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Rural-Urban Differences and Associated Socio-economic Factors in Menstrual Hygiene Practices among Adolescent Girls: A Comparative Study in XXX

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Research Article

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Rural-Urban Differences and Associated Socio-economic Factors in Menstrual Hygiene Practices among Adolescent Girls: A Comparative Study in XXX

Abstract

Background: Menstrual hygiene management (MHM) remains a critical challenge for adolescent girls in low- and middle-income countries like XXX, particularly in rural areas where socio-economic and cultural barriers limit access to hygienic products, knowledge, and facilities, adversely affecting health, education, and well-being. This study examines rural-urban differences in MHM practices among adolescent girls and the socio-economic and cultural factors associated with these differences, in Monohardi Upazila (rural site) and Narsingdi Sadar Upazila (urban site), Narsingdi District, XXX.

Methods: A cross-sectional quantitative design was used, involving 250 adolescent girls aged 11–19 years (120 rural, 130 urban) selected via simple random sampling. Data were collected through structured face-to-face interviews assessing socio-demographic characteristics, menstrual hygiene practices, knowledge levels, and socio-cultural beliefs. Descriptive statistics and Pearson's Chi-Square tests ($p < 0.05$) were applied using SPSS version 27 to identify associations between socio-economic factors and MHM behaviors; two adjusted multivariable binary logistic regression models were additionally run to test independent correlates of sanitary-pad use and hygiene-practice frequency, controlling for residence, socio-economic class, maternal literacy, restriction practice, and age group.

Results: Urban girls exhibited significantly better MHM practices than rural counterparts ($p < 0.001$ for key variables). Sanitary pad usage was higher in urban areas (84.6% vs. 53.3% rural), with urban girls also demonstrating more frequent pad changes (e.g., twice daily: 53.1% vs. 50.8%), safer disposal methods (household waste: 80.0% vs. 55.8%), and fewer cultural restrictions (e.g., avoiding outdoors: 15.4% vs. 42.5%). In the adjusted model, socio-economic class was the strongest independent correlate of sanitary-pad use (middle vs. lower class, adjusted OR = 71.60, 95% CI 19.70–260.27, $p < 0.001$) and of frequent hygiene practice (adjusted OR = 4.23, 95% CI 1.51–11.85, $p = 0.006$), while maternal literacy, cultural restriction practice, and urban/rural residence did not remain independently significant after adjustment. Rural girls showed markedly stronger normative rejection of pad reuse than urban girls (73.3% vs. 24.6% combined disagreement, $\chi^2 = 76.774$, $p < 0.001$), a counter-intuitive finding discussed below.

Conclusions: Socio-economic class, in particular, was significantly and independently associated with MHM practices, with urban-rural disparities underscoring structural inequities. Maternal literacy showed a strong bivariate but not independently significant adjusted association, suggesting a shared socio-economic pathway rather than an independently confirmed effect. Targeted interventions emphasizing education, affordable product access, infrastructure improvements, and stigma reduction are essential to enhance MHM, particularly in rural XXX, supporting Sustainable Development Goal 5 for gender equality.

Keywords: Menstrual hygiene management, socio-economic factors, cultural stigma, adolescent girls, rural-urban disparities, XXX.

1 Introduction

Adolescent[1] girls in low- and middle-income countries (LMICs) such as XXX face heightened risks to their social well-being and health [1]. Menstruation significantly contributes to this vulnerability, particularly where cultural norms and taboos treat it as a private, often shameful matter [2]. This entrenched silence impedes girls' ability to learn about and access essential resources for managing their menstrual hygiene management (MHM). While menstruation is a natural biological process occurring monthly for women from puberty until menopause, societal misconceptions frequently lead to stigma. In many contexts, the conversation of menstruation is perceived as unsuitable. As a result, many young girls are ignorant of important information about menstrual hygiene [3]. This creates societal norms in XXX which frequently hinder girls' participation in regular activities like social gatherings and education.

Gynecological infections, urinary tract infections (UTIs), and other reproductive health issues have been reported to be associated with poor MHM, which presents serious health concerns [4]. In low-resource areas, access to clean sanitary items is restricted. Inadequate information and inadequate sanitation infrastructure make these issues worse. According to studies, in rural XXX, girls often have less access to proper menstrual products than their urban counterparts. They are unable to obtain the information or assistance they need to properly manage their menstrual health due to cultural taboos [5, 6]. Although national and international efforts aim to educate people about healthy menstrual practices, adolescent girls in rural XXX continue to report limited knowledge of hygiene practices. Prior multi-country evidence indicates that girls from lower-income households are less likely to sustain hygienic menstrual practices, largely due to constrained access to sanitary products and disposal options [7]. Economic situation has a significant influence on the selection of menstrual products, the frequency of their replacement, and adherence to menstrual-related restrictions, and higher maternal literacy is positively correlated with better MHM [8]. Focused interventions that target these socio-economic and educational factors could meaningfully improve menstrual hygiene, especially for lower-income households.

By assessing adolescent girls' knowledge levels, the challenges they face, and their existing menstrual hygiene practices in both rural and urban settings, this study aims to inform future efforts to improve MHM outcomes, in line with Sustainable Development Goal (SDG) Target 5.6 on gender equality, health, and education. Cultural stigma, limited awareness, and inadequate facilities and resources hinder girls' ability to manage menstrual hygiene effectively, carrying detrimental effects on their physical and emotional health. Urban adolescent girls in XXX generally have somewhat better access to information, products, and infrastructure than rural girls, though persistent barriers remain: studies in Dhaka's urban areas report that around 70% of adolescent girls use sanitary pads, with better changing and disposal practices than rural counterparts, yet affordability, privacy, and school sanitation challenges persist [5]. Similarly, a BMC Women's Health analysis of Rajshahi found urban girls were significantly more likely to report good menstrual hygiene management practices than rural peers (32.3 % vs. 27.7 %). These urban advantages reflect greater access to sanitary

[1] The World Health Organization (WHO) defines an adolescent as any person between ages 10 and 19.

materials, improved awareness through media and peer networks, and more supportive school infrastructure [9].

Socio-economic factors significantly shape menstrual hygiene practices. Economic constraints directly impact an individual's ability to purchase essential sanitary products, and empirical evidence consistently reveals wealth-based disparities in access to MHM facilities and sanitary pads across diverse national contexts. Household wealth, educational attainment, rural-urban divides, and limitations in domestic infrastructure are key drivers of these inequities, with wealth emerging as a primary factor influencing unequal access to MHM resources [10]. This inequality often manifests as a critical shortage of safe, dedicated MHM facilities, compromising the health, safety, and dignity of women and girls, and unequal access ultimately compounds existing socio-economic inequalities [3].

Adolescent girls frequently possess constrained knowledge and practical experience regarding MHM. Societal taboos that inhibit open dialogue often result in insufficient or inaccurate understanding of reproductive anatomy and function [1], with consequences for physical, mental, and emotional well-being as well as social development and educational attainment [8]. Promoting MHM literacy among adolescent girls is therefore a critical public health priority for policymakers in LMICs [11]. Within XXX, cultural norms and women's restricted participation in household decisions contribute to persistent gaps in menstruation-related knowledge; although mothers and female relatives serve as the primary information sources, the guidance they offer is typically minimal and occasionally inaccurate, fostering adverse health outcomes and social difficulties [9]. Click or tap here to enter text.. Adolescent girls in rural and tribal communities in particular face barriers to accessing relevant information due to social prohibitions and unsupportive parental attitudes toward open discussion of these matters [12], and many report insufficient or incorrect knowledge about menstrual hygiene, increasing their risk of infection; mothers, television, friends, teachers, and relatives are consistently identified as the primary sources of menstrual health information [13]. Adherence to hygienic practices, including sanitary-pad use and thorough genital hygiene, is critical for mitigating these health risks [14].

Cultural and religious norms impose further constraints, including dietary restrictions and practices of untouchability during menstruation, which undermine adolescent girls' dignity and well-being and frequently result in inadequate menstrual education [15]. Many girls feel too ashamed or uncomfortable to discuss menstrual matters openly with parents, peers, or educators, and adherence to numerous rituals and restrictions often prevents access to scientific information about menstruation, compromising hygiene and contributing to negative outcomes; active engagement by healthcare providers is important for addressing these challenges [16]. The large-scale rural-urban comparative study in Rajshahi division of 586 girls aged 14–19 found that only 37.7% continuously used sanitary pads; among cloth users, approximately 71% reused the material, and although nearly all washed cloths, only 57% used soap. Fewer than half changed absorbent materials three or more times per day, and proper genital hygiene was practiced by fewer than 40%; over 55% buried menstrual materials and around 20% disposed of them in water bodies. Logistic regression in that study identified urban residence, younger age, smaller family size, and parental (paternal) education as significant correlates of better MHM practice [9]. Separately, exclusive use of

hygienic menstrual products among adolescent girls in urban India has been shown to be shaped by higher education, household wealth, access to private sanitation, media exposure, socio-demographic identity, and regional location [17].

While Ha and Alam (2022) provided an important urban-rural comparison of MHM practice, three specific gaps remain that the present study addresses. First, their multivariable model tested paternal (not maternal) education, family size, age, and residence as predictors, and found household wealth/perceived socio-economic status to be non-significant; the specific role of maternal literacy, which more directly mediates health-related decision-making for younger dependents in South Asian households, was not tested. Second, because their sampling was school-based and confined to grades 9–10, out-of-school and younger adolescent girls were structurally excluded, a population in which MHM disadvantage is likely most pronounced; the present study used household-based sampling capturing girls as young as 11 years, including those out of school. Third, the Rajshahi study is geographically confined to a single division in northwestern Bangladesh, whereas the present study provides comparative evidence from Dhaka division, a different administrative and cultural setting. This study therefore aims to examine rural-urban differences in MHM practices among adolescent girls in XXX and the socio-economic factors, including maternal literacy, socio-economic class, and cultural restriction practices associated with these differences, using a quantitative household survey design.

1.1 Theoretical Framework

1.1.1 Health Belief Model (HBM)

Originating in the 1950s through the work of Hochbaum, Rosenstock, and Becker, the Health Belief Model (HBM) links health behaviors directly to an individual's assessment of potential benefits. This framework posits that people are likeliest to adopt preventative health actions when three conditions align: 1) they perceive a health threat as severe, 2) they believe themselves personally vulnerable, and 3) they view the anticipated benefits of action as outweighing the associated costs or barriers [18, 19]. Widely applied in health behavior research, the HBM helps explain decision-making by analyzing personal beliefs about health risks and the advantages of specific behaviors. Its focus on subjective perceptions makes it particularly valuable for understanding menstrual hygiene practices, as it illuminates how adolescent girls' interpretations of menstruation shape their hygiene behaviors.

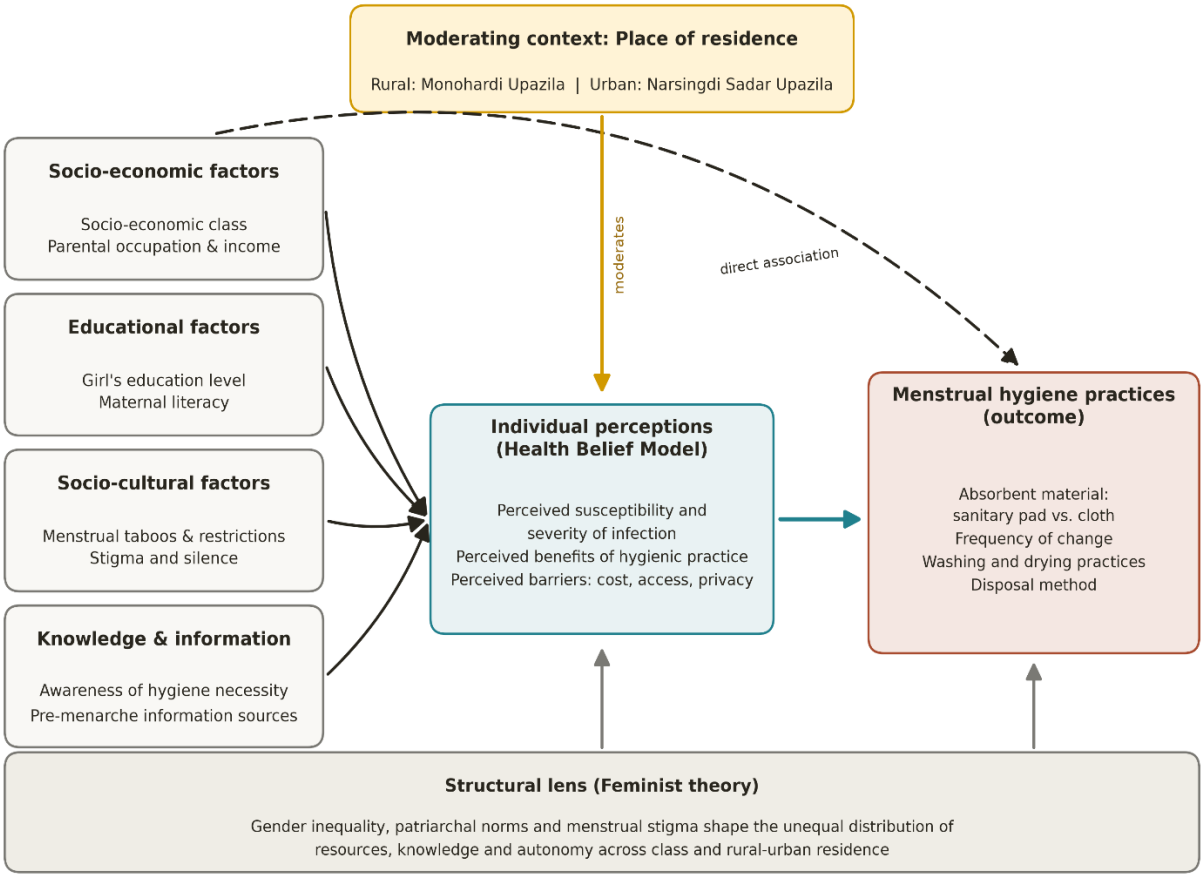
1.1.2 Feminist Theory

Marxist and socialist ideas are incorporated into feminist theory, which is based on the critical tradition of opposing oppressive power structures. Sex, gender, racism, prejudice, equality, diversity, and choice are among the constructs that it focuses on analytically. At its core, feminist research looks at social stratification, intersectionality, and strategies to bring about radical change [20]. This theoretical framework provides a critical analysis of sociocultural processes in relation to MHM. It demonstrates how girls' lived experiences and hygiene habits are influenced by a combination of menstruation stigmatization, ingrained gender inequality, and patriarchal structures. The societal stigma and silence surrounding menstruation are aggressively challenged by feminist theory, which promotes its

acknowledgement as a human rights issue, calling for fair access to menstruation education, supplies, and secure spaces for girls. The theory also critiques the medicalization of menstruation, the portrayal of a normal biological function as a pathological "problem" to be addressed, rather than as a matter of normative bodily autonomy.

The Health Belief Model and feminist theory are used as complementary rather than competing frameworks in this study. The HBM operates at the level of individual cognition, explaining how an adolescent girl's perceived susceptibility to infection and perceived benefits of hygienic practice shape her behavior, and is used to interpret the associations between maternal literacy, knowledge, and hygiene practice reported in Section 3. Feminist theory operates at the structural level, explaining why the knowledge, resources, and autonomy needed to act on those individual health beliefs are unequally distributed by gender, class, and rural–urban residence. Read together, the two frameworks connect individual health decision-making to the socio-economic and patriarchal structures that constrain it, which is the central relationship this study investigates.

Figure 1. Conceptual Framework of the Study

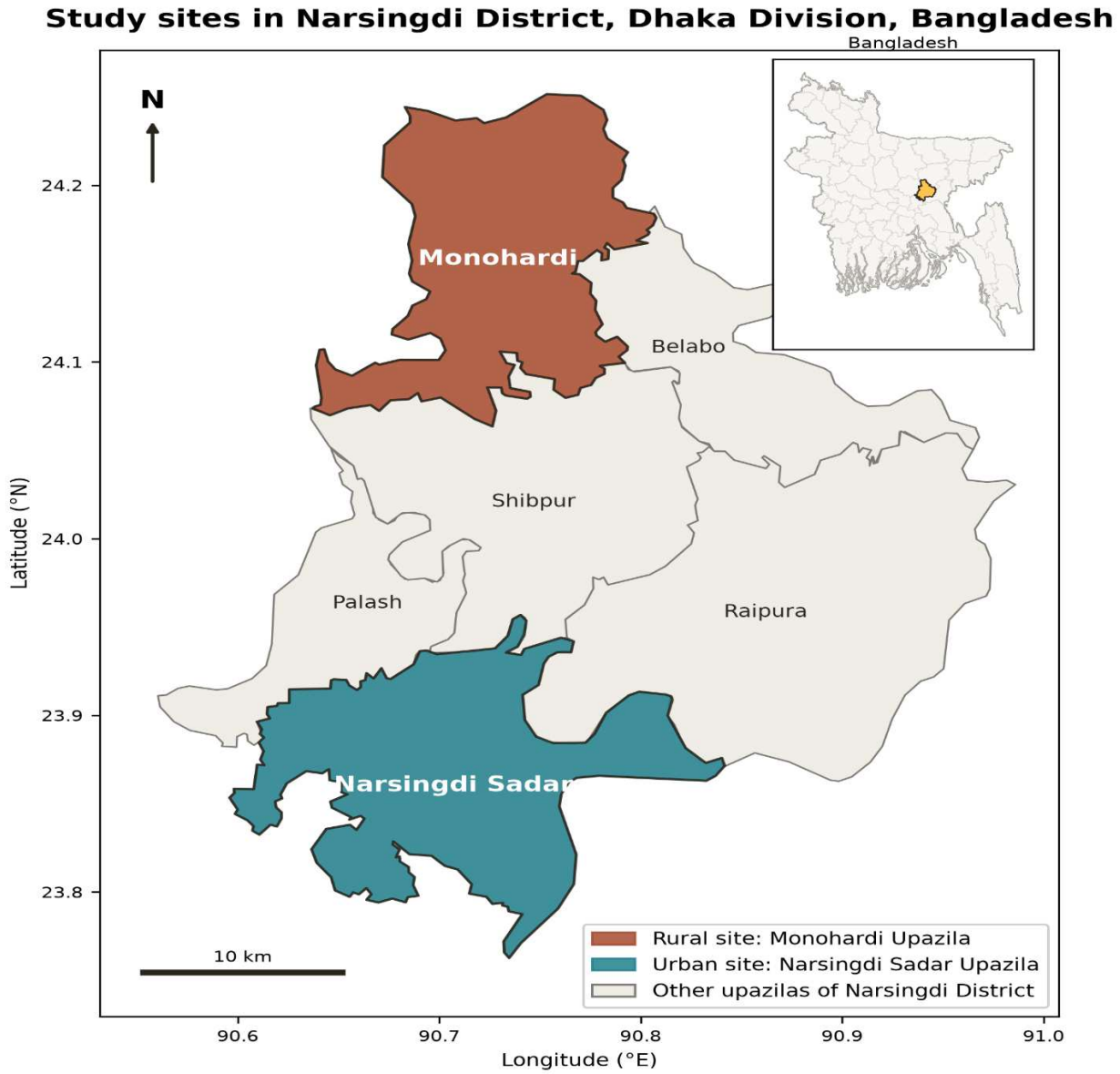


2 Materials and Methods

2.1 Methodology

This study employed a cross-sectional quantitative research design to assess the socio-economic, cultural, educational, and demographic factors associated with menstrual hygiene practices among adolescent girls. The cross-sectional approach allowed for a snapshot of data at a single point in time, enabling the identification of associations between various factors and menstrual hygiene behaviors. The study tested the null hypothesis (H0: There is no significant association between socio-economic factors and menstrual hygiene behavior of adolescent girls in rural and urban areas) against the alternative hypothesis (H1: There is a significant association between socio-economic factors and menstrual hygiene behavior of adolescent girls in rural and urban areas). The geographical location of the study sites is presented in **Figure 2.**

Figure 2: Geographical location of the study sites: the rural site (Monohardi Upazila, Narsingdi District) and the urban site (Narsingdi Sadar Upazila, Narsingdi District), XXX.



Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 27 and Microsoft Excel. Descriptive statistics were used to summarize socio-demographic characteristics, menstrual hygiene practices, and knowledge levels. Pearson's Chi-Square test was employed to assess significant associations between categorical variables, such as socio-economic status and hygiene practices. Two adjusted multivariable binary logistic regression models were additionally estimated to test the independent correlates of (a) sanitary-pad use versus cloth use and (b) frequent versus infrequent hygiene practice, controlling simultaneously for residence, socio-economic class, maternal literacy, restriction practice, and age group. The significance level was set at $p < 0.05$. These statistical methods enabled the identification of patterns and associations related to menstrual hygiene behaviors, testing the hypotheses regarding the relationship of socio-economic, cultural, and educational factors with MHM.

2.2 Methods

Data collection took place at two sites within Narsingdi District, Dhaka Division, XXX: (i) the rural site, Monohardi Upazila; and (ii) the urban site, Narsingdi Sadar Upazila. This rural setting was chosen to investigate menstrual hygiene practices among adolescent girls, as rural areas often face unique socio-economic and cultural challenges that impact health behaviors, while the urban site was selected to assess hygiene practices in a contrasting urban setting. We collected data through a survey method with a closed-ended questionnaire. Our total sample size was 250: 120 participants were from the rural site, and 130 participants were from the urban site. The study utilized simple random sampling to select participants from the target population. Data were collected through face-to-face interviews using a structured, pre-tested questionnaire with closed-ended questions capturing socio-demographic characteristics (age, education level, maternal literacy), menstrual hygiene practices (material use, disposal methods, frequency of changing pads), knowledge levels (awareness of hygiene necessity), and socio-cultural beliefs (taboos, restrictions). The use of closed-ended questions, including Likert scales, categorical classifications, and frequency scales, ensured standardized responses suitable for quantitative analysis. Eligible participants were adolescent girls resident in the selected study sites who had attained menarche, regardless of chronological age, provided they fell within the WHO adolescent age band (10–19 years); girls who had not yet reached menarche were excluded regardless of age. This menarche-based inclusion criterion accounts for the presence of participants as young as 11 years in the achieved sample. According to the 2022 Population and Housing Census, the urban catchment (Narsingdi Sadar Upazila) recorded a total of 855 females, among whom the number of adolescent girls is approximately 200; the rural catchment (Monohardi Upazila) recorded a total of 1,245 females, among whom the number of adolescent girls is approximately 180. These figures refer to the specific union/upazila-level enumeration blocks used as sampling frames for this study, not to district-wide totals [21]. The sample size was calculated using the Krejcie and Morgan sample-size formula [22].

2.2.1 Operational Definitions and Measurement

Socio-economic class was assigned using a modified composite index (household monthly income, parental occupation, and parental education), adapted from the widely used Kuppuswamy/BG Prasad-style composite approach applied in prior South Asian MHM studies [9], and categorized into Lower, Middle, and Upper tertiles. Maternal literacy was measured with a single closed-ended item with four response categories (illiterate, primary school, high school/secondary, graduation/tertiary); for the adjusted regression analysis (Section 3.4), this was dichotomized into "illiterate/primary" versus "secondary or higher." Hygiene practice frequency was measured with a single four-point ordinal item (rarely, sometimes, often, very often) capturing self-reported adherence to recommended hygienic behaviors (e.g., regular product changing, washing); for the adjusted model, this was dichotomized into "frequent" (often/very often) versus "infrequent" (rarely/sometimes). Knowledge and attitude items (Table 3) were measured using individual five-point Likert-scale statements (strongly disagree to strongly agree) rather than a single composite score, consistent with the original questionnaire design; we note the absence of a validated composite MHM knowledge/practice scale as a limitation. Cultural restriction practice was captured as a multi-category nominal item (avoid going outside, do not attend school, do not go to kitchen, not practiced) and, for the adjusted model, was dichotomized into "any restriction practiced" versus "none." The questionnaire was investigator-developed and pre-tested with 20 adolescent girls not included in the final analytic sample, for face validity and comprehensibility, rather than adapted from a previously psychometrically validated MHM instrument.

2.3 Sample Size Estimation Formula (Rural Area)

$$n = \frac{X^2 * N * P * (1 - P)}{\left(ME^2 * (N - 1)\right) + \left(X^2 * P * (1 - P)\right)}$$

Where,
n= sample size
X^2 = Chi-square for the specified confidence level at 1 degree of freedom
N= population size
P= population proportion
ME= desired margin of error
In Monohardi Upazila, there are 180 adolescent girls, which is our target population.
The total population size (N) is =180
Margin of error (ME) = 0.05 (for 5%)
P = 0.5
X^2 = 3.841
So,
n = X2* N * P * (1-P)/ (ME2* (N-1)) + (X2* P * (1-P))
= 3.841* 180 * 0.5 * 0.5 / {(0.05)2 * (180-1)} + {3.841 * 0.5 * 0.5}
= 122.78 = 123
A minimum of 123 participants was therefore required for the rural site. A total of 120 rural participants were ultimately enrolled (97.6% of the calculated minimum), a small shortfall

attributable to field logistics and the data-collection timeline rather than a deliberate rounding-down decision.

Sample Size Estimation Formula (Urban Area)

$$n = \frac{X^2 * N * P * (1 - P)}{\left(ME^2 * (N - 1)\right) + \left(X^2 * P * (1 - P)\right)}$$

Where,
n= sample size
X^2 = Chi-square for the specified confidence level at 1 degree of freedom
N= population size
P= population proportion
ME= desired margin of error
In Narsingdi Sadar Upazila, there are 200 adolescent girls, which is our target population.
The total population size (N) is =200
Margin of error (ME) = 0.05 (for 5%)
P = 0.5
X^2 = 3.841
So,
n = X2* N * P * (1-P)/ (ME2* (N-1)) + (X2* P * (1-P))
= 3.841* 200 * 0.5 * 0.5 / {(0.05)2 * (200-1)} + {3.841 * 0.5 * 0.5}
= 131.744 = 132
A minimum of 132 participants was therefore required for the urban site. A total of 130 urban participants were ultimately enrolled (98.5% of the calculated minimum), for the same field-logistics reasons noted above. This small shortfall in both strata (2.4% rural, 1.5% urban) is disclosed as a limitation in Section 5 and is unlikely to materially affect the statistical power of the chi-square and logistic regression analyses reported, given the achieved samples are within 3% of the calculated targets.

2.4 Ethical statement

This study was conducted in accordance with the Declaration of Helsinki and approved by the Ethical Committee of Noakhali Science and Technology University (NSTU) (Reference no: NSTU/SCI/EC/2025/232, dated January 15, 2025). Written informed consent was obtained from all participants prior to data collection. Because the study sample included girls below 18 years of age, written informed consent was obtained from a parent or legal guardian for all participants under 18, in addition to the participant's own written informed assent; for participants aged 18–19, consent was obtained directly from the participant. Parents/guardians and adolescent participants were briefed separately, in age-appropriate language for the latter, on the study purpose, procedures, voluntary nature of participation, and right to withdraw. This dual consent/assent procedure was reviewed and approved as part of the overall protocol by the NSTU Ethical Committee. Participants were informed of the study's purpose, procedures, potential risks, and their right to withdraw at any time without consequences. To ensure confidentiality, no personal identifiers (e.g., names, student IDs) were collected, and each participant was assigned a unique anonymized ID.

Physical questionnaires were stored in a locked, secure facility at NSTU, accessible only to the research team. Digital data were encrypted and stored on password-protected servers at NSTU, with access restricted to authorized researchers. Data will be retained for five years post-publication, in line with NSTU ethical guidelines, after which they will be securely destroyed. All procedures adhered to ethical standards for protecting participant privacy and data security, as outlined by the World Medical [23]. Participants reporting severe psychological distress during data collection were referred to NSTU's counseling services, ensuring ethical management of vulnerable cases.

3 Results

3.1 Socio-economic Characteristics of Rural-Urban Adolescent Girls

Table 1 shows that a total of 250 respondents participated in the study, including 52.0 percent from urban areas and 48.0 percent from rural areas. Age distribution differed significantly between urban and rural settings ($\chi^2 = 7.179$, $p = 0.028$). While the largest age group for both settings was 14–16 years old (60.8 percent overall; 62.3 percent urban, 59.2 percent rural), rural respondents had a notably higher proportion in the 17–19 category, 25.0 vs. 13.1 percent, and a lower proportion in the 11–13 category, 15.8 vs. 24.6 percent.

Table 01: Socio-economic Characteristics of Rural-Urban Adolescent Girls (Sample Size 250)

Variables	Urban, (n=130) (%)	Rural, (n=120) (%)	Total, (n=250) (%)	Chi-Square (χ^2)	P-value
Age Categories (11-19)					
11-13	32 (24.6%)	19 (15.8%)	51 (20.4%)	7.179	**0.028**
14-16	81 (62.3%)	71 (59.2%)	152 (60.8%)		
17-19	17 (13.1%)	30 (25.0%)	47 (18.8%)		
Education Levels					
PSC	17 (13.1%)	32 (26.7%)	49 (19.6%)	12.407	**0.006**
JSC	53 (40.8%)	50 (41.7%)	103 (41.2%)		
SSC	55 (42.3%)	38 (31.7%)	93 (37.2%)		
HSC	5 (3.8%)	0 (0.0%)	5 (2.0%)		
Mother's Literacy Level					
Illiterate	0 (0.0%)	32 (26.7%)	32 (12.8%)	47.139	**<0.001**
Primary School	12 (9.2%)	20 (16.7%)	32 (12.8%)		
High School	105 (80.8%)	60 (50.0%)	165 (66.0%)		
Graduation	13 (10.0%)	8 (6.7%)	21 (8.4%)		
Socio-economic Class					
Lower Class	14 (10.8%)	60 (50.0%)	74 (29.6%)	46.602	**<0.001**
Middle Class	102 (78.5%)	55 (45.8%)	157 (62.8%)		
Upper Class	14 (10.8%)	5 (4.2%)	19 (7.6%)		

Source: Author's Computation from the Field Data

Education level was also significantly different across settings ($\chi^2 = 12.407$, $p = 0.006$). Urban respondents were more likely to have completed SSC, nearly 42.3 percent, or HSC, 3.8 percent, than their rural counterparts, while rural respondents were more represented at the PSC level. Concerning mother's literacy level, a striking disparity emerged ($\chi^2 = 47.139$, $p < 0.001$). Urban mothers were almost universally literate, with 90.8 percent having at least a high school education (high school 80.8%; graduation 10.0%) and none classified as illiterate, whereas 26.7 percent of rural mothers were illiterate and 56.7 percent had secondary or higher education. Similarly, socio-economic class varied significantly between the two cohorts ($\chi^2 = 46.602$, $p < 0.001$). The majority of urban respondents, almost 78.5 percent, belonged to the middle-income group, with far smaller proportions in lower or upper classes; in contrast, rural respondents were disproportionately concentrated in the lower class, nearly 50.0 percent, and had minimal representation in the upper class, 4.2 percent.

3.2 Menstrual Hygiene Practices among Rural-Urban Adolescent Girls

The use of sanitary pads was significantly higher in urban areas (84.6 percent) compared to rural areas (53.3 percent; $\chi^2 = 27.400$, $p < 0.001$), where nearly half of respondents still relied on cloth (46.7 percent vs. 15.4 percent urban).

Table 02: Preferences of Menstrual Hygiene Practices among Rural-Urban Adolescent Girls

Variables	Urban, (n=130) (%)	Rural, (n=120) (%)	Total, (n=250) (%)	Chi-Square (χ^2)	P-value
Hygiene Practice					
Rarely	4 (3.1%)	8 (6.7%)	12 (4.8%)	11.643	**0.009**
Sometimes	10 (7.7%)	25 (20.8%)	35 (14.0%)		
Often	93 (71.5%)	68 (56.7%)	161 (64.4%)		
Very Often	23 (17.7%)	19 (15.8%)	42 (16.8%)		
Material Used for Menstrual Soaking					
Cloth	20 (15.4%)	56 (46.7%)	76 (30.4%)	27.400	**<0.001**
Sanitary Pad	110 (84.6%)	64 (53.3%)	174 (69.6%)		
Frequency of Changing Pads					
Once Daily	19 (14.6%)	34 (28.3%)	53 (21.2%)	9.207	**0.027**
Twice Daily	69 (53.1%)	61 (50.8%)	130 (52.0%)		
Thrice Daily	32 (24.6%)	21 (17.5%)	53 (21.2%)		
More Than Thrice	10 (7.7%)	4 (3.3%)	14 (5.6%)		
Restrictions Practiced During Menstruation					
Avoid Going Outside	20 (15.4%)	51 (42.5%)	71 (28.4%)	33.001	**<0.001**
Do Not Attend School	1 (0.8%)	7 (5.8%)	8 (3.2%)		
Do Not Go to Kitchen	4 (3.1%)	6 (5.0%)	10 (4.0%)		

Not Practiced	105 (80.8%)	56 (46.7%)	161 (64.4%)		
Disposal Method for Used Pad					
In the Toilet Pan	13 (10.0%)	13 (10.8%)	26 (10.4%)	21.896	**<0.001**
In the Open Field	13 (10.0%)	38 (31.7%)	51 (20.4%)		
Burn	0 (0.0%)	2 (1.7%)	2 (0.8%)		
With Other Waste	104 (80.0%)	67 (55.8%)	171 (68.4%)		

Source: Author's Computation from the Field Data

Table 2 data show clear urban-rural divides in menstrual hygiene among adolescent girls. Rural respondents were significantly more likely than urban peers to report less frequent hygiene practices "sometimes" (20.8% vs. 7.7%) and "rarely" (6.7% vs. 3.1%) and less "often" (56.7% vs. 71.5%) or "very often" (15.8% vs. 17.7%) sanitary behavior ($\chi^2 = 11.643$, $p = 0.009$). Frequency of changing pads also differed: 28.3 percent of rural girls changed pads only once per day compared with 14.6 percent of urban girls, while more urban girls changed pads multiple times daily; overall, more than 75 percent of both groups changed pads at least twice per day ($\chi^2 = 9.207$, $p = 0.027$). Restrictive norms were markedly more prevalent in rural areas: 42.5 percent avoided going outside, and 5.8 percent skipped school during menstruation, compared with 15.4 percent and 0.8 percent, respectively, in urban settings (any restriction practiced: 35.6 percent of respondents overall; $\chi^2 = 33.001$, $p < 0.001$). Disposal methods further underscored the gap: rural respondents disposed of used pads in open fields nearly three times more often than urban respondents (31.7 vs. 10.0 percent), whereas the majority of urban girls (80.0 percent) used household waste disposal methods ($\chi^2 = 21.896$, $p < 0.001$).

3.3 Knowledge and Attitudes of Adolescent Girls toward Menstrual Hygiene Practices

Adolescent girls' knowledge and attitudes regarding menstrual hygiene varied significantly by residence across every dimension assessed (all $p < 0.001$). Only 0.8 percent of urban girls felt neutral on whether hygiene during menstruation is necessary, compared with 30.0 percent among rural girls; a far larger share of urban girls held a strong-agreement stance (37.7 vs. 7.5 percent), while overall agreement (about 62 percent combined "agree") was comparable across groups ($\chi^2 = 60.552$). Regarding "bathing during period is necessary," urban respondents more frequently "strongly agreed" (42.3 vs. 32.5 percent) and "agreed" (56.9 vs. 38.3 percent), whereas 27.5 percent of rural girls expressed disagreement compared with none among urban respondents, reflecting notable skepticism in rural areas ($\chi^2 = 41.230$). Hand-washing after changing menstrual products was judged "necessary" (agree + strongly agree) by 97.6 percent of urban girls but only 53.3 percent of rural girls, with 32.5 percent of rural respondents actively disagreeing or strongly disagreeing ($\chi^2 = 69.016$).

Table-03: Knowledge and Attitudes of Adolescent Girls toward Menstrual Hygiene Practices

Variables	Urban, (n=130) (%)	Rural, (n=120) (%)	Total, (n=250) (%)	Chi-Square (χ^2)	P-value
Hygienic Practice is Necessary During Menstruation					
Neutral	1 (0.8%)	36 (30.0%)	37 (14.8%)	60.552	**<0.001**
Agree	80 (61.5%)	75 (62.5%)	155 (62.0%)		
Strongly Agree	49 (37.7%)	9 (7.5%)	58 (23.2%)		
Bathing During Period is Necessary					
Strongly Disagree	1 (0.8%)	12 (10.0%)	13 (5.2%)	41.230	**<0.001**
Disagree	0 (0.0%)	21 (17.5%)	21 (8.4%)		
Neutral	0 (0.0%)	2 (1.7%)	2 (0.8%)		
Agree	74 (56.9%)	46 (38.3%)	120 (48.0%)		
Strongly Agree	55 (42.3%)	39 (32.5%)	94 (37.6%)		
Washing Hands After Changing Menstrual Products is Necessary					
Strongly Disagree	1 (0.8%)	6 (5.0%)	7 (2.8%)	69.016	**<0.001**
Disagree	0 (0.0%)	33 (27.5%)	33 (13.2%)		
Neutral	2 (1.5%)	17 (14.2%)	19 (7.6%)		
Agree	70 (53.8%)	37 (30.8%)	107 (42.8%)		
Strongly Agree	57 (43.8%)	27 (22.5%)	84 (33.6%)		
Reuse of Sanitary Pads is a Good Practice					
Strongly Disagree	9 (6.9%)	51 (42.5%)	60 (24.0%)	76.774	**<0.001**
Disagree	23 (17.7%)	37 (30.8%)	60 (24.0%)		
Neutral	0 (0.0%)	2 (1.7%)	2 (0.8%)		
Agree	45 (34.6%)	23 (19.2%)	68 (27.2%)		
Strongly Agree	53 (40.8%)	7 (5.8%)	60 (24.0%)		
Menstrual Blood is Unhygienic					
Disagree	9 (6.9%)	10 (8.3%)	19 (7.6%)	31.011	**<0.001**
Neutral	4 (3.1%)	29 (24.2%)	33 (13.2%)		
Agree	75 (57.7%)	65 (54.2%)	140 (56.0%)		
Strongly Agree	42 (32.3%)	16 (13.3%)	58 (23.2%)		
Poor Menstrual Hygiene Predisposes to Infection					
Strongly Disagree	0 (0.0%)	16 (13.3%)	16 (6.4%)	40.891	**<0.001**
Disagree	5 (3.8%)	25 (20.8%)	30 (12.0%)		
Neutral	0 (0.0%)	1 (0.8%)	1 (0.4%)		
Agree	76 (58.5%)	48 (40.0%)	124 (49.6%)		
Strongly Agree	49 (37.7%)	30 (25.0%)	79 (31.6%)		
Discussion About Menstrual Hygiene is a Matter of Shame					
Strongly Disagree	14 (10.8%)	22 (18.3%)	36 (14.4%)	38.969	**<0.001**
Disagree	42 (32.3%)	36 (30.0%)	78 (31.2%)		
Neutral	6 (4.6%)	28 (23.3%)	34 (13.6%)		
Agree	62 (47.7%)	21 (17.5%)	83 (33.2%)		
Strongly Agree	6 (4.6%)	13 (10.8%)	19 (7.6%)		
Using Unhygienic Sanitary Products is Harmful					
Strongly Disagree	4 (3.1%)	22 (18.3%)	26 (10.4%)	116.970	**<0.001**
Disagree	2 (1.5%)	62 (51.7%)	64 (25.6%)		
Agree	76 (58.5%)	21 (17.5%)	97 (38.8%)		
Strongly Agree	48 (36.9%)	15 (12.5%)	63 (25.2%)		
Using Clean Water, Toilets, and Disposal Facilities is Essential					

Strongly Disagree	4 (3.1%)	5 (4.2%)	9 (3.6%)	46.150	**<0.001**
Disagree	1 (0.8%)	16 (13.3%)	17 (6.8%)		
Neutral	2 (1.5%)	21 (17.5%)	23 (9.2%)		
Agree	64 (49.2%)	56 (46.7%)	120 (48.0%)		
Strongly Agree	59 (45.4%)	22 (18.3%)	81 (32.4%)		

Source: Author's Computation from the Field Data

Regarding whether "reuse of sanitary pads is a good practice," the pattern was the reverse of what might be expected: rural respondents expressed markedly stronger disagreement than urban respondents. In rural areas, 42.5 percent "strongly disagreed" and 30.8 percent "disagreed" (73.3 percent combined disagreement), whereas in urban areas only 6.9 percent "strongly disagreed" and 17.7 percent "disagreed" (24.6 percent combined disagreement); conversely, 75.4 percent of urban respondents (34.6% agree + 40.8% strongly agree) agreed or strongly agreed that reuse is acceptable, compared with 25.0 percent of rural respondents (19.2% agree + 5.8% strongly agree) ($\chi^2 = 76.774$, $p < 0.001$). Finally, views of menstrual blood as unhygienic and poor hygiene as a risk factor for infection also showed stark contrasts: 32.3 percent of urban girls "strongly agreed" that menstrual blood is unhygienic, versus 13.3 percent of rural girls, and no urban respondent "strongly disagreed" that poor hygiene predisposes to infection, compared with 13.3 percent of rural respondents (χ^2 = 31.011 and 40.891, respectively). Nearly all urban girls (94.6%) agreed or strongly agreed that clean water, toilets, and disposal facilities are essential to menstrual hygiene, compared with 65.0% of rural girls, while 17.5% of rural girls remained neutral on this statement (χ^2 = 46.150, $p < 0.001$).

3.4 Adjusted Multivariable Analysis of Correlates of Menstrual Hygiene Outcomes

To determine whether the bivariate associations reported in Sections 3.1–3.3 reflect independent relationships or are attenuated by confounding among socio-economic and demographic variables, two adjusted multivariable binary logistic regression models were estimated. Model A predicts sanitary-pad use (versus cloth use) and Model B predicts frequent hygiene practice (versus infrequent practice); both models include residence (urban vs. rural), socio-economic class (lower/middle/upper), maternal literacy (illiterate-or-primary vs. secondary-or-higher), restriction practice (any vs. none), and age group (11–13/14–16/17–19) as covariates. Results are presented in **Table 4**.

Table 4. Adjusted Multivariable Logistic Regression Models of Correlates of Menstrual Hygiene Outcomes

Predictor	AOR	95% CI	*p*-value
Model A — Sanitary Pad Use vs. Cloth Use			
Residence: Urban (ref: Rural)	0.86	0.28–2.64	0.786
SES: Middle (ref: Lower)	71.60	19.70–260.27	**<0.001**
SES: Upper (ref: Lower)	46.87	6.46–340.09	**<0.001**

Maternal literacy: Secondary+ (ref: Illiterate/Primary)	1.39	0.39–4.92	0.613
Restriction practiced (ref: None)	0.74	0.24–2.32	0.610
Age 14–16 (ref: 11–13)	1.31	0.38–4.54	0.671
Age 17–19 (ref: 11–13)	0.22	0.05–0.995	**0.049**
Model B — Frequent Hygiene Practice vs. Infrequent			
Residence: Urban (ref: Rural)	1.89	0.86–4.17	0.115
SES: Middle (ref: Lower)	4.23	1.51–11.85	**0.006**
SES: Upper (ref: Lower)	4.49	0.78–25.78	0.092
Maternal literacy: Secondary+ (ref: Illiterate/Primary)	0.68	0.25–1.87	0.453
Restriction practiced (ref: None)	0.68	0.31–1.50	0.338
Age 14–16 (ref: 11–13)	0.88	0.36–2.18	0.785
Age 17–19 (ref: 11–13)	1.80	0.55–5.89	0.329

AOR = adjusted odds ratio; CI = confidence interval.

Source: *Authors' computation from the field data*

Socio-economic class emerged as the only variable independently and significantly associated with both outcomes after adjustment. Girls from middle-class households had substantially higher odds of using sanitary pads (AOR = 71.60, 95% CI 19.70–260.27, $p < 0.001$) and of practicing frequent hygiene (AOR = 4.23, 95% CI 1.51–11.85, $p = 0.006$) than girls from lower-class households; upper-class girls showed a similarly elevated odds ratio for pad use (AOR = 46.87, $p < 0.001$) though the estimate for frequent practice did not reach significance in the smaller upper-class stratum (AOR = 4.49, $p = 0.092$). By contrast, urban residence, maternal literacy, and restriction practice did not retain independent statistical significance in either adjusted model, indicating that their strong bivariate associations reported in Table 1 and Table 2 are substantially explained by their correlation with socio-economic class rather than reflecting independent effects. Age showed a significant inverse association with pad use only (17–19 vs. 11–13: AOR = 0.22, 95% CI 0.05–0.995, $p = 0.049$). The intermediate age category (14–16 vs. 11–13) was included in both models and was not significant (Model A: AOR = 1.31, 95% CI 0.38–4.54, p = 0.671; Model B: AOR = 0.88, 95% CI 0.36–2.18, p = 0.785).

4 Discussion

This study highlights substantial rural-urban disparities in MHM among adolescent girls in Narsingdi District (Dhaka Division) of XXX. It underscores how socio-economic, educational, and cultural factors are associated with menstrual outcomes. The urban cohort demonstrated significantly better practices, with 84.6% sanitary pad usage in urban versus 53.3% in rural settings, reflecting the advantages of greater access, literacy, and infrastructure. Urban girls exhibited superior MHM behaviors, including higher sanitary pad usage, more frequent pad changes, and safer disposal methods, which align with previous research indicating that urban environments facilitate better access to affordable products and sanitation infrastructure [24]. These differences can be attributed to broader structural

factors, such as improved educational opportunities and media exposure in urban settings, which enhance knowledge and reduce adherence to restrictive cultural norms [25].

Our bivariate results show that maternal literacy and higher socio-economic status are each positively associated with improved MHM behaviors, consistent with prior work in XXX and other LMICs: a flood-affected rural XXX study found that adolescent girls whose mothers had secondary or higher education were more than 1.6 times as likely to report good hygiene practices [11]. In the urban-rural comparative study in Rajshahi division, urban residence, smaller family size, and paternal educational attainment were identified as significant correlates of better MHM [9], notably a different parental-education variable (paternal, not maternal) than the one examined here is one of the gaps this study addresses (Section 1). However, once socio-economic class, maternal literacy, residence, restriction practice, and age were considered jointly in the adjusted models reported in Section 3.4, socio-economic class was the only variable that remained independently and significantly associated with both sanitary-pad use (AOR = 71.60 for middle vs. lower class, $p < 0.001$) and frequent hygiene practice (AOR = 4.23, $p = 0.006$). Maternal literacy showed a strong bivariate association with hygiene indicators (Table 1) but did not retain independent significance after adjustment (AOR = 1.39, $p = 0.613$ for pad use; AOR = 0.68, $p = 0.453$ for frequent practice), suggesting that its apparent bivariate effect operates substantially through its correlation with household socio-economic class rather than through an independent causal pathway. This refines rather than contradicts our overall interpretation: socio-economic advantage, not maternal literacy alone, appears to be the more robust correlate of material access (sanitary pads) and consistent hygienic behavior once confounding is accounted for.

Maternal literacy remains a meaningful correlate of MHM outcomes at the bivariate level, with urban mothers being almost universally literate compared to 26.7% illiteracy in rural areas (Table 1), even though this study's adjusted models suggest the pathway from maternal literacy to daughters' hygiene behavior operates substantially through household socio-economic class. This intergenerational pattern is consistent with the Health Belief Model (HBM), in which perceived susceptibility to health risks (e.g., infections from poor hygiene) and cues to action from educated family members encourage positive behaviors [18, 19]. In rural contexts, lower maternal education co-occurs with practices such as cloth use (46.7% vs. 15.4% urban) and less frequent handwashing, which have been associated with increased risk of reproductive tract infections (RTIs) and urinary tract infections (UTIs) (Sebert Kuhlmann et al. 2019). Similarly, SES disparities, with 50% of rural girls from lower-class households versus 10.8% urban, are associated with inequities in access, as economic constraints limit affordability of sanitary products, consistent with national patterns of wealth-based inequalities in MHM [10].

Cultural stigma and taboos further compound rural challenges, with 42.5% of rural girls avoiding outdoor activities during menstruation compared to 15.4% urban, reflecting entrenched patriarchal structures that frame menstruation as shameful or impure [26]. This silence aligns with feminist theory, which critiques how gender inequality and stigmatization intersect with socio-economic factors to restrict girls' bodily autonomy and access to education and resources [20]. In flood-prone or rural areas, these issues can be amplified by environmental vulnerabilities, which have been associated with poorer hygiene

practices and heightened infection risk [27]. For instance, improper disposal in open fields (31.7% rural vs. 10% urban) not only poses environmental hazards but also reinforces social isolation, potentially impacting school attendance and overall well-being [28].

Attitudes toward MHM also revealed stark divides, with urban girls more likely to recognize the necessity of hygiene measures (e.g., 97.6% agreeing on handwashing post-change vs. 53.3% rural). Regarding pad reuse specifically, the pattern departs from this general urban advantage: rural respondents expressed markedly stronger normative disagreement with reuse (73.3% combined disagreement) than urban respondents (24.6% combined disagreement), even though rural girls report reusing cloth materials more often in practice out of necessity (Section 3.2). This apparent paradox stronger stated disapproval of reuse coexisting with higher actual reuse is consistent with a resource-constraint interpretation: rural girls may recognize reuse as suboptimal in principle while lacking the financial means to avoid it, whereas urban girls' more permissive attitude toward reuse may reflect lower perceived personal risk, since fewer urban girls need to reuse materials in the first place. These patterns echo studies in similar LMICs, where taboos and limited information sources hinder open discussion and have been associated with adverse health outcomes [29]. Prolonged pad wear or cloth reuse, common in rural settings, has been linked to bacterial vaginosis and candidiasis in the broader literature, underscoring the need for targeted education [30].

These results have implications for public health policy in XXX, particularly in advancing SDG 5 (gender equality) by addressing MHM as a human rights issue [31]. Interventions should prioritize rural areas through school-based programs, affordable product access, and community campaigns to challenge stigma, involving healthcare providers and men to foster supportive environments [32]. Upgrading sanitation facilities and integrating MHM into curricula could help mitigate disparities, especially in vulnerable regions affected by climate events [10].

5 Limitations

Limitations include the cross-sectional design, which precludes establishing causal or temporal ordering between socio-economic factors and MHM behaviors, and reliance on self-reported data, potentially subject to social desirability bias. The questionnaire was investigator-developed and pilot-tested with only 20 girls not included in the final sample, rather than validated against an existing psychometric MHM instrument; the individual Likert-scale knowledge/attitude items (Table 3) were analyzed singly rather than combined into a validated composite score, and several variables (hygiene-practice frequency, maternal literacy, restriction practice) were dichotomized for regression modeling, which simplifies underlying ordinal or multi-category information. Additionally, the achieved sample fell slightly short of the calculated minimum in both strata (120 of 123 required rural participants, 97.6%; 130 of 132 required urban participants, 98.5%), attributable to field logistics rather than a sampling design flaw; this shortfall is small and unlikely to have materially affected statistical power. The sample, drawn from two upazilas of Narsingdi District within Dhaka Division, may not generalize nationally, and qualitative insights could enrich understanding of cultural nuances. Future research should employ longitudinal

designs to evaluate interventions, explore intersectional factors (e.g., disability, ethnicity), assess climate impacts on MHM [11], and validate a composite MHM knowledge/practice instrument for use in similar South Asian settings. By bridging these gaps, XXX can promote equitable menstrual health, enhancing adolescent girls' health, education, and empowerment.

6 Conclusion and Policy Recommendation

This study provides a quantitative comparison of menstrual hygiene practices among adolescent girls in rural and urban areas of Dhaka division, XXX. The results reveal significant disparities in pad usage, hygiene behaviors, disposal methods, and restrictions. Socio-economic class emerged as the strongest independent correlate of hygienic practices in the adjusted multivariable analysis, with maternal literacy showing a strong bivariate but not independently significant adjusted association; cultural restrictions and knowledge gaps further compound rural disadvantages. The study contributes to the literature by demonstrating how socio-economic and cultural factors intersect to shape MHM and by clarifying, through adjusted modeling, the relative independent contributions of socio-economic class versus maternal literacy. These insights can guide targeted interventions aimed at achieving gender equality under Sustainable Development Goal 5.

Developing community- and school-based programs that educate mothers and daughters about menstruation, hygiene practices, and health risks; incorporating MHM into reproductive health curricula and providing training for teachers and community health workers; and improving access to sanitary products. Given that this study did not assess menstrual cups and that cloth reliance remains substantially higher in rural areas (46.7%) than urban areas (15.4%), and given the adjusted-model evidence that socio-economic class is the dominant correlate of pad use, the primary product-access recommendation is to expand targeted subsidy or voucher programs for disposable sanitary pads for lower-socio-economic-class households in rural areas, rather than to recommend a product category (menstrual cups) that was not studied here. Support for local production and distribution through women-led entrepreneurship initiatives [10] may complement subsidy programs. Upgrading sanitation facilities in schools and communities, ensuring privacy, clean water, and disposal facilities, and implementing waste management systems for used menstrual products, particularly in rural areas, remain priorities. Public awareness campaigns should challenge taboos and engage men, boys, and community leaders, promoting open dialogue about menstruation in schools and households. Menstrual health indicators should be included in national WASH and health monitoring frameworks to track progress and inform policy, alongside pilot-program evaluation to identify scalable models. Longitudinal studies are needed to understand how interventions influence MHM over time and to explore the impact of climate events on menstrual health, prioritizing research on intersectional factors such as disability, ethnicity, and disaster exposure. Implementing these recommendations will require collaboration between government, NGOs, and communities; by addressing both material and cultural barriers, XXX can help ensure that all girls and women manage menstruation safely and with dignity, improving health outcomes and advancing gender equity.

List of Abbreviations

LMIC: Low- and Middle-Income Countries

MHM: Menstrual Hygiene Management

UTI: Urinary Tract Infection

SDG: Sustainable Development Goals

HBM: Health Belief Model

SPSS: Statistical Package for the Social Sciences

PSC: Primary School Completion

JSC: Junior School Completion

SSC: Secondary School Completion

HSC: Higher Secondary Certificate

KAP: Knowledge, Attitudes, and Practices

HCP: Healthcare Provider

NGOs: Non-Governmental Organizations

MHH: Menstrual Health and Hygiene

SE: Standard Error

Df: Degrees of Freedom

AOR: Adjusted Odds Ratio

CI: Confidence Interval

Statements

Data availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Author Contributions

Conceptualization-M.A.S. and A. O.; methodology- A.O. and S. U. S.; formal analysis- M.A.S. and A. O.; original draft preparation- A.O, S. U. S. and A. M. R.; writing- M.A.S., A.O. and S. U. S.; SPSS and testing- A.M.R. and A. O.; review and editing- M.A.S., and A. M. R. All the authors have read and agreed to publish this version of the manuscript.

Conflict of interest

The authors do not have any conflicts of interest.

Clinical Trial Number

Not applicable.

Declarations

Ethics statement

The authors affirm their unwavering commitment to ethical standards, ensuring that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2013. The study protocol was approved by the Ethical Committee of Noakhali Science and Technology University (Reference no: NSTU/SCI/EC/ 2025/232).

Consent to Participate

Informed consent was obtained from all individual participants included in the study. For participants under 18 years of age, written informed consent was additionally obtained from a parent or legal guardian, together with the adolescent participant's own informed assent (see Section 2.4), reaffirming the authors' commitment to transparency and ethical conduct.

Consent to publish

Not applicable.

References

1. Chandra-Mouli V, Patel SV (2020) Mapping the Knowledge and Understanding of Menarche, Menstrual Hygiene and Menstrual Health Among Adolescent Girls in Low- and Middle-Income Countries. The Palgrave Handbook of Critical Menstruation Studies 609–636

2. Hennegan J, Shannon AK, Rubli J, Schwab KJ, Melendez-Torres GJ (2019) Women's and girls' experiences of menstruation in low- and middle-income countries: A systematic review and qualitative metasynthesis. PLoS Med 16:e1002803

3. Rossouw L, Ross H (2021) Understanding Period Poverty: Socio-Economic Inequalities in Menstrual Hygiene Management in Eight Low- and Middle-Income Countries. International Journal of Environmental Research and Public Health 2021, Vol 18, Page 2571 18:2571

4. Rawat G, Tyagi A (2020) Women's Health Science Journal Committed to Create Value for Researchers Menstrual Hygiene: A Salubrious Approach to Curb Gynecological Problems. https://doi.org/10.23880/whsj-16000147

5. Hossain MA, Chowdhury AM, Sharmin S, Bashak A (2024) Menstrual Hygiene Practice among Adolescent Girls in Selective Slum Areas of Dhaka City in Bangladesh. International Journal of Human and Health Sciences (IJHHS) 8:79–83

6. Alam MU, Sultana F, Hunter EC, Winch PJ, Unicomb L, Sarker S, Mahfuz MT, Al-Masud A, Rahman M, Luby SP (2022) Evaluation of a menstrual hygiene intervention in urban and rural schools in Bangladesh: a pilot study. BMC Public Health 2022 22:1 22:1100-

7. Pednekar S, Some S, Rivankar K, Thakore R (2022) Enabling factors for sustainable menstrual hygiene management practices: a rapid review. Discover Sustainability 3:1–14

8. Majeed J, Sharma P, Ajmera P, Dalal K (2022) Menstrual hygiene practices and associated factors among Indian adolescent girls: a meta-analysis. Reprod Health 19:1–13

9. Ha MAT, Alam MZ (2022) Menstrual hygiene management practice among adolescent girls: an urban–rural comparative study in Rajshahi division, Bangladesh. BMC Women's Health 2022 22:1 22:1–15

10. Hasan E, Chakma S, Khanam M, Hajizadeh M (2025) Socioeconomic inequalities and its spatial pattern in sanitary napkin use in Bangladesh: evidence from the 2019 multiple indicator cluster survey. Popul Health Metr 23:1–17

11. Ahmed T, Hasan MK, Aunto TK, Ahmed T, Zahid D (2025) Menstrual hygiene knowledge and practices among adolescent schoolgirls in flood-affected rural Bangladesh. Reprod Health. https://doi.org/10.1186/S12978-025-02041-X

12. Kumari S, Sood S, Davis S, Chaudhury S (2021) Knowledge and practices related to menstruation among tribal adolescent girls. Ind Psychiatry J 30:S160–S165

13. Njee RM, Imeda CP, Ali SM, et al (2024) Menstrual health and hygiene knowledge among post menarche adolescent school girls in urban and rural Tanzania. PLoS One 19:e0284072

14. Sucharita Bhanja S, Page | (2024) Menstruation Hygiene Practices Among Adolescent Girls: A Sociological Study of Chandannagar Village in Aul Block, Kendrapara District, Odisha. Quest Journals Journal of Research in Humanities and Social Science 12:2321–9467

15. Parle J, Khatoon Z (2019) Knowledge, attitude, practice and perception about menstruation and menstrual hygiene among adolescent school girls in rural areas of Raigad district. Int J Community Med Public Health 6:2490–2497

16. Chandar D, Vaishnavi Y, Priyan S, Ganesh Kumar S, Chandar D (2018) Awareness and practices of menstrual hygiene among females of reproductive age in rural Puducherry - a mixed method study. Int J Adolesc Med Health. https://doi.org/10.1515/IJAMH-2017-0221

17. Roy D, Kasemi N, Halder M, Majumder M (2024) Factors Associated with Exclusive Use of Hygienic Methods during Menstruation among Adolescent Girls (15–19 Years) in Urban India: Evidence from NFHS-5. Heliyon 10:e29731

18. Hochbaum, G. M. (1958). Public Participation in Medical Screening Programs A Sociopsychological Study. PHS Publication No. 572, Government Printing Office. - References - Scientific Research Publishing. https://www.scirp.org/reference/referencespapers?referenceid=3419399. Accessed 4 Aug 2026

19. Rosenstock IM (1974) Historical Origins of the Health Belief Model. Health Education & Behavior 2:328–335

20. hooks bell (2014) Feminist Theory : From Margin to Center. https://doi.org/10.4324/9781315743172

21. (2023) Report on post enumeration check of the population and housing census, 2022. Bangladesh Institute of Development Studies

22. Krejcie R V., Morgan DW (1970) Determining Sample Size for Research Activities. Educ Psychol Meas 30:607–610

23. Association WM (2013) World Medical Association Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects. JAMA 310:2191–2194

24. Khan S (2015) White School Uniforms and Development Theory: How Menstrual Hygiene Management Became an International Issue for Female Education. https://doi.org/10.17615/DPPJ-X991

25. Ali TS, Rizvi SN (2010) Menstrual knowledge and practices of female adolescents in urban Karachi, Pakistan. J Adolesc 33:531–541

26. Das N, Tasa AS (2019) Menstrual hygiene: knowledge and practices during menstruation among adolescent girls in urban slums of Jorhat district, Assam, India. Int J Community Med Public Health 6:3068–3075

27. Dasgupta, Sarkar (2008) Menstrual Hygiene: How Hygienic is the Adolescent Girl? Indian J Community Med 33:77

28. Sood S, Stevens S, Okumura M, Hauer M, Ramaiya A (2022) A Systematic Review of Menstrual Health and Hygiene Management (MHHM) as a Human Right for Adolescents Girls. International Journal of Sexual Health 34:483

29. Garg S, Anand T (2015) Menstruation related myths in India: strategies for combating it. J Family Med Prim Care 4:184

30. Sebert Kuhlmann A, Peters Bergquist E, Danjoint D, Wall LL (2019) Unmet Menstrual Hygiene Needs Among Low-Income Women. Obstetrics and gynecology 133:238–244

31. Winkler IT, Roaf V (2014) Bringing the Dirty Bloody Linen Out of the Closet: Menstrual Hygiene as a Priority for Achieving Gender Equality. Cardozo Journal of Law and Gender 21:1–37

32. Sommer M, Hirsch JS, Nathanson C, Parker RG (2015) Comfortably, Safely, and Without Shame: Defining Menstrual Hygiene Management as a Public Health Issue. Am J Public Health 105:1302