple expression. Introducing a logit function, we may rewrite the above

equation in the following form:

$$g(X) = \text{logit}(\pi_i) = \log \frac{\pi_i}{1 - \pi_i} = \beta_0 + \beta_1 x_{i1} + \dots + \beta_p x_{ip}.$$

The next step is to estimate the parameters. For that purpose, we use the maximum likelihood technique. The likelihood is maximized by finding estimates of the parameters that are most likely to yield the data. The MLE (Maximum Likelihood Estimator) of β_0 and β_1 can be obtained by maximizing the following likelihood function:

$$L(\beta_0, \beta_1) = \prod_{i=1}^n \frac{\exp(\beta_0 + \beta_1 x_i)}{1 + \exp(\beta_0 + \beta_1 x_i)}.$$

The likelihood equation can be challenging, prompting our use of the log-likelihood function for simplified and more accurate parameter estimations. By maximizing the function below, we obtain results comparable to those from the likelihood function:

$$l(\pi, \mathbf{y}) = \sum_{i=1}^N [y_i \log(\pi_i) + (n_i - y_i) \log(1 - \pi_i) + \log(n_i C y_i)].$$

3.4. Adjusted odds ratio

The adjusted odds ratio (AOR) is a key measure used to describe the association between an exposure variable and an outcome while controlling for potential confounding factors. It represents the change in the odds of an event associated with a specific exposure after accounting for other covariates included in the model. In multivariable logistic regression, the estimated coefficients reflect the change in log odds of the outcome for a one-unit increase in the exposure variable, holding all other variables constant. The AOR, obtained by exponentiating these coefficients, provides a more refined estimate of the exposure–outcome relationship by isolating the independent effect of the exposure. This makes it particularly useful in observational studies where multiple factors may simultaneously influence the

outcome.

3.5. Statistical analysis

Bivariate and multivariate analyses were conducted in this study. At the bivariate level, the association between independent variables and the dependent variable was assessed using the chi-square test. Statistical significance was evaluated at the 5% level based on p-values, and significant variables were considered for inclusion in the final regression model. Although the religion of the household head was not statistically significant in the bivariate analysis, it was retained in the final model because it was significant in a previous study conducted in Bangladesh (Hasan et al., 2025). To identify predictors of the outcome variable, binary logistic regression was employed. Since the outcome variable was binary, a generalized linear model (GLM) with a logit link function and binomial family was used.

Stata version 16 was used to perform all statistical analyses. The survey's complex design, incorporating clustering, stratification, and sampling weights, was accounted for by using the 'svy' code command in Stata. Statistical significance was set at the 0.05 threshold, and the associations were assessed through odds ratios and their corresponding 95% confidence intervals. We used the forward selection technique as a model selection procedure with a pre-specified threshold ($\alpha = 0.25$). Model fit was assessed using the likelihood ratio test and the Akaike Information Criterion (AIC), with a lower AIC indicating better relative fit. Model adequacy and internal validity were evaluated using standard diagnostics, coefficient stability during model reduction, and consistency of effect estimates across specifications. To assess the spatial variation of washable menstrual items utilization among females of reproductive age in Bangladesh, district-level mapping was conducted. The mapping of reusable menstrual material usage among women was performed utilizing the software ArcGIS version 10.8. This analytical tool facilitated the visualization of spatial patterns by representing the percentage of women utilizing reusable menstrual materials across different

districts. A subgroup analysis was then conducted across various wealth indices, and the marginal probabilities of using reusable menstrual materials were reported, to evaluate the impact of different predictors within and between wealth categories. This part of the analysis was conducted using R software.

4. Analysis and results

4.1. Bivariate analyses

The spatial mapping presented in Figure 1 illustrates the distribution of the reuse of period-related materials among women of reproductive age on a district-wise scale: reusable menstrual management materials are widespread across most districts in Bangladesh. The district-level analysis revealed notable variations in the proportions of use of sustainable menstrual management products. Notably, Dhaka district, the center of the country, exhibited the lowest prevalence at 45%, followed by Kushtia and Jhenaidah districts with prevalence rates of 47% and 49%, respectively. This prevalence would have been higher if we had considered the northern or southern part of the country.

Table 1 reveals that more than two-thirds of females used reusable menstrual management materials. Almost 3 in 4 women who lived in rural areas (74%) used reusable materials. Women from the Dhaka division have the least tendency to use reusable menstrual materials (60%), which represents almost one-fourth of the total women of reproductive age. Around 70% of women from families with male household heads use reusable menstrual materials. Almost 80% of women from households with uneducated househeads used reusable materials. Reuse of menstrual materials is most often found among uneducated women (91%).

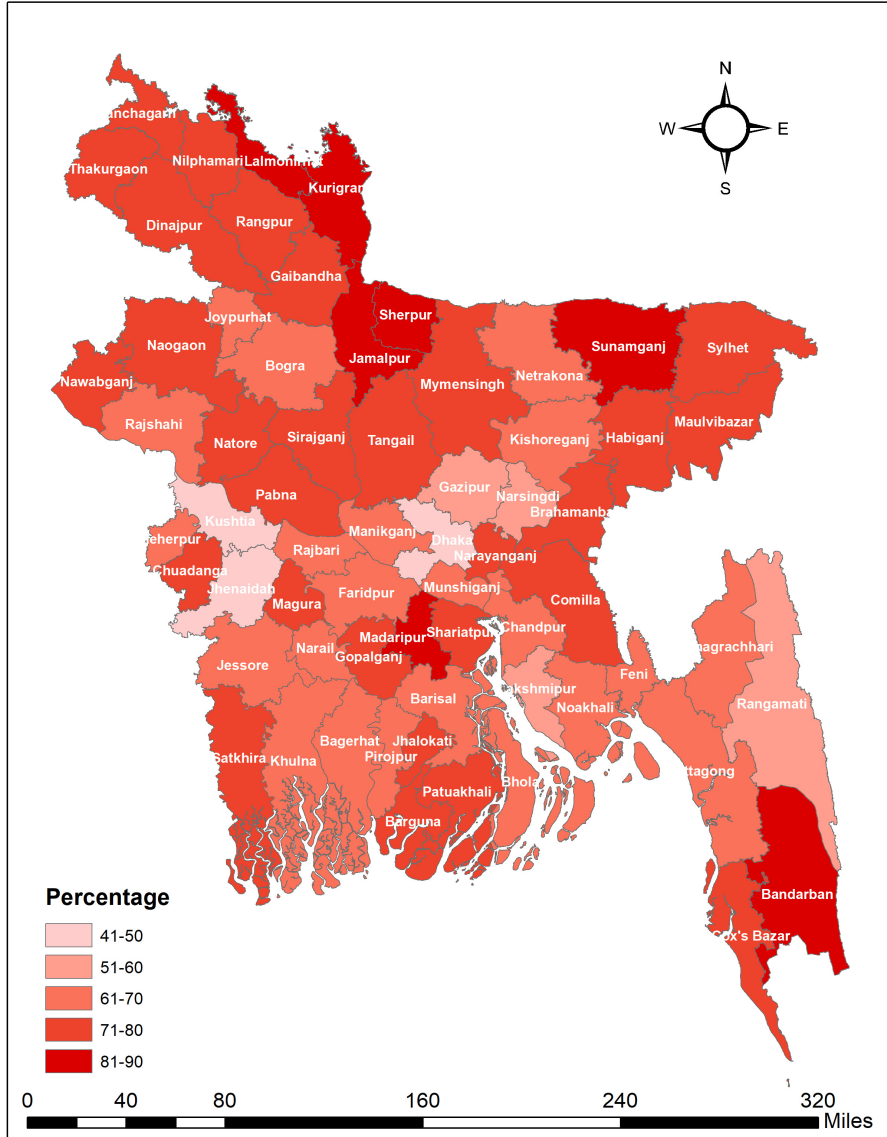


Figure 1. A district-level map showing the distribution of reusable menstrual management materials

Table 1. Sociodemographic distribution of reusable menstrual management material usage among women aged 15–49 years

Background characteristics	Use reusable menstrual management materials			Cramér's V stat.	p val.
	No	Yes	Total		
	n (%)	n (%)	n (%)		
Total	17,573 (31.34)	38,504 (68.66)	56,077 (100)		
Area					
Urban	6,417 (47.8)	7,008 (52.2)	13,425 (100)	0.199	<0.001
Rural	11,156 (26.16)	31,496 (73.84)	42,652 (100)		
Division					
Barishal	949 (31.83)	2,032 (68.17)	2,981 (100)	0.148	<0.001
Chattogram	3,251 (29.77)	7,666 (70.23)	10,917 (100)		
Dhaka	5,829 (40.45)	8,583 (59.55)	14,412 (100)		
Khulna	2,413 (37.25)	4,063 (62.75)	6,476 (100)		
Mymensingh	862 (23.3)	2,837 (76.7)	3,699 (100)		
Rajshahi	1,997 (26.99)	5,401 (73.01)	7,398 (100)		
Rangpur	1,285 (21.66)	4,645 (78.34)	5,930 (100)		
Sylhet	990 (23.2)	3,276 (76.8)	4,266 (100)		
Sex of household head					
Male	15,336 (30.91)	34,269 (69.09)	49,605 (100)	0.025	<0.001
Female	2,238 (34.58)	4,234 (65.42)	6,472 (100)		

Table 1 continued from previous page

Table 1 continued from previous page					
Background characteristics	Use reusable menstrual management materials			Cramér's V stat.	p val.
	No	Yes	Total		
	n (%)	n (%)	n (%)		
Education of household head					
Pre-primary or none	3,507 (19.63)	14,363 (80.37)	17,870 (100)	0.252	<0.001
Primary complete	3,709 (24.18)	11,627 (75.82)	15,336 (100)		
Secondary or higher	10,347 (45.29)	12,502 (54.71)	22,849 (100)		
Education of women					
Pre-primary or none	683 (9.03)	6,879 (90.97)	7,562 (100)	0.312	<0.001
Primary complete	1,653 (13.52)	10,567 (86.48)	12,220 (100)		
Secondary or higher	15,238 (41.98)	21,057 (58.02)	36,295 (100)		
Wealth index quintile					
Poor	2,956 (14.79)	17,028 (85.21)	19,984 (100)	0.323	<0.001
Middle	2,790 (24.71)	8,504 (75.29)	11,294 (100)		
Rich	11,826 (47.69)	12,972 (52.31)	24,799 (100)		
Age					
15–24	9,096 (43.11)	12,002 (56.89)	21,098 (100)	0.211	<0.001
25–34	5,218 (28.52)	13,076 (71.48)	18,295 (100)		
35–49	3,259 (19.53)	13,425 (80.47)	16,685 (100)		
Religion of household head					
Others	1,655 (30.98)	3,690 (69.02)	5,345 (100)	0.003	0.865

Table 1 continued from previous page

Background characteristics	Use reusable menstrual management materials			Cramér's V stat.	p val.
	No	Yes	Total		
	n (%)	n (%)	n (%)		
Muslim	15,918 (31.38)	34,814 (68.62)	50,732 (100)		
Currently married					
Yes	11,880 (27.34)	31,575 (72.66)	43,455 (100)	0.160	<0.001
No	5,693 (45.11)	6,929 (54.89)	12,622 (100)		
Use of mass media					
No	3,393 (17.81)	15,664 (82.19)	19,057 (100)	0.209	<0.001
Use anyone of those	14,180 (38.3)	22,840 (61.7)	37,020 (100)		
Functional difficulties					
Yes	266 (21.18)	991 (78.82)	1,257 (100)	0.029	<0.001
No	14,239 (29.52)	33,989 (70.48)	48,228 (100)		

Women from the poorest households were more inclined to utilize reusable products (87%) than those from the wealthiest households (40%). A greater percentage of women within the age range of 45 to 49 made use of reusable menstrual materials (83%) compared with women aged 15–19 years (54%). Among currently unmarried women, more than 50% used reusable materials, which is lower than the percentage among currently married women. A substantial proportion of women who had less exposure to mass media (82%) used reusable menstrual materials. Women with functional difficulties are more prone to use reusable materials (79%) than those without functional difficulties (Table 1).

4.2. Binomial logistic regression

All socio-demographic variables except the religion of the household head, sex of the household head, and functional difficulties considered in the model were significantly associated with the use of reusable menstrual components (Table 2). Women from the Sylhet division were 2.22 times more inclined to use reusable menstrual products (95% CI: 1.95, 2.53) than women from Barishal. Women dwelling in countryside areas were 1.59 times more likely to practice using reusable menstrual items (95% CI: 1.51, 1.67) than women living in urban areas. A higher academic achievement among household heads significantly reduced the likelihood of reusing menstrual components (AOR: 0.60; 95% CI: 0.57, 0.64) in comparison with household heads with no education or only pre-primary education. Higher educated women were 63% less likely (AOR: 0.37; 95% CI: 0.34, 0.41) to prefer reusable products over those with little or no education. Wealthy women (AOR: 0.36; 95% CI: 0.34, 0.38) had lower odds of using reusable menstrual materials during menstruation. Women aged 35–49 years were over two times as likely (95% CI: 2.10, 2.37) to use reusable components for menstruation management than those aged 15–24 years.

Table 2. Binomial Logistic Regression analysis to identify predictors of reusable menstrual material usage

Socio-demographic variable	AOR (95% CI)	p-value
Divisions		
Barishal (ref)		
Chattogram	1.92 (1.72, 2.14)	<0.001
Dhaka	1.34 (1.2, 1.49)	<0.001
Khulna	1.15 (1.03, 1.29)	0.014
Mymensingh	1.73 (1.51, 1.97)	<0.001
Rajshahi	1.7 (1.52, 1.91)	<0.001
Rangpur	2.01 (1.78, 2.26)	<0.001
Sylhet	2.22 (1.95, 2.53)	<0.001
Area of residence		
Urban (ref)		
Rural	1.59 (1.51, 1.67)	<0.001

Table 2 continued from previous page

Socio-demographic variable	AOR (95% CI)	p-value
Sex of household head		
Male (ref)		
Female	1.02 (0.95, 1.09)	0.648
Education level of household head		
Pre-primary or none (ref)		
Primary	1.01 (0.95, 1.08)	0.758
Secondary or higher	0.60 (0.57, 0.64)	<0.001
Education level of women		
Pre-primary or none (ref)		
Primary	0.93 (0.84, 1.03)	0.145
Secondary or higher	0.37 (0.34, 0.41)	<0.001
Wealth index		
Poor (ref)		
Middle	0.75 (0.7, 0.81)	<0.001
Rich	0.36 (0.34, 0.38)	<0.001
Age of women		
15–24 (ref)		
25–34	1.61 (1.53, 1.7)	<0.001
35–49	2.23 (2.1, 2.37)	<0.001
Religion of household head		
Others (ref)		
Muslim	1.04 (0.97, 1.13)	0.271
Currently married		
Yes (ref)		
No	0.63 (0.59, 0.67)	<0.001
Use of mass media		
No (ref)		
Yes	0.71 (0.67, 0.75)	<0.001
Functional difficulties		
Yes (ref)		
No	0.89 (0.76, 1.03)	0.124

37% lower odds of using reusable materials were observed among currently unmarried women (AOR: 0.63; 95% CI: 0.59, 0.67). The odds of using reusable menstrual materials were 29% less (AOR: 0.71; 95% CI: 0.67, 0.75) for women who were exposed to mass media than for those who were

not (Table 2).

4.3. Subgroup analysis

Subgroup analysis was carried out based on the wealth index, which revealed the most substantial disparities in the application of reusable menstrual items compared to other factors. While the primary analysis identifies the key determinants, it falls short of capturing the nuanced interactions of these factors within distinct socioeconomic strata. By focusing on subgroup analysis, we can explore these variations more comprehensively, revealing whether and to what extent the effects of these factors differ across wealth quintiles.

Residence in different divisions resulted in notable differences in the application of reusable menstrual products among women within the same wealth quintile (Figure 2). For example, 82% of females from the Barishal division in the poor wealth quintile used reusable menstrual materials, while this figure increased to 94% among women from the Sylhet division, despite both groups belonging to the same wealth quintile. When comparing across wealth quintiles, the disparity became even more pronounced. In the Rangpur division, 91% of women in the poor wealth index used reusable materials, but this figure dropped significantly to only 57% for women in the rich wealth quintile.

The education level of the household head did not significantly impact the application of reusable period-related products among women in the poor and middle wealth indices (Figure 3). However, in the rich wealth index, only 49% of women with a household head possessing secondary or higher education were inclined to use reusable materials, a figure notably lower than that for women whose household heads had no or only primary education. Across different wealth indices, this disparity became more apparent. For example, while 49% of women in the rich wealth group used reusable materials, this percentage was significantly higher among women in the poor wealth group, with household heads having the same educational

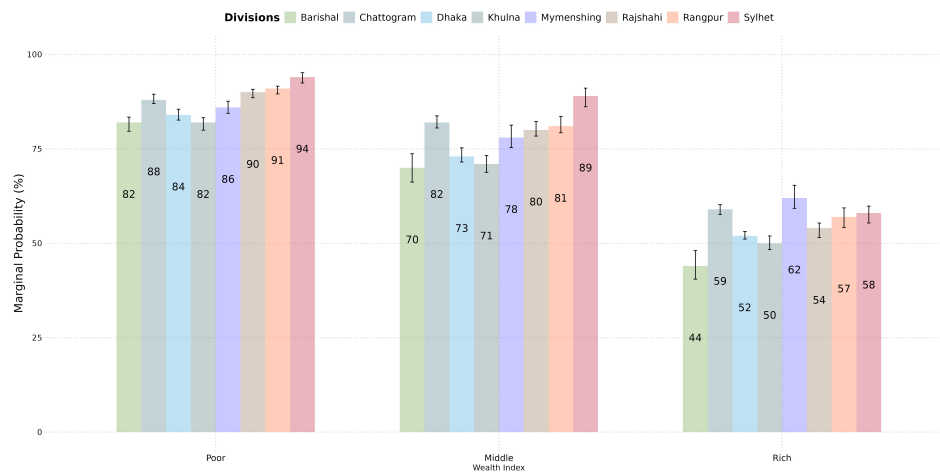


Figure 2. Marginal probability of using reusable menstrual materials across different divisions, stratified by wealth quintiles.

level.

The education level of women plays a crucial role in the application of reusable period-related items across all wealth indices. In the rich wealth index, only 49% of women with secondary or higher education used reusable materials, a figure notably lower than that for those with no education or pre-primary (78%) or primary education (74%). This highlights a significant gap in the use of reusable materials based on educational attainment. Moreover, a striking difference was observed across wealth indices. For instance, while 74% of women with primary education in the rich wealth index used reusable materials, this percentage was significantly higher, at 90%, among women with primary education in the poor wealth group. This suggests that socioeconomic factors, including wealth and education, intersect to influence menstrual material usage patterns (Figure 3).

Within the low wealth index, the area of residence does not appear to significantly influence the practice of using menstrual items among women (Figure 4). However, in the rich wealth index, rural women were found to use reusable menstrual materials at a rate approximately 12% higher than their urban counterparts, and this difference was statistically significant.

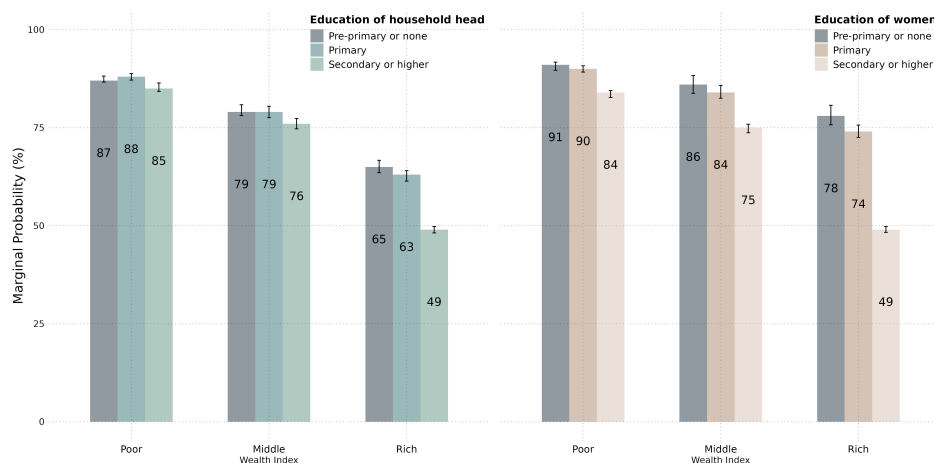


Figure 3. Marginal probability of using reusable menstrual materials across different education levels of the household head and the women themselves, stratified by wealth quintiles.

Additionally, a notable disparity was observed between wealth indices. The differences in menstrual material usage between urban and rural women were more pronounced when comparing the poor and rich wealth indices, with wealthier women in urban areas demonstrating a markedly lower likelihood of using reusable materials than their rural counterparts. This highlights the intersection of socioeconomic status and geographic location in influencing menstrual hygiene practices.

Among young women aged 15–24, 83% of the poor wealth index used reusable menstrual materials, compared to nearly 90% of older women aged 35–49. This difference in usage was observed consistently across all wealth indices. Additionally, significant variations within the same age group across wealth indices were noted. For example, 88% of women aged 25–34 from the poor wealth index used reusable menstrual materials, while only 55% of their counterparts in the rich wealth index did so. Marital status also influences menstrual material usage. Among poor women, 88% of married women used reusable materials, compared to 82% of unmarried women. Similar trends were observed across other wealth indices. In the middle wealth index, 79%

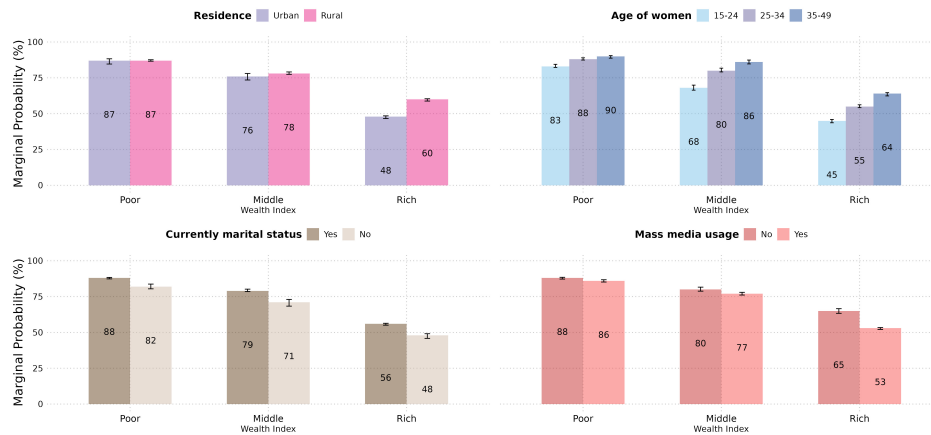


Figure 4. Marginal probability of using reusable menstrual materials across area of residence, age of women, current marital status, and mass media usage, stratified by wealth quintiles.

of married women used reusable materials, while the figure dropped to 71% for unmarried women. Additionally, substantial differences were detected in menstrual material usage within the same marital status across wealth indices. For instance, 88% of married women in the poor wealth index used reusable menstrual materials, compared to only 56% of their counterparts in the rich wealth index. Exposure to mass media significantly influenced the choice of menstrual materials. In the highest wealth quintile, 53% of women who used mass media reported using reusable materials, whereas 65% of those who did not use mass media used them. Notably, there was a difference across wealth indices as well. In the poor wealth index, 86% of women who used mass media used reusable menstrual materials, whereas the figure was 77% for women from the middle wealth quintile (Figure 4).

5. Discussion

Findings from this investigation indicate that demographic and socio-economic characteristics are linked to the reusability of menstrual management materials among women aged 15 to 49. Women with an urban place of liv-

ing, higher level of education, higher level of household education, female household head, richest economic status, lower age, currently unmarried, and using mass media were less prone to use reusable menstrual items.

This study found that almost 2 out of 3 women use reusable menstrual materials in Bangladesh. It is therefore an important question whether or not they can maintain hygiene. Inadequate cleaning and storage of reusable materials may foster the development of infections (Torondel et al., 2018). Since there is no evidence that menstruating women in Bangladesh dry their reusable materials in the sunlight and properly store them, they could face an increased risk of infections such as candidiasis, bacterial vaginosis, and urogenital infections. These infections are risk factors for adverse pregnancy outcomes, HIV, and Human Papillomavirus Infection (Johnson and Lewis, 2008). Existing studies surrounding Bangladesh have reported a greater proportion of reusable menstrual items. For example, research conducted in Nepal found that before the earthquake, 66.7% of women used reusable sanitary clothes (Budhathoki et al., 2018). Another study revealed that in India, women of reproductive age exhibited a prevalence of 42% to 51.2% in the use of reusable menstrual materials (Torondel et al., 2018). Available evidence highlights that the type of menstrual materials chosen is affected by price, access, and prevailing cultural beliefs (Shannon et al., 2021; Hennegan et al., 2019). Parental influence, personal preferences, and socioeconomic pressures collectively influenced menstrual hygiene practices (Kaur et al., 2018). The percentage of reusable materials is lower in the national capital Dhaka. The lower prevalence of use of reusable menstrual products in Dhaka, the central hub of the country, may be attributed to several potential positive factors. Firstly, the advanced education levels among women residing in Dhaka, coupled with increased connectivity to mass media, foster awareness about various menstrual hygiene products. Additionally, the city's accessibility to a wide range of menstrual products meets the diverse needs and preferences of women. Another contributing factor may be the comparatively higher rate of employment among women in Dhaka. Given

the demanding nature of modern lifestyles, where time is often a precious commodity, the convenience offered by disposable menstrual materials becomes particularly appealing. With disposable options readily available and requiring less time for maintenance, women may find them more suitable for their busy schedules. Lacking these, in the Northern or Southern regions, the prevalence of reusable materials is higher.

Women residing in rural areas exhibited a higher inclination towards the utilization of reusable menstrual materials when compared to their counterparts in urban settings. Previous research has indicated that women in remote regions preferred reusable pads, whereas those in urban areas showed a preference for commercially available sanitary pads (Anaba et al., 2022; Kaur et al., 2018). Women in rural communities are at a higher likelihood of being unemployed or involved in low-paying jobs, resulting in limited income for the purchase of commercial sanitary pads. In addition to cost constraints, the availability of disposable pads and, obviously, the social and cultural practices may vary between rural and urban areas. There is supporting evidence indicating that individuals who menstruate prefer reusable pads due to their cost-effectiveness and ready availability (Kambala et al., 2020).

We found that the education level of the household head influences the utilization of modern menstrual items, which is in line with other studies. (Afiaz and Biswas, 2021). The variable sex of the household head was not statistically significant in the adjusted analysis and therefore should not be included in this conclusion. The likely reasons for this could be the issues in understanding that arise during menstruation. Naturally, women are likely to be more attentive to these matters than men, given that they experience these challenges firsthand. Moreover, heads of households with higher education are expected to possess greater awareness regarding menstrual cycles and the necessary care for women during these times.

Our findings revealed a higher prevalence of reusable menstrual material usage among women with lower educational attainment, in contrast to those

with a higher level of education. This outcome aligns with expectations, because women with higher education are typically more likely to have jobs and therefore can manage the cost of disposable pads. Additionally, literate women have better access to health information related to sanitary items. This is consistent with the results from research undertaken in Ghana (Anaba et al., 2022).

Notably, the adoption of washable menstrual materials was prominent among females falling within the lower economic strata. Understandably, women with limited economic means may face challenges in affording commercially available sanitary pads. Another possible explanation could be that women of lower economic backgrounds tend to have less education and awareness about menstrual hygiene. They often adhere to traditional practices passed down from their families due to their familiarity with these methods. These findings are similar to the study conducted in Ghana. Women from the poorest economic status were more likely to use reusable period-related products in Ghana. Another study conducted in Bangladesh discovered that women belonging to lower wealth brackets were more inclined to use traditional methods, which included reusable menstrual products (Anaba et al., 2022).

The age of individuals was identified as a significant factor influencing the choice of reusable menstrual materials. We found that older women are more likely to have reusable menstrual materials during their menstruation. This aligns with research conducted in India, where findings indicated that adult women tended to opt for reusable materials, whereas younger women displayed a preference for disposable sanitary products (Garikipati and Boudot, 2017). In Malawi, adolescent girls expressed a perception that reusable materials were considered 'old-fashioned,' leading to a preference for single-use pads (Kambala et al., 2020).

Women with access to mass media were less inclined to adopt reusable menstrual products. Several studies have shown the same findings as ours. One study in Bangladesh found that women with more access to mass me-

dia were more likely to use modern menstrual materials than traditional materials (Afiaz and Biswas, 2021). Another study based on the same topic but conducted in Ghana also showed the same results that women who had more access to mass media used less reusable menstrual materials (Anaba et al., 2022). A potential reason may be that television, radio, and newspapers frequently promote commercial sanitary products, which may influence women who are exposed to mass media.

Subgroup analysis provided a fresh perspective in this context, revealing variations in the application of reusable menstrual products across different wealth indices. Regional disparities contributed significantly to the differences observed in the adoption of these materials among various wealth quintiles. Notably, women in the richest wealth quintile across all divisions exhibited a lower inclination to use reusable menstrual products. However, considerable variation persisted within each division, highlighting the influence of wealth indices on the utilization of such products. This complexity underscored the multiple factors that affected menstrual material usage at both the individual and societal levels.

The area of residence significantly influenced the use of reusable menstrual products, particularly among the wealthier quintiles. Urban and rural residents displayed distinct usage patterns within the higher wealth group, while no notable differences were observed in the lower or middle wealth quintiles. This disparity between urban and rural settings was apparent across wealth indices, indicating that the place of residence can affect the accessibility of and preference for reusable menstrual items. Importantly, the risk associated with using these materials varied significantly based on the educational status of both the household head and the women themselves. Additionally, substantial disparities emerged within the same educational status when comparing women across different wealth quintiles, highlighting the complex interplay between socioeconomic status and education in shaping menstrual material usage.

The age of women played a crucial role in the variation of reusable men-

strual material usage across different wealth quintiles, with significant differences observed within the same age group when comparing wealth indices, underscoring the influence of socioeconomic status. Additionally, marital status substantially contributed to the variation in the use of reusable menstrual products, as distinct differences emerged across wealth quintiles even among women of the same marital status, emphasizing the intersection of these factors with wealth. Exposure to mass media also emerged as a significant factor influencing the use of reusable menstrual products, particularly in the highest wealth quintile. Clear disparities in menstrual product usage were evident between those exposed to mass media and those who were not, highlighting the potential of media as a powerful tool for shaping behavior and promoting awareness about reusable menstrual options.

5.1. Strengths and limitations

To our knowledge, this is one of the first studies in Bangladesh to investigate menstrual hygiene practices among reproductive-aged women using nationally representative data, allowing the results to be generalizable to the wider population. Also, we employed appropriate statistical analysis, such as multi-level analysis, to observe the correlation among districts of Bangladesh as well as among clusters within districts.

Due to the cross-sectional design of the study, it is not possible to establish causal relationships between the factors and the outcome variable; therefore, the findings should be interpreted with caution. Additionally, since data collection relied on self-reporting, there is a possibility of social desirability bias.

5.2. Implications for policy, practice and research

The results of this study can inform menstrual health policy, program development, and further research. The Bangladesh Health Services must promote awareness of proper menstrual hygiene practices among the public. Leveraging mass media can serve as a valuable tool for disseminating in-

formation on menstrual health. Furthermore, the Bangladesh Education Service should strengthen its initiatives in menstrual health education by offering practical guidance on the proper utilization of reusable menstrual items and teaching girls about the safe handling of such products. Additionally, addressing the stigma and shame surrounding the drying of reusable menstrual materials in sunlight necessitates the implementation of comprehensive social and behavioral change communication programs. These collective efforts aim to mitigate unhygienic practices associated with reusable materials and reduce the risk of infections among users.

Eliminating all taxes on sanitary napkins would support adolescent girls and adult women who currently find these products unaffordable. WaterAid's analysis strongly advocates for the removal of taxes on the production of disposable sanitary napkins, highlighting its potential to enhance menstrual health and hygiene for millions of women and girls across the country (WaterAid Bangladesh, 2024). Under the current tariff proposal by the National Board of Revenue (NBR), the total tax burden on sanitary pads or napkins amounts to a staggering 127.84%. This Total Tax Incidence (TTI) is calculated based on the Assessable Value (AV) of the products and includes 25% customs duty, 45% supplementary duty, 15% VAT, 5% advance income tax, 3% regulatory duty, and 4% advance trade VAT (ATV) (Das et al., 2015). Other African countries, including Ethiopia, Tanzania, and Kenya, have either lowered or withdrawn taxes on sanitary items to make them accessible (Welham, 2020).

This study emphasizes the importance of the Bangladesh government's lowering of taxes on sanitary napkins, aiming to enhance affordability and accessibility for women and girls, especially for lower-tier people. In the lowest socioeconomic quintile, the risks associated with using reusable menstrual materials remain consistently high, regardless of socio-demographic variables, when compared to other wealth tiers. Therefore, planning initiatives must prioritize the needs of women in lower-income brackets, ensuring they receive increased support and access to appropriate menstrual prod-

ucts.

This study lays the groundwork for future research in the field to provide valuable insights for policy development and program implementation. Currently, there is limited understanding of the specific types of reusable menstrual materials preferred by women in Bangladesh, as well as the health implications associated with their use. Future research should focus on the acceptability of safer and easily maintainable reusable menstrual options, such as menstrual cups. Moreover, there is a significant gap in the literature concerning the socio-cultural factors and beliefs related to the use of reusable menstrual materials and the experiences of women who choose these products. Programs should be initiated to deliver targeted interventions for women, particularly those in lower-income groups, with follow-up assessments to determine whether the risks associated with using reusable menstrual materials are being reduced.

6. Conclusion

The findings indicated that about two-thirds of women in Bangladesh utilize reusable menstrual products. Women residing in rural areas, possessing lower levels of education, coming from households with lower educational attainment, with a male head of the household, belonging to the poorest economic bracket, older in age, currently married, and not engaging with mass media, were found to have a higher likelihood of utilizing reusable menstrual products. The subgroup analysis highlighted how variations in the adoption of reusable menstrual products differ across wealth indices, underscoring the necessity for targeted interventions that specifically address the needs of lower-income women. The findings demonstrate that while a large proportion of women use reusable menstrual management items, those in wealthier quintiles exhibit lower usage rates, indicating potential barriers rooted in socioeconomic factors and access to hygiene products.

Developing educational campaigns to raise consciousness about the benefits and proper use of reusable menstrual products, as well as enhancing

knowledge of menstrual hygiene, is essential, particularly for women in rural areas and those with lower educational attainment in the lower wealth quintiles. Future initiatives should address both demand- and supply-side considerations, including broadcasting documentaries on menstrual hygiene through various platforms such as television, YouTube, Facebook, and radio. Additionally, it is crucial to strengthen the supply side by improving access to health services for target groups through mobile health technology and information and communication technology. By combining education, outreach, and resource accessibility, these efforts can significantly enhance menstrual health and hygiene practices among females in Bangladesh.

7. Declaration

Md. Niamul Islam and Khondoker Shahriar Islam contributed equally to this work and are considered joint first authors. Khondoker Shahriar Islam is the corresponding author. Md. Niamul Islam conceptualized the study and provided the research idea. Md. Niamul Islam, Khondoker Shahriar Islam, and Asma Ul Hosna wrote the main manuscript. Md. Niamul Islam and Khondoker Shahriar Islam prepared the figures and performed the data analysis. Ema Akter provided insights and supervised the research. All authors reviewed and approved the final manuscript.

Rather than collecting primary data, this study used secondary data from the 2019 Multiple Indicator Cluster Survey (MICS), conducted by the Bangladesh Bureau of Statistics (BBS) with technical support from UNICEF and UNFPA. Informed oral consent was obtained from all respondents, and confidentiality was ensured. The dataset is nationally representative and can be requested from the Bangladesh Bureau of Statistics (<https://bbs.gov.bd/>). The authors declare no competing interests and received no external funding. We acknowledge the Bangladesh Bureau of Statistics, UNICEF Bangladesh, and UNFPA Bangladesh for providing access to the MICS dataset.

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