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Association between Menstrual Hygiene Management and School Performance among the School-Going Girls in Rural Bangladesh

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Abstract: Background: This study investigated the relationship between menstrual hygiene practices and academic performance among rural Bangladeshi adolescent girls. Methods: A cross-sectional survey was carried out among the 499 secondary-school-going adolescent girls in grades 7–10 (aged 11–17 years, mean ± SD = 14.04 ± 1.11 years) attending either public or private institutions in rural Bangladesh. Menstruation hygiene management (MHM) was defined based on three indicators such as (i) change materials (pads/cloths) less than every 6 h, (ii) hand washing practice with soap before and after changing pads/cloths, or not washing the external genitalia at least once per day, and (iii) using a sanitary pad or drying of re-usable cloths under direct sunlight. The MHM was categorized as poor (if not practicing or practicing only one issue), average (if practicing only two issues), or good (if practicing all of the issues). School performance was determined by the total marks obtained in their last final examination (<60% marks defined as low performance and ≥60% marks defined as good performance). Binary logistics regression models were developed at the <0.05 significance level. Results: The mean age of the participants was 12 years, where 83% reported a regular menstrual cycle pattern. Overall, prevalence of practicing poor, average, and good MHM were found to be 28.46%, 55.71%, and 15.83%, respectively. About 52% of girls reported using sanitary napkins (manufactured disposable pads), 43.4% reported using pieces of reusable cloths per occasion (multiple uses), and almost all (96.29%) reported using detergents to clean multiple-use cloths. We found 2.9 times (AOR: 2.90, 95% CI: 1.61–5.24) and 5.7 times (AOR: 5.65, 95% CI: 2.72–11.71) higher odds to achieve good academic performance among those who practiced 'average' and 'good' MHM after adjusting age, education, paternal education, occupation, maternal education, household wealth status, and respondent's knowledge of menstruation. Conclusions: Results suggested that girls' school academic performance can be improved by practicing good menstrual hygiene practices. School-based menstrual hygiene management education could be useful.

Keywords: adolescent girls; menstrual hygiene; reproductive health; academic performance; Bangladesh

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1. Background

Menstruation is a part of the female reproductive cycle that starts at puberty. A systematic review and qualitative meta synthesis study considered menstruation as a physiological barrier for adolescent girls that restricts their movement outside of the

home [1]. The use of limited water and sanitation facilities in schools exacerbates the situation further and impedes girls' school attendance during menstruation, compromising their ability to maintain proper hygiene and privacy [2]. With the advent of puberty, adolescent girls may experience limited upward mobility, limiting their access to education and livelihood opportunities [3]. Several qualitative studies found that many school-age girls do not attend school during menstruation [2,4] due to shame, fear of having visible stains on their clothing, and absence of a private place to manage menstruation [2,4] or dysmenorrhea [5]. In 2017, a systematic review carried out in low-and middle-income countries reported that the event of menstruation tends to be coincident with the transition from primary to secondary education. In fact, in many cultures, the event of menarche may signal to family and community that a girl is ready to get married, thus reducing her chances of staying in school [6].

Studies carried out in Indonesia, Kenya, and Pakistan discussed the relationship between MHM and school attendance and academic attainment [7–9]. More than half of the schools in low-income countries lack sufficient latrines for girls or have latrines that are not very clean [10]. Evidence suggests that adolescent girls can miss up to four consecutive days (10–20% of school time) of school every month because of their menstrual periods, which severely impacts their academic achievement [11,12]. Poor Menstrual Hygiene Management (MHM) practice among adolescent girls is caused by lack of information, privacy, water, sanitation, and hygiene (WASH) facilities, and sanitary pads [12]. The paucity of WASH infrastructure along with poor quality remains a major concern in many developing countries; even if latrine facilities exist, they often exceed the WHO recommended student-toilet ratio (1:30 for boys and 1:25 for girls) [11,13]. Pit latrines found in some schools lack door locks, toilet paper, soap, and even facilities to dispose of sanitary products [14]. Water taps, if present, are situated at a distance from latrines, which render proper menstrual hygiene management impossible [15].

According to the World Health Organization (WHO), the availability of adequate clean water and hygiene in schools is essential for meeting the SDG 6: access and equitable sanitation and hygiene for all, paying attention to the needs of the women and children [16]. Poor access to water and sanitation facilities, lack of privacy, limited knowledge of menstrual hygiene practice [17], social stigma, and cultural restriction on activities [2] all inhibit the implementation of MHM at school. Menstruation poses a set of physical, socio-cultural, and economic challenges to adolescent girls that may interfere with their ability to attend a school or to participate in class fully [18].

Barriers to Menstruation Hygiene Management (MHM) among Bangladeshi girls may also hamper progress towards achieving the Sustainable Development Goals 3, 4, 5, and 6 [19]. However, a systematic review carried out on the health and social effects of MHM identified that little attempt that has been made to quantify the complex ways by which menstruation affects girls at schools [20]. Menstruation's possible role as a barrier to, or negative influence on schooling has recently become of interest [21]. Another systematic review concluded that there is a lack of research capturing MHM practices or quantifying the health, education, and psychological consequences of different MHM practices [22]. A pilot study reported multicomponent MHM intervention developed by the authors was acceptable and feasible and suggests a cluster randomized trial to evaluate the effectiveness of intervention on MHM and school attendance [23]. This study was carried out to assess the status of menstrual hygiene practices by the adolescent girls of some of the selected secondary schools in Patuakhali, one of the southern districts in Bangladesh. The study investigated if there is an association between academic performance and the MHM practices of the adolescent girls.

2. Materials and Methods

2.1. Study Design and Participants

We conducted a cross-sectional study with school-going adolescent girls residing in Dumki Upazila of Patuakhali district- a rural area in South-central Bangladesh. The

selection criterion for study participants included secondary school-going adolescent girls (grade 7–10) attending either public or private institutes, generally healthy and experienced menarche. There was no age restriction during the selection process. Exclusion criteria included those who did not experience menarche and those with known active cases of infectious disease. The data were collected from February to April 2019.

2.2. Sample Size and Sampling

In calculating the sample size for this study we considered: (i) precisely estimating the outcome variable, and (ii) comparing the findings across domains. For our calculation, the prevalence was assumed to be 68% (menstruation knowledge among girls), 10% (use of disposable pad), and 32% (menstrual problems interfere with school performance) [24,25]. We calculated sample size for each of the three prevalence with a 5% margin of error, 95% level of confidence, 80% power of the test, 1.5 design effect, and 95% response rate. Notably, the value of the design effect is often unknown and can be calculated after the survey. Since no study has been conducted in Bangladesh on the same variables we considered in the present study, we assumed a conservative design effect of 1.5 [26]. This conservative design effect gives approximately 0.04 of the between-school variations (equivalently, ~1% of the intra-class correlation). Two-stage cluster random sampling was applied to collect the data from the students. There were 21 schools in the studied area, and each school was considered as a cluster. In the first stage of sampling, 11 schools were selected randomly. In the second stage, students of grades 7–10 from each school were randomly selected using probability proportional to school size (Figure 1). That is, more students were selected from those schools having more students. Random selections of schools and study participants (i.e., adolescent girls) were created using the computer-generated random number sequence. This is equivalent to the lottery method, where each student from the schools is assigned a number, and only randomly picked numbers are the selected study participants.

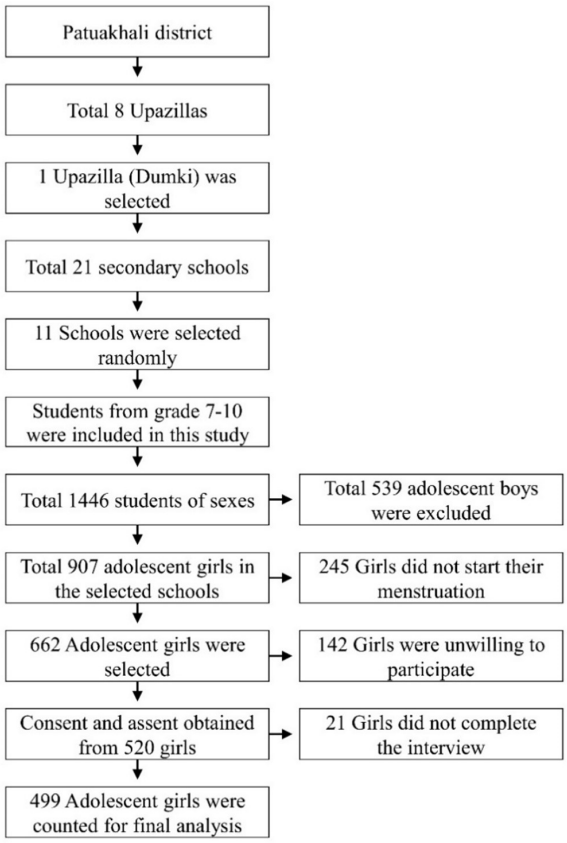

Figure 1. Participant enrollment procedure for this study.

2.3. Data Collection Tools and Technique

Data were collected by face-to-face interviews using a hard copy of a pre-tested structured questionnaire. A total of nine female graduate-level students were recruited as research assistants. They were trained for 2 days by the lead investigator to correctly adhere to the questionnaire format, questions, and response options to reduce interviewer bias. At first, study teams visited the selected schools the day before the survey and received permission from the school authority to carry-out the study. Consent and assent forms were read comprehensively in front of all students upon permission, and hard copies of both forms were given to the respective participants. They were requested to take consent forms with them to their houses and get consent from their parents. They were further requested to get a signature from their parents if parents approved their participation in the study. Data were collected only from those girls whose parents provided their signature on the written consent form. Students were informed that participating in the study would neither affect their relationship with the schoolteachers nor their reputation. On the following day, research assistants divided into three groups (each group having 3 members) and visited the selected school. Once a copy of the consent and assent forms were returned to the research assistants, an individual interview was conducted in a separate private setting.

2.4. Outcome Measurement

School academic grade was the outcome variable of the study. It was measured by the total marks obtained in their last final examination. All studied schools followed a similar academic curriculum and examination standard developed by the Ministry of Education, division of secondary and high secondary education. The grade sheet was obtained from the school's register book. The total score was later transformed into 100 percentage and defined 'low performance' as those students who scored <60% and 'good performance' as those scored $\geq$60% in their last final examination [27].

2.5. Explanatory Variables

The WHO and UNICEF Joint Monitoring Program (JMP) for drinking water, sanitation, and hygiene defines MHM as "Women and adolescent girls are using a clean menstrual management material to absorb or collect menstrual blood, that can be changed in privacy as often as necessary for the duration of a menstrual period, using soap and water for washing the body as required, and having access to safe and convenient facilities to dispose of used menstrual management materials. They understand the basic facts linked to the menstrual cycle and how to manage it with dignity and without discomfort or fear" [28]. For this study, we used a modified version of MHM that assessed similar issues stated by the WHO and UNICEF JMP [7,29]. MHM was defined based on three indicators such as (i) change materials (pads/cloths) less than every 6 h, (ii) hand washing practice with soap before and after changing pads/cloths, or not washing the external genitalia at least once per day, and (iii) using sanitary pads or, drying of re-usable cloths under direct sunlight. The MHM was categorized as poor (if not practicing or practicing only one issue), average (if practicing only two issues), or good (if practicing all of the issues). These categories of 'poor' and 'good' practice were based on earlier studies developed by WaterAid, SHARE, and DFID [30]. We created a modified version that additionally added an 'average' category. Socio-demographic variables considered in this study were: age of respondents, education, parental education, paternal occupation, maternal occupation, household wealth status, family size, and respondent's knowledge on menstruation. Participant's knowledge of menstruation was assessed using 10 questions that were adopted from the literature [7] and categorized using tertile.

2.6. Statistical Analysis

Both descriptive and inferential statistics were used. Household wealth index was constructed using factor analysis [29,31] of household-level key socioeconomic variables. The Rao-Scott Chi-square test was used to compare the prevalence of good school academic

performance and different socio-demographic characteristics. The binary logistic regression model was applied to assess the adjusted relationship between MHM and academic grades. Variables that were found to be significantly associated with the outcome variable (academic performance) in bivariate analysis were considered as confounders in the final multivariable model. Notably, data were hierarchical, and there was cluster (school) to cluster variation in terms of the outcome of interest. Therefore, the parameters of the logistic regression were estimated using the generalized estimating equation to account for the clustering effect. In this case, we considered an exchangeable correlation structure among the clusters. The effect estimates of MHM on school performances remained approximately the same regardless of removing any of the confounders from the adjusted model. Since we have many variables in the adjusted model, the backward selection based on the AIC criterion was also used to achieve the most parsimonious model. However, the stepwise regression model suggests all of the covariates selected for the adjustment were relevant (i.e., none of the variables were removed from the final model). The adjusted odds ratio (AOR) and the corresponding confidence interval (CI) were reported. All analyses were performed using the statistical software package STATA (version 15.0).

2.7. Ethical Consideration

Ethical clearance was obtained from the Institutional Ethical Committee (IEC) of Patuakhali Science and Technology University, Patuakhali, Bangladesh (reference no. PSTU/IEC/2019/01). Informed written consent and assent were obtained from each of the participants and their respective parents/guardians. The consent and assent forms contained contact information of the principal investigator for possible communication. The purpose, the process, and the risk-benefits from participating in the study were described in both forms. Participants were informed that there will be no financial or other financial or non-financial incentives for participating in the study, and that their participation is voluntary. They were informed that they may withdraw from the participation in the study at any time after initial participation, without any prejudice or penalty.

3. Results

3.1. Background Characteristics and the Girls Based on the School Performance

Table 1 shows the background characteristics of the study participants and the prevalence of school performance measures among the school-going girls. A total of 499 girls (response rate 78%) aged between 11 and 17 years were included in this analysis. Nearly two-thirds (62.5%) of respondents were 11 to 14 years in age. Of the participants, only 11.4% of the girls' fathers and 5.6% of the mothers had completed grade 10 or above. A total of 44.5% of the participants' fathers were either businessmen or jobholders, while 94.8% of mothers were homemakers. Additionally, 38.7% of girls belonged to poor households. Among the girls, more than half practice an average MHM (55.7%) and only 15.8% practice good MHM. The prevalence of good school performance was significantly higher among those grade nine students (30.5%) those whose fathers had completed grade 10 or above (35.1%) or was a jobholder (33.0%), whose mother had completed grade 10 or above (50.0%), those from a rich household (31.7%), those with high-degree knowledge on menstruation (32.7%), and those who practice good MHM (38.0%).

3.2. Menstrual Information of the Adolescent Girls and Association with MHM

Table 2 shows the basic descriptive information about the menstruation and its association with MHM among the girls. The average age (±SD) of the menarche was 12.03 (±0.95) years and the majority of the girls (83.0%) reported that their menstrual cycle was regular. A majority of the girls (45.9%) reported that they had learned about menstruation from their mother. Among the participants, just more than half of the girls (51.9%) reported they use sanitary napkins during their period and 43.3% of them reported they use pieces of reusable cloth. Of the girls who use sanitary pads, the majority of them (75.3%) never bought it; their mothers (67.2%) mainly bought it for them, and majority store it in a special

cupboard (52.9%). Of the girls who used reusable cloths, about 41.7% mentioned that they usually dry the cloths hiding under other clothes and mainly use detergent (96.3%) to clean the cloths. Prevalence of different level of MHM significantly varied according to knowledge about menstruation before menarche, type of materials used during period, opinion on the advantages of sanitary pads, method of drying reusable cloths, changing pad/cloth at every 6 h, washing hands with soap before and after changing pad/cloths, washing genitalia at least once per day, and proper washing and drying of reusable cloths.

Table 1. Bivariate analysis of socio-demographic characteristics and school performance among school-going girls (N = 499).

Characteristics	*n* (%)	School Performance (%)		χ^2 (df)	*p*
		Poor	Good		
Age (Years)					
11–14	312 (62.5)	72.4	27.5	2.80 (1)	0.094
15–17	187 (37.5)	79.1	20.9		
Current level of education					
Grade 7	82 (16.4)	85.4	14.6	9.98 (3)	0.019 *
Grade 8	151 (30.3)	70.2	29.8		
Grade 9	131 (26.3)	69.5	30.5		
Grade 10	135 (27.1)	79.3	20.7		
Father's education					
0–4	260 (52.1)	73.5	26.5	6.05 (2)	0.048 *
5–9	182 (36.5)	80.2	19.8		
10+	57 (11.4)	64.9	35.1		
Father's occupation					
Agriculture based	86 (17.2)	86.0	14.0	10.29 (4)	0.036 *
Labor	90 (18.0)	76.7	23.3		
Business	107 (21.4)	72.0	28.0		
Job	115 (23.1)	67.0	33.0		
Others	101 (20.2)	76.2	23.8		
Mother's education					
0–4	244 (48.9)	75.0	25.0	10.38 (2)	0.006 *
5–9	227 (45.5)	78.0	22.0		
10+	28 (5.6)	50.0	50.0		
Mother's occupation					
Homemaker	473 (94.8)	75.3	24.7	0.478 (1)	0.489
Working outside	26 (5.2)	69.2	30.8		
Household wealth status					
Low	193 (38.7)	81.3	18.7	7.88 (2)	0.019 *
Middle	161 (32.3)	73.3	26.7		
High	145 (29.1)	68.3	31.7		
Family size					
≤4	161 (32.3)	76.4	23.6	0.26 (1)	0.607
>4	338 (67.7)	74.3	25.7		
Knowledge level of menstruation					
Low	263 (52.70)	80.6	19.4	9.64 (2)	0.008 *
Middle	135 (27.1)	69.6	30.4		
High	101 (20.2)	67.3	32.7		
Menstrual Hygiene Management					
Poor	142 (28.5)	87.3	12.7	19.64 (2)	<0.001 *
Average	278 (55.7)	72.3	27.7		
Good	79 (15.8)	62.0	38.0		

* Chi-square test significant at 5% level of significance.

Table 2. Menstrual information of the girls and association with menstrual hygiene management.

Characteristics	Frequency (%)	Menstrual Hygiene Management (%)			χ^2 (df)	*p*
		Poor	Average	Good		
Age at menarche (years) (mean ± SD)						12.03 ± 0.95
Menstrual status						
Regular	414 (83.0)	27.3	56.0	16.7	2.27 (2)	0.321
Irregular	85 (17.0)	34.1	54.1	11.8		
Main source of knowledge about menstruation						
Newspapers/TV/Radio	9 (1.8)	33.3	44.4	22.2	13.30 (14)	0.503
School teachers	57 (11.4)	19.3	61.4	19.3		
Mother	229 (45.9)	28.4	57.6	14.0		
Relatives	37 (7.4)	37.8	51.4	10.8		
Elder sister	93 (18.6)	36.6	45.2	18.3		
Friends	31 (6.2)	19.4	58.1	22.6		
Books	15 (3.0)	20.0	66.7	13.3		
Others	28 (5.6)	21.4	64.3	14.3		
Have knowledge before menarche						
Yes	212 (42.5)	23.6	56.6	19.8	6.81 (2)	0.033 *
No	287 (57.5)	32.1	55.1	12.9		
Feelings at first menstruation						
Feared	283 (56.7)	25.4	58.7	15.9	17.86 (10)	0.057
Worried	81 (16.2)	39.5	46.9	13.6		
Anxiety	22 (4.4)	27.3	45.5	27.3		
Felt shy	63 (12.6)	27.0	65.1	7.9		
No feelings	47 (9.4)	27.7	48.9	23.4		
Excited	3 (0.6)	66.7	0.0	33.3		
Miss school in last menstruation						
Yes	114 (22.7)	33.6	48.7	17.7	8.39 (4)	0.078
No	385 (77.3)	27.0	57.9	15.1		
Usual feelings about menstruation						
Fear	17 (3.4)	41.2	47.1	11.8	15.91 (12)	0.195
Worry	19 (3.8)	47.4	52.6	0.0		
Anxiety	12 (2.4)	16.7	58.3	25.0		
Shy	21 (4.2)	23.8	66.7	9.5		
Pain	128 (25.7)	25.0	53.1	21.9		
Normal	301 (60.5)	28.7	57.0	14.3		
Materials used during menstruation						
Sanitary napkin	259 (51.9)	31.7	68.0	0.4	116.92 (4)	<0.001 *
Piece of new cloths (one-time use)	23 (4.6)	30.4	69.6	0.0		
Piece of reusable cloths per occasions (multiple use)	216 (43.3)	24.5	39.8	35.6		
Number of pads use per day during menstruation (N = 259) (mean ± SD)						2.66 ± 0.829
Feel shy to buy pads (N = 259)						
Yes	38 (14.6)	36.1	63.9	0.0	2.22 (2)	0.328
No	26 (10.1)	42.3	57.7	0.0		
Never bought	195 (75.3)	29.2	70.8	0.0		
Who usually buy pads (N = 259)						
Mother	174 (67.2)	29.3	70.7	0.0	4.89 (3)	0.180
Father	16 (6.2)	18.8	81.3	0.0		
By own	25 (9.6)	48.0	52.0	0.0		
Elder sister	44 (17.0)	34.1	65.9	0.0		
Mode of disposal of the used pads (N = 259)						
Burn	7 (2.7)	57.1	42.9	0.0	5.50 (5)	0.357
Bin	67 (25.8)	28.4	71.6	0.0		
Latrine	58 (22.4)	31.0	69.0	0.0		
Buried	85 (32.8)	28.2	71.8	0.0		
Anywhere nearby (back door of the house)	26 (10.1)	46.2	53.8	0.0		
Other	16 (6.2)	28.6	71.4	0.0		
Storage place of pads (N = 259)						
With regular cloths	63 (24.3)	27.0	73.0	0.0	1.97 (2)	0.373
Special cup board	137 (52.9)	30.7	69.3	0.0		
Keep it to my mother	59 (22.8)	38.6	61.4	0.0		
Advantage of sanitary pads (N = 259)						
Comfortable	143 (55.2)	32.6	67.4	0.0	12.71 (4)	0.013 *
Adequate absorption	36 (13.9)	13.9	86.1	0.0		
Easy to use	55 (21.2)	32.7	67.3	0.0		
Do not soil cloths	22 (8.5)	40.9	59.1	0.0		
No itching	3 (1.2)	100.0	0.0	0.0		

Table 2. *Cont.*

Characteristics	Frequency (%)	Menstrual Hygiene Management (%)			χ^2 (df)	*p*
		Poor	Average	Good		
Disadvantage of sanitary pads (N = 259)						
Expensive	131 (50.6)	30.5	69.5	0.0	2.19 (3)	0.534
Not easily available	35 (13.5)	37.1	62.9	0.0		
Feel disgusted	17 (6.6)	17.6	82.4	0.0		
No disadvantage	76 (29.3)	33.3	66.7	0.0		
Method of drying reusable cloths (N = 216)						
Under direct sunlight	109 (50.5)	3.7	23.9	72.5	132 (4)	<0.001 *
Hiding under other cloths	90 (41.7)	42.6	57.4	0.0		
Bathroom	17 (7.8)	52.9	47.1	0.0		
Storage place of washed reusable cloths (N = 216)						
Plastic bag	132 (61.1)	21.2	39.4	39.4	8.59 (8)	0.378
Bathroom	5 (2.3)	60.0	20.0	20.0		
Under mattress	16 (7.4)	31.3	25.0	43.8		
In a dark, damp place	8 (3.7)	12.5	50.0	37.5		
Hidden from other family member	55 (25.5)	27.1	45.8	27.1		
Cleaning agent used during cleaning of cloths (N = 216)						
Detergent	208 (96.3)	25.0	38.2	36.8	8.34 (4)	0.080
Liquid antiseptic	5 (2.3)	0.0	80.0	20.0		
Plain water	3 (1.4)	0.0	100.0	0.0		
Change pad/cloths at school						
Yes	87 (17.4)	19.5	64.4	16.1	4.24 (2)	0.120
No	412 (82.6)	30.2	54.0	15.8		
Change pad/cloth every 6 hr.						
Yes	360 (72.1)	5.8	72.2	21.9	326.18 (2)	<0.001 *
No	139 (27.9)	87.1	12.9	0.0		
Wash hands with soap before and after changing pads/cloths						
Yes	453 (90.8)	23.2	59.4	17.4	68.01 (2)	<0.001 *
No	46 (9.2)	80.4	19.6	0.0		
Wash genitalia at least once per day						
Yes	459 (92.0)	27.5	55.6	17.0	6.94 (2)	0.031 *
No	40 (8.0)	40.0	57.5	2.5		
Reusable cloths with proper washing and drying (N = 216)						
Yes	110 (50.6)	3.6	24.5	71.8	132.29 (2)	<0.001 *
No	106 (49.4)	45.5	54.5	0.0		

* Chi-square test significant at 5% level of significance.

3.3. Association of Menstruation Hygiene Management and School Performance

The average and good menstruation hygiene management were significantly associated with higher odds of good school performance among girls (Table 3). From the regression analysis, girls who practiced average and good menstrual hygiene compared with poor had 2.7- and 4.3-times higher odds for good school performance respectively (COR = 2.72 and 4.38; 95% CI: 1.57–4.70 and 2.25–8.51 respectively). This association remained significant when the model was adjusted with the level of education of the respondent, occupational status of their father, educational status of their mother, wealth index, and knowledge level on menstruation. The odds of good performance were 2.7 times higher among girls who practiced average menstruation hygiene management (AOR: 2.71, 95% CI: 1.49–4.90), while it was 5.0 times higher among those girls who practiced good menstruation hygiene management (AOR: 5.08, 95% CI: 2.46–10.46).

3.4. Association between Socio-Demographic Variables and School Performance

Table 3 also shows the likelihood of socio-demographic variables and good school performance. Girls who are currently reading in grade 8 (AOR = 2.72, 95% CI: 1.31–5.65), whose fathers are service holders (AOR = 2.33, 95% CI: 1.09–4.97), whose mothers have 10+ educational status (AOR = 2.54, 95% CI: 1.08–5.94), and those with a high level of knowledge on menstruation (AOR = 1.94, 95% CI: 1.10–3.41) had a higher possibility of performing well in school when we adjusted the regression model with the level of education of the respondent, occupational status of their father, educational status of their mother, wealth index, and knowledge level on menstruation.

Table 3. Regression models of menstrual hygiene management and socio-demographics with academic performance of the adolescent girls.

Characteristics	Crude [1]			Adjusted [2]		
	OR	95% CI	*p*	OR	95% CI	*p*
Menstruation Hygiene Management						
Poor	1.00			1.00		
Average	2.72	1.57–4.70	<0.001 *	2.71	1.49–4.90	0.001 *
Good	4.38	2.25–8.51	<0.001	5.08	2.46–10.46	<0.001 *
Current level of education						
Grade 7	1.00			1.00		
Grade 8	2.31	1.16–4.58	0.016 *	2.72	1.31–5.65	0.007 *
Grade 9	2.61	1.30–5.26	0.007 *	1.99	0.94–4.23	0.071
Grade 10	1.48	0.72–3.06	0.284	1.36	0.62–2.95	0.434
Father's education						
0–4	1.00			1.00		
5–9	0.72	0.46–1.12	0.151	0.76	0.45–1.26	0.294
10+	1.76	0.96–3.20	0.063	0.85	0.41–1.76	0.677
Father's occupation						
Agriculture based	1.00			1.00		
Labor	2.12	0.97–4.61	0.057	2.16	0.96–4.82	0.060
Business	2.85	1.34–6.03	0.006 *	2.14	0.98–4.65	0.053
Job	3.64	1.75–7.58	0.001 *	2.33	1.09–4.97	0.028 *
Others	2.04	0.95–4.38	0.065	1.85	0.84–4.06	0.122
Mother's education						
0–4	1.00			1.00		
5–9	0.84	0.55–1.27	0.426	0.84	0.54–1.31	0.460
10+	2.74	1.24–6.02	0.012 *	2.54	1.08–5.94	0.031 *
Mother's occupation						
Homemaker	1.00			1.00		
Working outside	1.35	0.58–3.12	0.477	1.08	0.42–2.75	0.864
Household wealth status						
Low	1.00			1.00		
Middle	1.60	0.98–2.62	0.058	1.35	0.80–2.30	0.256
High	2.26	1.38–3.70	0.001 *	1.41	0.81–2.46	0.215
Knowledge level of menstruation						
Low	1.00			1.00		
Middle	1.94	1.20–3.11	0.006 *	1.82	1.09–3.03	0.021 *
High	2.11	1.26–3.54	0.004 *	1.94	1.10–3.41	0.021 *

[1] only adjusted with clustering effect. [2] adjusted with level of education of the respondent, occupational status of their father, educational status of their mother, wealth index, and knowledge level on menstruation. * Significant *p*-value.

4. Discussion

The study determined the relationship between MHM and the academic performance of rural Bangladeshi adolescent girls. We found a significant positive association between those who were higher on the scale of MHM and had higher academic performance. Earlier studies supported the linkage identified that menstrual hygiene is a good predictor of the gynecological problems and was found to be associated with serious ill-health, including reproductive and urinary tract infections in India [32,33]. Several other studies reported that poor MHM adversely affects both physical and health outcomes such as irritation, discomfort, and urogenital symptoms [34,35]. In contrast, a study conducted in Ghana reported inconclusive consequences of poor MHM and found a lack of direct evidence between poor MHM and school absenteeism [36]. A similar finding was also reported by Sumpter and Torondel (2013) in their systematic review [20].

Our study described MHM in detail among the school-going adolescent girls in Bangladesh. We noted that almost half of adolescent girls (43.4%) used a piece of reusable cloth per occasions of menstruation (multiple uses). We found almost all participants who use reusable cloths use detergent to wash the cloths. Unclean reusable cloths may

lead to several reproductive diseases; however, another study reported that reusable cloth could be made hygienic after proper washing [20]. Similarly, a study in India reported that, overall, 28% of girls used reusable clothes, highest in Chhattisgarh (61%) [37]. One of the reasons for using reusable cloth is the expensive price of commercial sanitary pads available in the market [38]. We revealed around 50% of participants considered this as a disadvantage. However, an earlier qualitative evaluation of a controlled trial carried out in rural Uganda found that using reusable pads improved girls' comfort and reliability given that the provision of Water, Sanitation and Hygiene (WASH) facilities is ensured in schools [39].

Furthermore, the study highlighted washing, drying, and privacy of the reusable cloths as key challenges for the girls. We noticed that 84.6% of girls were not aware of the reason for menstruation. Potentially, this could mean that they would be more likely to be frightened, confused, and feel embarrassed by menarche, which could lead to developing negative attitudes towards menstruation [40]. A cluster quasi-randomized control trial concluded that puberty education could improve girls' confidence in discussions of menstruation, which would also facilitate constructive discussion with their primary source of knowledge (i.e., with teachers and peers) [41]. We noted that MHM is a complex phenomenon and is linked with various factors. We found that mothers are the primary source for menstruation knowledge among those who had low MHM scores. It is plausible that mothers may not have proper menstrual hygiene education to teach their children. An earlier Bangladeshi study reported that menstrual hygiene education among the schoolgirls improves menstrual hygiene knowledge, beliefs, and practices [25].

Moreover, we revealed that one-fourth of girls used a bin (25%) to dispose of their used menstrual products. It may pose adverse environmental hazards since disposing used menstrual pads provides breeding places for germs and microbes and contaminates the water body and soil [42]. Infections like hepatitis and HIV/AIDS remain active in the soil for up to six months, which threatens the neighboring population [42]. This unhealthy disposal practice may be the result of inadequate facilities at home and schools. Another study supported the statement that girls were reported being absent from school due to the lack of a disposal system, broken locks/doors of latrines, the lack of a water tap, bucket, and poor water supply [43]. This creates adverse schooling experiences and can lead to absenteeism from school [39]. A recent study suggested the launch of menstrual hygiene education, accessible sanitary products, and adequate sanitary facilities at school to improve the schooling experience of adolescent girls [37]. It was found that adolescent girls' schooling experiences will be improved if they receive menstrual hygiene education and proper access to sanitary products and sanitary facilities at school [37]. In addition to the security of WASH facilities at the school level, another review article recorded socio-cultural changes in under-resourced settings such as the genders of the teachers, who are mostly male, embarrassment by the peers due to the accidental menstrual soiling of clothes, longer distances between school and home, leaks/stains, poor family support, and purchasing capability [44].

Overall, the findings of our study logically aligned with the comprehensive menstrual experience framework presented by Hennegan et al. [1]. This systematic review and qualitative meta-synthesis described pathways on how socio-cultural context creates a range of barriers and adverse menstrual experiences. For instance, the study described that menstrual practice is not only dependent on physical and economic resources but also social support (family, peers, teachers, and health professionals), behavioral expectations, and adequate knowledge. These factors influence women's perception of menstrual practice, which eventually affects their physical and mental health, educational and economical status, and also their social participation. In this study, we only covered the consequence of menstrual practices on their educational outcomes; however, regarding policy implications, we recommend that Hennegan et al.'s integrated model of menstrual experience should be carefully considered before carrying out a menstrual intervention approach.

One of the limitations of this study was that data were self-reported by the school-going adolescent girls, and so it may differ from their actual menstrual hygiene practice. Social desirability bias may have appeared in our study results, since girls may tend to over-report their good menstrual hygiene practice. We interviewed each girl separately in a private room to minimize the social desirability bias. However, the study failed to verify participants' MHM information with their respective mothers/guardians. Furthermore, the study did not collect information on access to WASH facilities either in school or at home, which could help to identify the barriers and challenges to maintain good MHM. The study further failed to establish a temporal relationship among the variables because of its cross-sectional nature of the data. Additionally, generalizability is limited since the data were not country representative. We therefore advise caution while interpreting the results. Another limitation was the low response rate. The reason behind this low response rate is not clear; however, cultural conservativeness related to women's reproductive health particularly in rural Bangladesh may have played a major role here. Although participants in this study were not representative of all adolescent girls in Bangladesh, the study generated additional information regarding the negative consequences of poor MHM that has been occurring among the rural school-going adolescent girls in Bangladesh. The strengths of the study include scaling the MHM category adopted from earlier evidence. We did not depend on self-reported academic results (outcome of the study) as an indicator of school performance; rather, we directly collected data from the school's registrar office using adolescent girls' respective class roll numbers. We did not find a recent study investigating the association of menstrual hygiene practice and school performance among the adolescent girls in rural Bangladesh.

Considering the preventable nature of the adverse consequences, including the poor academic performance, policy makers should consider adopting a community-based approach ensuring participation from all possible stakeholders such as school authority, parents, government representatives, community elders, and local influential persons (religious and spiritual leaders) to work collaboratively to improve the MHM of their respective community girls. In addition, a countrywide school-based menstrual hygiene management education campaign may improve the general awareness of the communities in Bangladesh.

5. Conclusions

Mothers are the primary source of menstrual information for the rural Bangladeshi adolescent girls and more than 80% of them lack knowledge on the reasons for menstruation. Half of the girls use sanitary napkins (manufactured disposable pads); however, only one-fourth of the adolescent girls dispose their used menstrual products to the designated bin. Furthermore, the study demonstrated a strong relationship between good menstrual hygiene practice and school performance among rural Bangladeshi adolescent girls. The likelihood of good school performance significantly increases with good MHM status. Future research is warranted to guide and inform a practical culturally appropriate adaptable solution designed to create a comprehensive framework to improve MHM.

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Data Availability Statement: After considering all aspects of ethical issue and as per existing rule, anonymized data may be shared with qualified researchers.

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