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Menstrual hygiene management among Bangladeshi adolescent schoolgirls: risk factors affecting school absence

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Title page

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Abstract

Background: Many adolescent girls in low and middle-income countries lack appropriate facilities and support in school to manage menstruation. Little research has been conducted on how menstruation affects academic performance. This study examines the association of menstrual hygiene management knowledge, facilities, and practice with absence from school during menstruation among Bangladeshi schoolgirls.

Methods: We conducted a nationally representative, cross-sectional study in Bangladeshi schools from March to June 2013 among 11 to 17 year old girls who reached menarche. We sampled 700 schools from 50 urban and 50 rural clusters using a probability proportional to size technique. We interviewed 2,332 schoolgirls and conducted spot checks in each school for menstrual hygiene facilities. To assess factors associated with absence from school, we estimated adjusted prevalence difference using generalized estimating equations to account for school-level clustering.

Results: Among schoolgirls, who reached menarche, 41% (931) reported missing school, an average of 2.8 missed days per menstrual cycle. Students who felt uncomfortable at school during menstruation (99% vs. 32%; APD=58%; CI: 54, 63) and who believed menstrual problems interfere with school performance (64% vs. 30%; APD=27; CI: 20, 33) were more likely to miss school during menstruation than who did not. School absence during menstruation was less common among girls attending schools with unlocked toilet for girls (35% vs. 43%; APD=-5.4; CI: -10, -1.6).School absence was more common among girls who were forbidden from any activities (41% vs. 33%; APD=9.1; CI: 3.3, 14) during menstruation.

Conclusion: Risk factors for school absence included girl's attitude, misconceptions about menstruation, insufficient and inadequate facilities at school, and family restriction. Enabling girls to manage menstruation at school by providing knowledge and management methods prior to menarche, privacy and a positive social environment around menstrual issues has the potential to benefit students by reducing school absence.

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ARTICLE SUMMARY

Strengths and limitations of this study

- We attempted to quantify the complex ways by which menstruation affects girls at school
- We conducted a nationally representative, cross-sectional study in Bangladeshi schools and interviewed 2,332 students from 700 schools
- We used a sampling weight to determine national estimates which might over represents small schools
- We identified adolescent schoolgirls at school who reached menarche with the help of female teacher, and so our sample might be non-representative because teachers might be more likely to have suggested including girls who have difficulty with menstruation.

BACKGROUND

Menstrual hygiene management at school is constrained by poor access to water and sanitation, lack of privacy, and limited education about menstrual hygiene[1] as well as social stigma and cultural restrictions on activities[2].

Girls' education has a long-term positive impact on development, especially in low income communities[3]. However, a number of small-scale, mostly qualitative, studies have found that many school-age girls do not attend school during menstruation[2 4-6] due to shame, fear of having visible stains on their clothing, absence of a private place to manage menstruation in school[2 5 7 8] or dysmenorrhoea[9 10]. In an Ethiopian study, about 90% of girls stated that their academic performance or class rank declined after menarche[5]. However, little attempt has been made to quantify the complex ways by which menstruation affects girls at school[11].

Barriers to menstrual hygiene management among Bangladeshi girls may hamper progress toward Sustainable Development Goals 3 (ensure healthy lives and well being for all at all ages), 4 (ensure inclusive and equitable quality education and promote lifelong learning opportunities for all), 5 (promote gender equality and empower all women and girls) and 6 (ensure the availability and sustainable management of water and sanitation for all)[12]. This study aims to describe the current state of menstrual hygiene management in Bangladeshi schools and examine the association of menstrual hygiene knowledge, facilities and practice with absence from school during menstruation.

METHODS

Study design and school sampling

We conducted a national, cross-sectional study in Bangladeshi schools from March to June 2013 among girls who had reached menarche and were enrolled in grades two to nine as part of a study to examine water, sanitation and hygiene facilities, knowledge and practices[13]. We used probability proportional to size sampling to select 50 rural villages and 50 urban areas as clusters. For the selection of rural clusters we used National Population and Housing Census 2011 data[14], and for the urban sampling frame we used the 2006 Urban Health Survey data[15].

As part of the Bangladesh National Hygiene Baseline Survey[13], we determined the sample size required to estimate the national coverage of handwashing with soap in school.

We assumed 80% power, and α of 0.05 with a design effect of 12, and based our calculations on the indicator 'schools having soap and water at handwashing location' from a recent rural schools survey[16]. We assumed a 10% difference in this indicator between rural and urban schools and estimated that 672 schools would be required to measure this difference. We sampled the seven government and non-government schools, at both primary and secondary level, nearest to the midpoint of each cluster and thus selected 700 schools.

Selection of participants

Field staff asked female teachers to mark on the attendance registry which of the girls present in school on the day of the survey had reached menarche. The field staff then numbered the eligible girls and used a random number generator to select four of these girls from grades two to five in primary schools and from grades six to nine in secondary schools to take the survey. If any students selected from the register were not interested in participating in the survey, the team interviewed those who consented and then continued to the next school.

Data collection

Trained female data collectors administered the survey verbally and recorded responses using a computer tablet-based structured questionnaire and conducted facility spot checks. During spot checks, the team looked for menstrual hygiene facilities, particularly the presence and type of toilet, the presence of soap inside or within 10 meter of the toilet, presence of water, and a disposal bin inside the toilet, and whether the door was unlocked from the outside and therefore accessible to students. We designed data collection instruments during group discussions with all stakeholders and included questions to collect data on variables reported in published studies of menstrual hygiene.

The girls were asked if they usually missed class during menstruation, the average number of days they were absent during each cycle and whether they thought menstrual hygiene management problems impacted school performance. Finally, we reviewed the national education curriculum for grades two to nine to understand the current menstrual hygiene education syllabus and textbook material.

Outcome and exposures

The primary outcome variable was reported school absence. Exposures included girl's attitude and knowledge about menstruation (how girls feel at school during menstruation, current perception about menstruation and believing menstrual hygiene problems interfere

with school performance), school facilities and programs for girls (gender separated toilet at school for girls, gender separated unlocked toilet at school for girls, providing menstrual hygiene management education at school), and practices related to menstruation (forbidden activities during menstruation, not allowed to go out during menstruation).

Statistical analysis

We conducted statistical analysis according to a predefined conceptual model (Figure 1) that reflected our hypothesis about how school absence could be affected by a range of factors. First, we performed descriptive analysis to determine student characteristics, students' attitude and knowledge about menstruation, school facilities and programs for menstrual hygiene management, and student's menstrual hygiene practice. We reported means and standard deviations for continuous variables that were normally distributed. Because we used a probability proportional to size technique to select clusters, but not sampling units (schools) from within the clusters, we used a sampling weight to determine national estimates, calculated as f=1/F, where F is the total number of population clusters. All percentages and means reported are weighted national estimates.

We calculated the prevalence difference for school absence among school students for our exposures of interest using generalized estimating equations (GEE) with robust standard errors to account for school-level clustering and adjust over-dispersion. Exposures were grouped in four blocks by following the conceptual model: (1) attitude, (2) knowledge, (3) school facilities and programs, and (4) practices. We performed bivariate analysis between exposures and outcome to calculate crude association. We further considered only those exposures associated with outcomes with a $p<0.2$. We then conducted multivariable analysis among the exposures within each block including confounders identified in the conceptual model. We retained exposure within each block associated with outcome at the $p<0.05$ level. We then built an overall multivariate model by using exposure variables from each block that were associated with school absence at the $p<0.05$ level and which captured most of the measurement. We identified 'feel uncomfortable at school during menstruation' variable from girl's attitude block; 'believe menstrual problems interfere with school performance' variable from knowledge block; 'gender separated unlocked toilet for girls at school' variable form school facilities block and 'forbidden from any activities during menstruation' variable from practice block for overall multivariable analysis. We calculated the adjusted prevalence difference for the outcome with the exposures of interest identified in the previous step by controlling for potential confounders identified in the conceptual model. We identified the

student's age and area of school (rural or urban) as confounders, as we would expect these factors to be associated with menstruation-related attitude, knowledge, facilities and practices as well as predict school absence (Figure 1).

We used the WHO/UNICEF Joint Monitoring Program definitions for improved water source and improved toilet[17]. We defined a toilet as 'functional' if students could use it on the day of the survey, if it had a working door and if it was lockable from the inside with a latch. We calculated the 'school year' based on the academic calendar for primary and secondary schools of Bangladesh, with weekends and holidays excluded.

Ethical consideration

The data collectors obtained informed verbal assent from participants and informed written consent from their guardians as well as the consent of the head teacher. We obtained approval from icddr,b's Ethical Review Committee and the Policy Support Unit of the Ministry of Local Government.

RESULTS

School and student characteristics

Seventy-six percent of schools included in the study were primary schools and 24% were secondary. Primary schools had an average of 310 students and secondary schools 559. The mean age of interviewed girls was 13 among 2,332 participants. Average age at menarche was 12 (Table 1) and 98% of students started menstruation before age 14.

Table 1 Characteristics of Bangladeshi schools, and girl students, 2013

Indicators	n/N	% * or mean (SD)	95% CI
Type of school by grade level:			
Primary	511/700	76	(73, 80)
Secondary	189/700	24	(20, 27)
Type of school by management:			
Government	466/700	67	(64, 70)
Non-government	234/700	33	(29, 37)
Mean number of students per school			
Primary	N=511	310 (288)	-
Secondary	N=189	559 (389)	-
Female teacher present at school:			
Primary	2,419/3,297	61	(57, 65)
Secondary	1,456/3,753	22	(19, 25)
Mean age of interviewed students	N=2,332	12.8 (1)	-
Mean grade level of respondents	N=2,332	6 (1.6)	-
Mean age at menarche (years)	N=2,326	11.9 (0.9)	-

*Weighted percentage

Knowledge, attitude, facilities, and practices

Sixty-four percent of girls reported they had no knowledge of menstruation before reaching menarche. Twenty-six percent of girls received information on menstruation prior to menarche from their female relatives before menarche and <1% from their teachers. Thirty-two percent of respondents stated that menstrual problems interfered with school performance. Only 9% of girls reported that schools provided menstrual hygiene education sessions for girls. On average, schools provided menstrual hygiene education sessions at grade eight, when girls were around 14 years old (Table 2).

Table 2 Menstrual hygiene knowledge, practices and school facilities for Bangladeshi schoolgirls, 2013

Indicators	n/N	%* or mean (SD)	95% CI
Current perception about menstruation:			
No idea	1132/2,332	49	(44, 55)
A normal biological process for women	959/2,332	40	(34, 45)
A female illness	229/2,332	10	(7, 14)
Curse of God	12/2,332	1	(0.1, 1)
Knew/ heard about menstruation before menarche	862/2,332	36	(33, 39)
Knew/heard about menstruation issues before menarche from:			
Mother/sister/aunt/grandmother	592/2,332	26	(23, 29)
Friend	255/2,332	11	(8, 14)
Teacher	15/2,332	0.64	(0.32, 0.91)
Believe menstrual problems interfere with school performance	756/2,332	32	(27, 37)
Materials used during menstruation:			
Re-used cloth	1,904/2,332	86	(84, 88)
Disposable pad	355/2,332	10	(8.5, 12)
Other†	43/2,332	2	(1.2, 3)
Mean number of menstrual cloth changes per day	N=1,898	3 (1)	
Washed cloth with soap and improved water source for repeated use	1,225/1,904	57	(50, 63)
Washed cloth with soap and improved source of water and dried in sunlight for repeated use	525/1,904	25	(21, 29)
School has a place‡ to change menstrual materials	733/2,332	31	(27, 35)
Schools with separate improved toilet for girls	602/700	82	
Schools with separate improved and unlocked toilet for girls	671/2,332	28	(24, 33)
Mean number of female students per improved and unlocked toilet for girls	N=363	98 (48)	-

School has improved toilet with soap and water available	213/2,332	9	(6.9, 12)
Perceived that school facilities were inappropriate for managing menstrual hygiene	1,906/2,332	82	(77, 88)
Disposal location of absorbent materials at school:			
Did not change and dispose at school	1,935/2,332	83	(79, 86)
Inside toilet pan	85/2,332	4	(2.6, 4.8)
Hidden inside classroom	73/2,332	3	(1.8, 4.6)
In the open	71/2,332	3	(2, 4)
Menstrual hygiene education session had ever been provided at school	213/2,332	9	(6.8, 11)
Mean grade level for which menstrual hygiene education sessions were provided at school	N=213	8 (1.7)	
Family enforced prohibitions during menstruation:			
Not allowed to go out/to certain places	1096/2,332	71	(68, 74)
Not allowed to perform religious activities	1,185/2,332	54	(49, 60)
Not allowed to cook/eat certain food	741/2,332	32	(29, 34)
No restriction	362/2,332	16	(13, 19)
Instructed not to walk fast/run	160/2,332	7	(5, 8)

*Weighted;
†Cotton/Tissue paper/ waste fabrics from garment factories;
‡Unlocked toilet for girls or change room

Textbooks addressed some issues related to adolescence i. e. what is puberty, when it starts and what happens after this. However, the menstrual hygiene content mainly described menstruation as a biological process, and did not provide practical information about how to manage changes to girls' bodies.

Eighty-two percent of girls judged school facilities as inappropriate for managing menstrual hygiene. Eighty-two percent of schools had an improved toilet for girls, but only 28% of schools had one or more improved toilet that was unlocked. Thus, 54% of schools did not have an improved, unlocked toilet that students could access and only 9% of schools among all had a toilet with soap and water inside. There were 31% of schools that had a designated private unlocked toilet or change room to change menstrual materials. Among the schools that had a private unlocked toilet, there were a mean of 98 girls for each toilet.

Eighty-six percent of girls used cloth during menstruation; 10% used disposable pads. Girls attending urban schools were more likely to use disposable pads (urban: 21%, rural: 9%, APD: 12; CI: 8.1, 16). Among cloth users, 64% washed their cloths with soap. Only 3% of girls washed their cloths with soap, dried them in sunlight and stored them with other cloth for repeated use, which is identified as the best cloth cleansing practice in the Bangladesh National Hygiene Promotion Strategy[18]. Eighty-six percent of girls reported that they did not change their menstrual cloth during school hours, which spanned approximately four

hours for primary and seven hours for secondary schools. School students reported family-imposed restrictions during menstruation: 71% reported that they were 'not allowed to go out/to certain places', 51% reported that they were 'not allowed to perform religious activities', 32% reported that they were 'not allowed to cook/eat certain food' and 7% reported that they were 'instructed not to walk fast' during menstruation (Table 2).

School absence

Forty-one percent of girls reported missing school during menstruation. Absentee girls missed an average of 2.8 days each menstrual cycle, constituting approximately 16% of the academic year. When asked why they missed school, 59% reported that they felt uncomfortable sitting beside boys during menstruation, 31% reported that they felt embarrassed at school during menstruation, 5% reported that there was no place to change menstrual materials in school and 4% said their guardians forbade them to go to school (Table 3).

Table 3 School absence among Bangladeshi schoolgirls, 2013

Indicators	n/N	%* or mean (SD)	95% CI
Reported missing school during menstruation	931/2332	41	(36, 46)
Mean number of days per menstrual cycle that adolescent school girls reported missing school	N=931	2.8 (1.4)	-
Reasons for missing school (multiple responses):			
Feel uncomfortable sitting beside boys during menstruation	547/931	59	(56, 63)
Feel uncomfortable at school during menstruation	287/931	31	(26, 34)
Remain sick	186/931	20	(16, 24)
Heavy bleeding	83/931	9	(6, 15)
No place to change rag/cloths	48/931	5	(3, 7)
Forbidden by guardian	40/931	4	(2, 9)

*Weighted percentage

After controlling for confounders, school absence during menstruation were more common among girls who felt uncomfortable at school during menstruation (99% vs. 32%; APD=58%; CI: 54, 63) and who perceived menstrual hygiene management interferes with school performance than who did not (64% vs. 30%; APD=27; CI: 20, 33) (Table 4).

Table 4 Factors associated with school absence among Bangladeshi schoolgirls, 2013

	Absent during menstruation	PD† (%)	95% CI	APD‡	95% CI

	n (%*)				
Feel uncomfortable at school during menstruation					
Yes	287 (99)	66	(61, 71)	58	54, 63
No	2,045 (32)	-	-	-	-
Current perception about menstruation:					
A normal biological process	959 (38)	-	-	-	-
No idea	1,132 (40)	0.5	(-5.7, 6.7)	-	-
A female illness	229 (52)	10	(0.2, 18)	-	-
Believe menstrual problems interfere with school performance					
Yes	756 (64)	36	(29, 44)	27	(20, 33)
No	1,576 (30)	-	-	-	-
Gender separated toilet at school					
Yes	1,036 (36)	-5.0	(-11, 0.5)	-	-
No	1,296 (43)	-	-	-	-
Gender separated unlocked toilet for girls at school					
Yes	945 (35)	-5.5	(-11, -0.5)	-5.4	(-10, -1.6)
No	1,387 (43)	-	-	-	-
School provided menstrual hygiene education session for girls					
Yes	213 (40)	-1.5	(-11, 14)	-	-
No	2,119 (42)	-	-	-	-
Forbidden from any activities during menstruation					
Yes	1,970 (41)	10	(2.3, 18)	9.1	(3.3, 14)
No	362 (33)	-	-	-	-
Not allowed to go out during menstruation					
Yes	604 (46)	5.9	(-0.6, 12)	-	-
No	1,728 (38)	-	-	-	-

* Weighted percentage;
† Prevalence difference;
‡ Adjusted prevalence difference calculated by adjusting for 'feel uncomfortable at school during menstruation', 'believe menstrual problems interfere with school performance', 'unlocked toilet for girls at school', 'student's age' and 'area of school (rural vs. urban)

School absence during menstruation was less common among girls where the schools had an unlocked or open gender separated toilet for girls than when there was a locked toilet for girls (35% vs. 43%; APD=-5.4; CI: -10, -1.6). Girls were more likely to miss schools who were forbidden from any activities during menstruation (41% vs. 33%; APD=9.1; CI: 3.3, 14) compared to those who did not (Table 4).

Girls who used cloth that was washed with water only or washed with soap and not dried in sunlight were just as likely to miss school compared to girls who used pads (42% vs. 40%; APD= -2.1;CI: -9.1, 5.1) or who used cloth washed with soap and water and dried in sunlight (42% vs. 38%; APD= -4.4; CI: -12, 3.4).

DISCUSSION

Forty-one percent of girls usually missed school during menstruation, likely impacting school performance[2 4]; we estimated they were absent for 16% of the school year. In our study school absence during menstruation was independently associated with negative attitudes and perceptions about menstruation, not having a gender separated unlocked toilet for girls at schools and forbidden from activities during menstruation, factors that are similar to other studies[5 7 8 19-23].

Negative attitudes about menstruation, such as perceiving it as something unhealthy, shameful, or obstructive to learning, were common reasons for absence. Such attitudes may arise from the prevalent patriarchal culture in the society[22] and that around two-thirds of girls did not know about menstruation before they reached menarche. Some studies reported that, girls who didn't receive any information about menstruation before menarche were more stigmatized about menstruation contributing to a culture of shame among them[24-26]. Increasing the knowledge and changing attitudes about menstruation among adolescent schoolgirls in Pakistan increased girls' confidence to manage menstruation hygienically [27]. In Bangladesh, a six-month educational intervention among 438 students from three schools demonstrated an 31% increase in students' knowledge about menstruation and a 5.1% decrease in school absence among participants from baseline[28]. In Ghana, menstrual hygiene education was found to increase girls' school attendance by around 6 days per 65 days term (9% of a girls' school year)[29].

This study identified several limitations in the current school curriculum on menstruation. The strict biological focus of school textbooks provided no opportunity for constructive discussion of healthy attitudes[30] or salient social and religious issues. Moreover, teaching reproductive health is not mandated by the government. Even where schools had some course material on menstruation, 91% of girls reported that they had never received menstrual hygiene education sessions at school. Students usually participate in such classes after commencing menstruation and less than 1% of students cited school teachers as a source of information. Our study provides little insight on why < 1% of schools provides

education on menstruation that addresses social and cultural issues. One reason might be that the national education curriculum does not sufficiently address social and cultural issues regarding menstruation; these were missing from the text books. Lack of timely information results in poor menstrual hygiene practices[31] and increased risk of urinary tract infection[32]. In addition, only 25% of secondary school teachers are female in Bangladesh, compared to 61% of primary school teachers[33]. Girls may not feel comfortable discussing menstruation with men[22 31 32]. The difficulty of providing menstrual education to Bangladeshi girls is thus twofold: first, schools and the education board need to be persuaded to consider menstrual hygiene as part of their educational mission. Second, the timing, content, and delivery of the menstrual curriculum need to be revised to better address the needs of girls.

Lacking a separate improved accessible or open toilet at school for girls was another reason for absence. In Bangladesh, the number of girls per toilet was two times higher than the national recommended standard of 50 girls per toilet[18]. Simply ensuring that toilets in schools are unlocked from the outside may increase the number of accessible toilet for girls as more than half of the separate toilets for girls were locked during school hours. A study conducted in Kenyan schools found that toilet access was more effective in reducing absence among girls than among boys due to its impact on menstrual hygiene management[34]. In our study lack of gender-separated open toilets was associated with missing school, similar to a finding in a recent systematic review[35] suggesting that simply ensuring gender-separated toilets for girls to change menstrual materials is important. Similar studies from other countries also report similar findings[23 29 36 37]. A study from India reported that 28% of girls missed school during menstruation due to lack of facilities[37], and in Nepal, 41% of students reported lack of privacy for cleaning and washing as a major reason for absence during menstruation[23]. In Ghana, girls missed school due to inadequate sanitation facilities at school during menstruation[29].

Disposable sanitary napkin use was not common in this setting, and was not associated with school attendance. This finding stands in contrast to a similar study conducted in Ethiopia, where students “who did not use disposable sanitary napkins were 5.4 times more likely to be absent from school than their counterparts”[5] but supports a recent systematic review [38].

Restriction imposed by guardians was independently associated with school absence in our study. Guardians may impose this restriction due to cultural norms, proscription and

stigma related to menstruation[22 23]which should be addressed by menstrual health and education programs[39].The issue of restriction also indicated the importance of a broader discussion on menstrual hygiene within the community.

This absence rate during menstruation was higher than that reported in a smaller-scale study in Maharashtra, India where data were collected using a self-administered structured questionnaire (561 girls, 14% absent)[9], but similar to those reported in Habru, Ethiopia (595 girls, 55% absent)[5], and West Bengal, India (190 girls, 39% absent)[40]. Common school absence illustrates the urgent need to address menstrual hygiene management in schools across low and middle-income countries to meet development goals.

This study had some important limitations. We identified adolescent schoolgirls who reached menarche with the help of female teacher, and so our sample might be non-representative because teachers might have suggested including girls who have difficulty with menstruation. Conversely, those who were absent on the survey day may have been menstruating and so have been under-represented. We did not explore the reasons behind schools keeping toilets locked from outside or why most schools taught about menstruation after girls reach menarche, because this study did not include a qualitative investigation.

CONCLUSION

Qualitative evidence from several countries suggests that menstruation affects girls' school attendance. Our study quantified the magnitude of this effect. In a nationally representative sample, nearly half of schoolgirls in Bangladesh miss 16% of school days because of menstruation. The risk factor analysis suggests several modifiable factors that contributed to school absence. Although further research to assess the effectiveness of interventions to address these problems would be productive, the current data suggest that: schools should ensure that toilets are open during school hours; textbook should be revised in a way that menstruation is taught three years earlier than currently presented so that girls can learn about menstruation before they experience it. A broader discussion within the community might also create a more supportive environment for girls to attend school during menstruation. Efforts are also required to develop the capacity of teachers to teach menstrual hygiene education. We recommend conducting further exploratory studies to better understand beliefs and norms about menstruation, use and preference of absorbents and issues related to discomfort at school. We also recommend further research on the impact of

gender-separated toilets and menstrual hygiene education on school attendance and girls' educational outcomes.

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All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organization for the submitted work; no financial relationships with any organizations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Author's contribution

Mahbub-Ul Alam, MPH, Stephen P. Luby, MD, Amal K. Halder, Phd, Md. Khairul Islam, MPhil, Aftab Opel, MSS, Abul K. Shoab, MSc, Probir K. Ghosh, MSc, Mahbubur Rahman, MPH, Therese Mahon, MA, Leanne Unicomb, Phd

Contributors: MA, SPL, AKH, KI, AO and LU conceived and designed the original protocol. All authors except TM were involved in amending the protocol. MA, AKH, MR and LU coordinated the study throughout. Data entry, cleaning and analysis was carried out by AKS, PKG and MA. AKS cleaned the data and ran preliminary analysis with input from MA, AKH, LU, MR, SPL and TM. MA carried out advanced analysis and AKH, LU, MR, SPL, PKG, AO, KI and TM provided advice on data interpretation. MA wrote the first draft of the manuscript with LU and AKH. All authors contributed to subsequent and final drafts.

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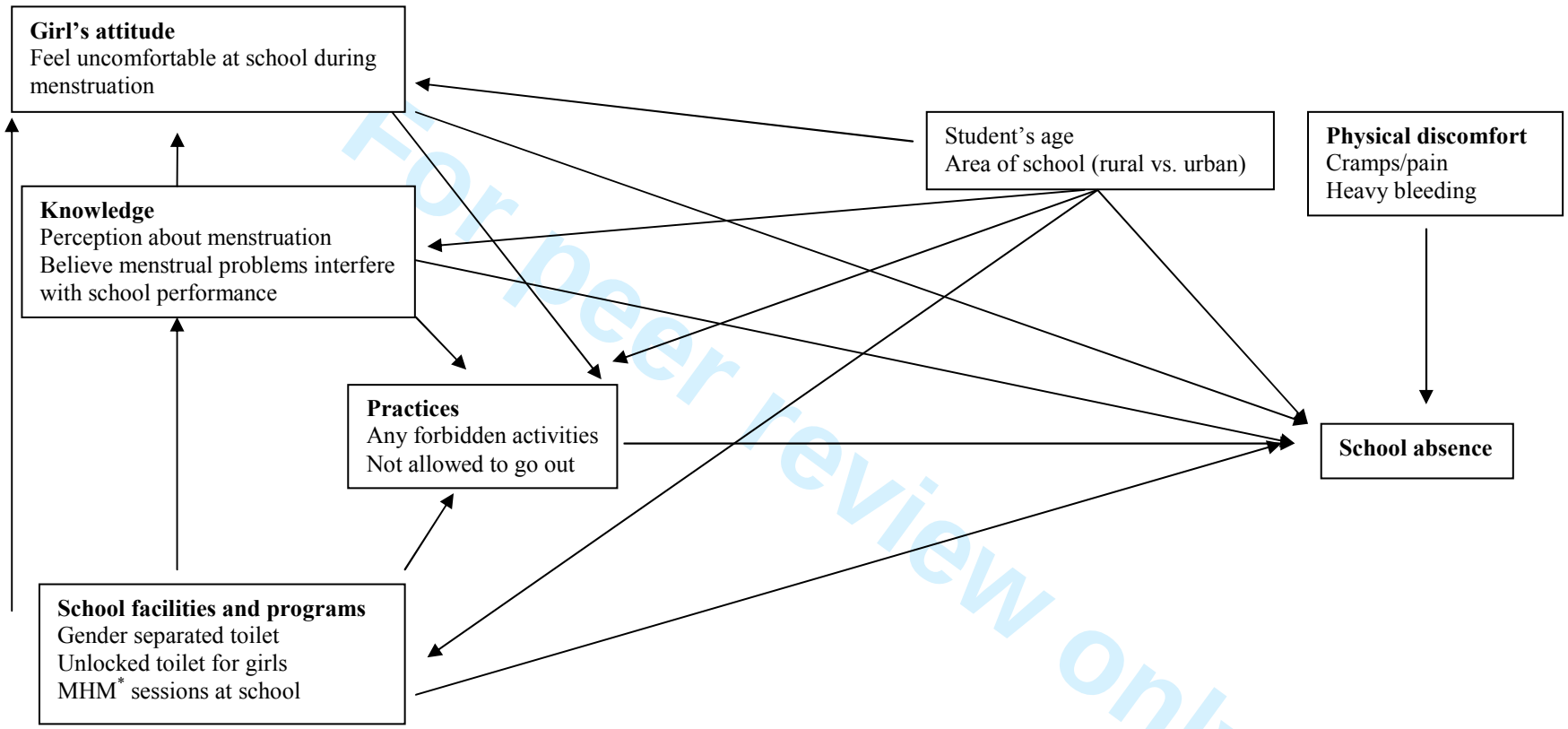

Figure 1: Conceptual framework for school absence during menstruation among schoolgirls

* MHM: menstrual hygiene management

STROBE 2007 (v4) Statement—Checklist of items for the manuscript titled " Menstrual hygiene management among Bangladeshi adolescent schoolgirls: risk factors affecting school absence"

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7 and 8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8
Bias	9	Describe any efforts to address potential sources of bias	*8*
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	8
		(*e*) Describe any sensitivity analyses	

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15
Generalisability	21	Discuss the generalisability (external validity) of the study results	16
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Menstrual hygiene management among Bangladeshi adolescent schoolgirls and risk factors affecting school absence: results from a cross-sectional survey

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Abstract

Background: Many adolescent girls in low and middle-income countries lack appropriate facilities and support in school to manage menstruation. Little research has been conducted on how menstruation affects academic performance. This study examines the association of menstrual hygiene management knowledge, facilities, and practice with absence from school during menstruation among Bangladeshi schoolgirls.

Methods: We conducted a nationally representative, cross-sectional study in Bangladeshi schools from March to June, 2013 among 11 to 17-year-old girls who reached menarche. We sampled 700 schools from 50 urban and 50 rural clusters using a probability proportional to size technique. We interviewed 2,332 schoolgirls and conducted spot checks in each school for menstrual hygiene facilities. To assess factors associated with reported school absence, we estimated adjusted prevalence difference (APD) for controlling confounders' effect using generalized estimating equations to account for school-level clustering.

Results: Among schoolgirls, who reached menarche, 41% (931) reported missing school, an average of 2.8 missed days per menstrual cycle. Students who felt uncomfortable at school during menstruation (99% vs. 32%; APD=58%; CI: 54, 63) and who believed menstrual problems interfere with school performance (64% vs. 30%; APD=27; CI: 20, 33) were more likely to miss school during menstruation than who did not. School absence during menstruation was less common among girls attending schools with unlocked toilet for girls (35% vs. 43%; APD=-5.4; CI: -10, -1.6). School absence was more common among girls who were forbidden from any activities during menstruation (41% vs. 33%; APD=9.1; CI: 3.3, 14).

Conclusion: Risk factors for school absence included girl's attitude, misconceptions about menstruation, insufficient and inadequate facilities at school, and family restriction. Enabling girls to manage menstruation at school by providing knowledge and management methods prior to menarche, privacy and a positive social environment around menstrual issues has the potential to benefit students by reducing school absence.

Abstract word count: 300 words

ARTICLE SUMMARY

Strengths and limitations of this study

- We attempted to quantify the complex ways by which menstruation affects girls at school
- We conducted a nationally representative, cross-sectional study in Bangladeshi schools and interviewed 2,332 students from 700 schools
- We used a sampling weight to determine national estimates which might over represents small schools
- With the help of female teachers at school, we identified adolescent schoolgirls who reached menarche, and so our sample might be non-representative because teachers might be more likely to have suggested including girls who have difficulty with menstruation.

BACKGROUND

Menstrual hygiene management (MHM) at school is constrained by poor access to water and sanitation, lack of privacy, and limited education about menstrual hygiene[1] as well as social stigma and cultural restrictions on activities[2]. Menstruation poses a set of physical, socio-cultural and economic challenges to adolescent girls that may interfere with their ability to attend school or to participate fully in classroom[3].

Girls' education has a long-term positive impact on personal welfare and health as well as economic and social development, especially in low-income communities[4]. Better educated women are more likely to be healthier than uneducated women, participate more in the formal labor market, earn higher incomes, get married at a later age, have fewer children, potentially ensuring better health status and education for their children[5] which can reduce poverty and contribute to a country's development. However, a number of small-scale, mostly qualitative studies have found that many school-age girls do not attend school during menstruation[2, 6-8]due to shame, fear of having visible stains on their clothing, absence of a private place to manage menstruation in school[2, 7, 9, 10]or dysmenorrhoea[11, 12]. In an Ethiopian study, about 90% of girls stated that their academic performance or class rank declined after menarche[7]. However, little attempt has been made to quantify the complex ways by which menstruation affects girls at school[13]. The present study measured school absence reported by students and used this to quantify its relationship with MHM.

Barriers to menstrual hygiene management among Bangladeshi girls may hamper progress toward Sustainable Development Goals 3 (ensure healthy lives and well being for all at all ages), 4 (ensure inclusive and equitable quality education and promote lifelong learning opportunities for all), 5 (promote gender equality and empower all women and girls) and 6 (ensure the availability and sustainable management of water and sanitation for all)[14]. This study aims to describe the current state of MHM among student from Bangladeshi schools and examine the association between menstrual hygiene knowledge, facilities and practice and absence from school during menstruation.

METHODS

Study design and school sampling

We conducted a national, cross-sectional study in Bangladeshi schools from March to June 2013 among girls who had reached menarche and were enrolled in grades two to nine as

part of a study to examine water, sanitation and hygiene facilities, knowledge and practices[15]. We used probability proportional to size sampling to select 50 rural villages and 50 urban areas as clusters so that we would have sufficient power across the national hygiene survey to compare rural and urban prevalence. For the selection of rural clusters we used National Population and Housing Census 2011 data[16], and for the urban sampling frame we used the 2006 Urban Health Survey data[17] as primary data from National Population and Housing Census 2011 on the urban area were not available during the design phase of our study.

As part of the Bangladesh National Hygiene Baseline Survey[15], we determined the sample size required to estimate the national coverage of handwashing with soap in school. We assumed 80% power, and α of 0.05 with a design effect of 12, and based our calculations on the indicator 'schools having soap and water at handwashing location' from a recent rural schools survey[18]. We assumed a 10% difference in this indicator between rural and urban schools and estimated that 672 schools would be required to measure this difference. We sampled the seven government and non-government schools, at both primary and secondary level, nearest to the midpoint of each cluster and thus selected 700 schools.

Selection of participants

Field staff asked female teachers to mark on the attendance registry which of the girls present in school on the day of the survey had reached menarche. Students had to seek permission from teachers before leaving school due to any urgent matter and usually girls inform female teachers about issues related to menstruation. The field staff then numbered the eligible girls and used a random number generator to select four of these girls from grades two to five in primary schools and from grades six to nine in secondary schools to take the survey. If any students selected from the register were not interested in participating in the survey, the team interviewed those who consented and then continued to the next school.

Data collection

Trained female data collectors conducted facility spot checks then administered the survey verbally and recorded responses using a computer tablet-based structured questionnaire. Visits to schools were unannounced and surveys were conducted after obtaining informed consent from the school authority. During spot checks, the team looked for menstrual hygiene facilities, particularly the presence and type of toilet, the presence of soap inside or within 10 meters of the toilet, presence of water, and a disposal bin inside the

toilet, and whether the door was unlocked from the outside and therefore accessible to students. We designed data collection instruments during group discussions with all stakeholders and included questions to collect data on variables reported in published studies of menstrual hygiene[2, 13, 19-21].

The girls were asked if they missed class during their last three menstrual cycles, the average number of days they were absent per cycle during their last three cycles and whether they thought menstrual hygiene management problems impacted school performance. Finally, we reviewed the national education curriculum for grades two to nine to understand the current menstrual hygiene education syllabus and textbook material.

Outcome and exposures

The primary outcome variable was reported average number of school absence days in the last three menstrual cycles. The interviewer asked girls "Did you miss any class during menstruation in the last three months?" If the respondents answered yes, the interviewer asked "how often (average of last three months in school days)?" The girls' attitude and knowledge about menstruation, reason for school absence during menstruation and practices related to menstruation were collected by asking open ended, multiple-choice questions. The interviewer coded the response into categories with an option for other if an appropriate category was not listed. The full questionnaire is included as supplementary file.

Statistical analysis

We conducted statistical analysis according to a predefined conceptual model (Figure 1) that reflected our hypothesis about how school absence could be affected by a range of factors. First, we performed descriptive analysis to determine student characteristics, students' attitude and knowledge about menstruation, school facilities and programs for menstrual hygiene management, and student's menstrual hygiene practice. We reported means and standard deviations for continuous variables that were normally distributed. Because we used a probability proportional to size technique to select clusters among 86,925 rural clusters and 10,552 urban clusters, we used a sampling weight to calculate national estimates adjusting for rural/urban balance, calculated as f=1/F, where F is the total number of urban or rural clusters. We also weighted for school size to calculate national estimates, calculated as s=1/S, where S is the total number of the students in the school. All percentages and means reported are weighted national estimates.

We calculated the prevalence difference for school absence among school students for our exposures of interest using generalized estimating equations (GEE) with robust standard errors to account for school-level clustering and adjust over-dispersion. Exposures were grouped in four blocks by following the conceptual model: (1) attitude, (2) knowledge, (3) school facilities and programs, and (4) practices. We performed bivariate analysis between exposures and outcome to calculate crude association. We further considered only those exposures associated with outcomes with a $p<0.2$. We then conducted multivariable analysis among the exposures within each block including confounders identified in the conceptual model. We retained exposure within each block associated with outcome at the $p<0.05$ level. We then built an overall multivariate model by using exposure variables from each block that were associated with school absence at the $p<0.05$ level and which captured most of the measurement. We identified 'feel uncomfortable at school during menstruation' variable from girl's attitude block; 'believe menstrual problems interfere with school performance' variable from knowledge block; 'gender separated unlocked toilet for girls at school' variable form school facilities block and 'forbidden from any activities during menstruation' variable from practice block for overall multivariable analysis. We calculated the adjusted prevalence difference for the outcome with the exposures of interest identified in the previous step by controlling for potential confounders identified in the conceptual model. We identified the student's age and area of the school (rural or urban) as confounders, as we would expect these factors to be associated with menstruation-related attitude, knowledge, facilities and practices as well as predict school absence (Figure 1).

We used the WHO/UNICEF Joint Monitoring Program definitions for improved water source and improved toilet[22]. We defined a toilet as 'functional' if students could use it on the day of the survey, if it had a working door and if it was lockable from the inside with a latch. We calculated the 'school year' based on the academic calendar for primary and secondary schools of Bangladesh, with weekends and holidays excluded.

Ethical consideration

The data collectors obtained informed verbal assent from participants and informed written consent from their guardians as well as the consent of the head teacher. We obtained approval from icddr,b's Ethical Review Committee and the Policy Support Unit of the Ministry of Local Government.

RESULTS

School and student characteristics

Seventy-six percent of schools included in the study were primary schools and 24% were secondary. Primary schools had an average of 310 students and secondary schools 559. In primary schools 61% of teachers were women whereas in secondary schools only 22% of teachers were women. The mean age of interviewed girls was 13 among 2,332 participants. Average age at menarche was 12 (Table 1) and 98% of students started menstruation before age 14.

Table 1 Characteristics of Bangladeshi schools, and girl students, 2013

Indicators	n/N	% * or mean (SD)	95% CI %
Type of school by grade level:			
Primary	511/700	76	(73, 80)
Secondary	189/700	24	(20, 27)
Type of school by management:			
Government	466/700	67	(64, 70)
Non-government	234/700	33	(29, 37)
Mean number of students per school			
Primary	N=511	310 (288)	-
Secondary	N=189	559 (389)	-
Female teacher present at school:			
Primary	2,419/3,297	61	(57, 65)
Secondary	1,456/3,753	22	(19, 25)
Mean age of interviewed students	N=2,332	12.8 (1)	-
Mean grade level of respondents	N=2,332	6 (1.6)	-
Mean age at menarche (years)	N=2,326	11.9 (0.9)	-

*Weighted percentage for rural/urban balance and school size

Knowledge, attitude, facilities, and practices

Sixty-four percent of girls reported they had no knowledge of menstruation before reaching menarche. Twenty-six percent of girls received information on menstruation prior to menarche from their female relatives before menarche and <1% from their teachers. Thirty-two percent of respondents stated that menstrual problems interfered with school performance. Only 9% of girls reported that schools provided menstrual hygiene education sessions for girls. On average, schools provided menstrual hygiene education sessions at grade eight, when girls were around 14 years old (Table 2).

Table 2 Menstrual hygiene knowledge, practices and school facilities for Bangladeshi schoolgirls, 2013

Indicators	n/N	%* or mean (SD)	95% CI %
Current perception about menstruation:			
No idea	1132/2,332	49	(44, 55)
A normal biological process for women	959/2,332	40	(34, 45)
A female illness	229/2,332	10	(7, 14)
Curse of God	12/2,332	1	(0.1, 1)
Knew/ heard about menstruation before menarche	862/2,332	36	(33, 39)
Knew/heard about menstruation issues before menarche from:			
Mother/sister/aunt/grandmother	592/2,332	26	(23, 29)
Friend	255/2,332	11	(8, 14)
Teacher	15/2,332	0.64	(0.32, 0.91)
Believe menstrual problems interfere with school performance	756/2,332	32	(27, 37)
Materials used during menstruation:			
Re-used cloth	1,904/2,332	86	(84, 88)
Disposable pad	355/2,332	10	(8.5, 12)
Other†	43/2,332	2	(1.2, 3)
Mean number of menstrual cloth changes per day	N=1,898	3 (1)	
Washed cloth with soap and improved water source for repeated use	1,225/1,904	57	(50, 63)
Washed cloth with soap and improved source of water and dried in sunlight for repeated use	525/1,904	25	(21, 29)
School has a place‡ to change menstrual materials	733/2,332	31	(27, 35)
Schools with separate improved toilet for girls	602/700	82	
Schools with separate improved and unlocked toilet for girls	671/2,332	28	(24, 33)
Mean number of female students per improved and unlocked toilet for girls	N=363	98 (48)	-
School has improved toilet with soap and water available	213/2,332	9	(6.9, 12)
Perceived that school facilities were inappropriate for managing menstrual hygiene	1,906/2,332	82	(77, 88)
Disposal location of absorbent materials at school:			
Did not change and dispose at school	1,935/2,332	83	(79, 86)
Inside toilet pan	85/2,332	4	(2.6, 4.8)
Hidden inside classroom	73/2,332	3	(1.8, 4.6)
In the open	71/2,332	3	(2, 4)
Menstrual hygiene education session had ever been provided at school	213/2,332	9	(6.8, 11)
Mean grade level for which menstrual hygiene education sessions were provided at school	N=213	8 (1.7)	
Family enforced prohibitions during menstruation:			
Not allowed to go out/to certain places	1096/2,332	71	(68, 74)
Not allowed to perform religious activities	1,185/2,332	54	(49, 60)
Not allowed to cook/eat certain food	741/2,332	32	(29, 34)
No restriction	362/2,332	16	(13, 19)
Instructed not to walk fast/run	160/2,332	7	(5, 8)

*Weighted for rural/urban balance and school size;

[†]Cotton/Tissue paper/ waste fabrics from garment factories;
[‡]Unlocked toilet for girls or change room

Textbooks addressed some issues related to adolescence i. e. what is puberty, when it starts and what happens after this. However, the menstrual hygiene content mainly described menstruation as a biological process, and did not provide practical information about how to manage changes to girls' bodies.

Eighty-two percent of girls judged school facilities as inappropriate for managing menstrual hygiene. Eighty-two percent of schools had an improved toilet for girls, but only 28% of schools had one or more improved toilet that was unlocked from the outside and therefore accessible to students. Thus, 54% of schools did not have an improved, unlocked toilet that students could access and only 9% of schools among all had a toilet with soap and water inside. Thirty one percent of schools had a designated private unlocked toilet or change room to change menstrual materials. Among the schools that had a private unlocked toilet, there were a mean of 98 girls for each toilet.

Eighty-six percent of girls used cloth during menstruation; 10% used disposable pads. Girls attending urban schools were more likely to use disposable pads (urban: 21%, rural: 9%, APD: 12; CI: 8.1, 16). Among cloth users, 64% washed their cloths with soap. Only 3% of girls washed their cloths with soap, dried them in sunlight and stored them with other cloth for repeated use, which is identified as the best cloth cleansing practice in the Bangladesh National Hygiene Promotion Strategy[23]. Eighty-six percent of girls reported that they did not change their menstrual cloth during school hours, which spanned approximately four hours for primary and seven hours for secondary schools. School students reported family-imposed restrictions during menstruation: 71% reported that they were 'not allowed to go out/to certain places', 51% reported that they were 'not allowed to perform religious activities', 32% reported that they were 'not allowed to cook/eat certain food' and 7% reported that they were 'instructed not to walk fast' during menstruation (Table 2).

School absence

Forty-one percent of girls reported missing school during menstruation, 42% (449/1,106) in rural schools and 38% (482/1,226) in urban schools. Absentee girls missed an average of 2.8 days each menstrual cycle, constituting approximately 16% of the academic year. When asked why they missed school, 59% reported that they felt uncomfortable sitting beside boys during menstruation, 31% reported that they felt embarrassed at school during

menstruation, 5% reported that there was no place to change menstrual materials in school and 4% said their guardians forbade them to go to school (Table 3).

Table 3 School absence among Bangladeshi schoolgirls, 2013

Indicators	n/N	%* or mean (SD)	95% CI %
Reported missing school during menstruation	931/2332	41	(36, 46)
Mean number of days per menstrual cycle that adolescent school girls reported missing school	N=931	2.8 (1.4)	-
Reasons for missing school (multiple responses):			
Feel uncomfortable sitting beside boys during menstruation	547/931	59	(56, 63)
Feel uncomfortable at school during menstruation	287/931	31	(26, 34)
Remain sick	186/931	20	(16, 24)
Heavy bleeding	83/931	9	(6, 15)
No place to change rag/cloths	48/931	5	(3, 7)
Forbidden by guardian	40/931	4	(2, 9)

*Weighted percentage for rural/urban balance and school size

After controlling for confounders, school absence during menstruation were more common among girls who felt uncomfortable at school during menstruation (99% vs. 32%; APD=58%; CI: 54, 63) and who perceived menstrual hygiene management interferes with school performance than who did not (64% vs. 30%; APD=27; CI: 20, 33) (Table 4).

Table 4 Factors associated with school absence during menstruation among Bangladeshi schoolgirls, 2013

	Absent during menstruation n (%*)	PD† (%)	95% CI %	p-value	APD‡ %	95% CI %	p-value
Feel uncomfortable at school during menstruation							
Yes	284/287 (99)	66	(61, 71)	0.000	58	54, 63	0.000
No	647/2,045 (32)	-	-	-	-	-	
Current perception about menstruation:							
A normal biological process	357/959 (38)	-	-	-	-	-	
No idea	455/1,132 (40)	0.5	(-5.7, 6.7)	0.998	-	-	
A female illness	115/229 (52)	10	(0.2, 18)	0.015	-	-	
Believe menstrual problems interfere with school performance							
Yes	480/756 (64)	36	(29, 44)	0.000	27	(20, 33)	0.000
No	4511,576 (30)	-	-	-	-	-	

Gender separated toilet at school							
Yes	400/1,036 (36)	-5.0	(-11, 0.5)	0.075	-	-	
No	531/1,296 (43)	-	-	-	-	-	
Gender separated unlocked toilet for girls at school							
Yes	355/945 (35)	-5.5	(-11, -0.5)	0.039	-5.4	(-10, -1.6)	0.049
No	576/1,387 (43)	-	-	-	-	-	
School provided menstrual hygiene education session for girls							
Yes	72/213 (40)	-1.5	(-11, 14)	0.816	-	-	
No	859/2,119 (42)	-	-	-	-	-	
Forbidden from any activities during menstruation							
Yes	801/1,970 (41)	10	(2.3, 18)	0.011	9.1	(3.3, 14)	0.008
No	130/362 (33)	-	-	-	-	-	
Not allowed to go out during menstruation							
Yes	263/604 (46)	5.9	(-0.6, 12)	0.076	-	-	
No	668/1,728 (38)	-	-	-	-	-	

* Weighted percentage for rural/urban balance and school size;
† Prevalence difference;
‡ Adjusted prevalence difference calculated by adjusting for 'feel uncomfortable at school during menstruation', 'believe menstrual problems interfere with school performance', 'unlocked toilet for girls at school', 'student's age' and 'area of school (rural vs. urban)

School absence during menstruation was less common among girls where the schools had an unlocked or open gender separated toilet for girls than when toilet was found locked and unavailable to girls during the spot check (35% vs. 43%; APD=-5.4; CI: -10, -1.6). Girls who were forbidden from any activities during menstruation were more likely to miss schools (41% vs. 33%; APD=9.1; CI: 3.3, 14) compared to those who did not face such restrictions (Table 4).

Girls who used cloth that was washed with water only or washed with soap and not dried in sunlight were just as likely to miss school compared to girls who used pads (42% vs. 40%; APD= -2.1;CI: -9.1, 5.1) or who used cloth washed with soap and water and dried in sunlight (42% vs. 38%; APD= -4.4; CI: -12, 3.4).

DISCUSSION

In a nationally representative sample of school children across Bangladesh, 41% of girls post menarche reported usually missing school during menstruation[2, 6]. Assuming the number of days reported missed by the study subject is accurate, we estimated they were absent for 16% of the school year, a quantity of missed classroom work that would be expected to substantially impact school performance[2, 6]. In our study school absence during menstruation was independently associated with negative attitudes and perceptions about menstruation, not having a gender separated unlocked toilet for girls at schools and being forbidden from activities during menstruation, factors that are similar to other studies[7, 9, 10, 21, 24-27].

Other studies have noted marked difficulties in measuring school attendance[13, 20, 28]. In some qualitative studies girls reported missing school because of menstruation[2, 6, 9], but when investigators attempted to quantify this effect systematically they have not always replicated these findings[20, 28, 29]. Attendance is difficult to measure. Schools are often compensated based on the number of students enrolled, so there is a strong incentive to over-report attendance on routine monitoring, thus making official records invalid measures[30]. Various investigators have used different approaches to address this issue including diaries of girls[28, 31], and assessing attendance by study personnel on unannounced visits[30, 31]. It is also difficult to attribute absence to menstruation. Girls might be unwilling to mention menstruation as a reason they missed school because of stigma associated with menstruation[6, 29]. Girls also may leave school early and miss hours of a school day due to menstruation, that would not be counted as absence[21].

Nevertheless, several studies support the idea that menstruation affects attendance. Multiple intervention trials that have improved facilities for menstrual hygiene have measurably improved girls' attendance[27, 30-36]. In Bangladesh, a six-month educational intervention among 416 girl students aged 11- 16 years from three schools demonstrated a 31% increase in students' knowledge about menstruation and a 5.1% decrease in self-reported school absence among participants from baseline[34]. In Ghana, a menstrual hygiene education program increased girls' school attendance where attendance data were collected from teachers' register book, by around 6 days per 65 days term (9% of a girls' school year)[31]. A study conducted in Kenyan schools found that toilet access was more effective in reducing absence among girls than among boys due to its impact on menstrual hygiene management[30].

Not all studies have found a convincing relationship between menstruation and absenteeism. Oster and Thornton collected daily data on school attendance and menstrual calendars, and found that menstruation had only limited impact on school attendance[20]. That study included 198 schoolgirls from seventh and eighth grade of four schools and the mean age of girls was 14.2 years which was 1.4 years older than our surveyed girls. At the beginning of menarche, girls may miss more school days as they may not have fully developed strategies for coping with menstruation[20, 37]. An intervention trial providing a menstrual cup or sanitary pads compared to puberty and hygiene training found no impact on school absence among girls receiving the menstrual cup or pads [38]. This study, however, only enrolled schools with gender specific girls' toilet, while in our study we found the absence of an available gender specific toilet was one reason for school absence during menstruation. In addition, puberty and hygiene training may also have better prepared schoolgirls to manage menstruation in the control schools.

The 41% absence rate during menstruation in our study was higher than that reported in a smaller-scale study in Maharashtra, India where data were collected using a pre-tested, self-administered structured questionnaire among girls aged 10-19 years old (561 girls, 14% absent)[11], but similar to those reported in Habru, Ethiopia (595 girls, 55% absent)[7], and West Bengal, India (190 girls, 39% absent)[39] that also used a self-administered questionnaire for collecting school absence data. Considering both the global experience as well as local context within Bangladesh, we consider the self-report of Bangladeshi schoolgirls in our survey to be a credible assessment of their experience.

Girls were more likely to report absence from school if they also reported negative attitudes about menstruation, such as perceiving it as something unhealthy, shameful, or obstructive to learning. Such attitudes may arise from the prevalent patriarchal culture in the society[26] and that around two-thirds of girls did not know about menstruation before they reached menarche. Some studies reported that girls who didn't receive any information about menstruation before menarche were more stigmatized about menstruation contributing to a culture of shame among them[40-42]. Increasing the knowledge and changing attitudes about menstruation among adolescent schoolgirls in Pakistan increased girls' confidence to manage menstruation hygienically[43].

This study identified several weaknesses in the current school curriculum on menstruation. The strict biological focus of school textbooks provided no opportunity for constructive discussion of healthy attitudes[44] or salient social and religious issues.

Moreover, teaching reproductive health is not mandated by the government. Even where schools had some course material on menstruation, 91% of girls reported that they had never received menstrual hygiene education sessions at school. Students who did receive formal education sessions usually participated in such classes after commencing menstruation. Less than 1% of students cited schoolteachers as a source of information regarding menstruation. Our study suggest several reasons why schools in Bangladesh provide so little useful education on menstruation. First, the national education curriculum and textbooks do not address the important social and cultural issues regarding menstruation. Second, the lack of timely information contributes to poor menstrual hygiene practices[45] and increased risk of urinary tract infection[46]. Third, only 22% of secondary school teachers are female in Bangladesh, compared to 61% of primary school teachers. Girls may not feel comfortable discussing menstruation with men[26, 45, 46]. Improving menstrual education to Bangladeshi girls requires two steps: first, schools and the education board need to be persuaded to consider menstrual hygiene as part of their educational mission. Second, the timing, content, and delivery of the menstrual curriculum need to be revised to better address the needs of girls.

Lack of a gender-separated improved accessible or open toilet at school for girls was another reason for the absence. In Bangladesh, the number of girls per toilet was two times higher than the national recommended standard of 50 girls per toilet[23]. Simply ensuring that toilets in schools are unlocked from the outside may increase the number of the accessible toilet for girls as more than half of the separate toilets for girls were locked when the study team visited during school hours. In our study lack of gender-separated open toilets was associated with missing school, similar to a finding in a recent systematic review[33] suggesting that simply ensuring gender-separated toilets for girls to change menstrual materials is important. Studies from other countries also report similar findings[27, 31, 32, 35, 36]. A study from India reported that 28% of girls missed school during menstruation due to lack of facilities[35], and in Nepal, 41% of students reported a lack of privacy for cleaning and washing as a major reason for absence during menstruation[27]. In Ghana, girls missed school due to inadequate sanitation facilities at school during menstruation[31].

Disposable sanitary napkin use was uncommon among schoolgirls in Bangladesh, and was not associated with school attendance. This finding contrasts with a similar study conducted in Ethiopia, where students “who did not use disposable sanitary napkins were 5.4 times more likely to be absent from school than their counterparts”[7] but supports a recent

systematic review[47]. In Bangladesh, and some other settings, access to gender separated toilet might be a more effective intervention than provision of menstrual hygiene supplies.

Restrictions imposed by guardians were independently associated with school absence in our study. Guardians may impose such restriction due to cultural norms and stigma related to menstruation[26, 27] which should be addressed by menstrual health and education programs[48]. The issue of restrictions impacting girls education also indicated the importance of a broader discussion on menstrual hygiene within the community.

In addition to difficulties with measuring attendance discussed above, this study has other important limitations. We identified adolescent schoolgirls who reached menarche with the help of a female teacher, and so our sample might be non-representative as teachers might have suggested including girls who have difficulty with menstruation. Conversely, those who were absent on the survey day may have been menstruating and so may have been under-represented. We did not explore the reasons behind schools keeping toilets locked from outside or why most schools taught about menstruation after girls reach menarche, because this study did not include a qualitative investigation.

CONCLUSION

In a nationally representative sample, 41% of schoolgirls in Bangladesh reported missing16% of school days because of menstruation. The risk factor analysis suggests several modifiable factors contributed to school absence. Although further research to assess the effectiveness of interventions to address these problems would be productive, the current data suggest that: schools should ensure that toilets are open during school hours; the school curriculum should be revised in a way that menstruation is taught three years earlier than currently presented so that girls can learn about menstruation from female teachers before they experience menarche. A broader discussion within the community might also create a more supportive environment for girls to attend school during menstruation. Efforts are also required to develop the capacity of teachers to teach menstrual hygiene education. We recommend conducting further exploratory studies to better understand beliefs and norms about menstruation, use and preference of absorbents and issues related to discomfort at school and a better way to capture school attendance. We also recommend further research on the impact of gender-separated toilets and menstrual hygiene education on school attendance and girls' educational outcomes.

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Author's contribution

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Contributors: MA, SPL, AKH, KI, AO and LU conceived and designed the original protocol. All authors except TM were involved in amending the protocol. MA, AKH, MR and LU coordinated the study throughout. Data entry, cleaning and analysis was carried out by AKS, PKG and MA.AKS cleaned the data and ran preliminary analysis with input from MA, AKH, LU, MR, SPL and TM. MA carried out advanced analysis and AKH, LU, MR, SPL, PKG, AO, KI and TM provided advice on data interpretation. MA wrote the first draft of the manuscript with LU and AKH. All authors contributed to subsequent and final drafts.

Data sharing statement

No additional data are available.

Figure 1: Conceptual framework for school absence during menstruation among schoolgirls where exposures were categorized in four blocks for school absence outcome: (1) girl's attitude, (2) knowledge, (3) school facilities and programs, and (4) practices. Student's age and area of school were considered as confounder. Physical discomfort could be directly linked with school absence.

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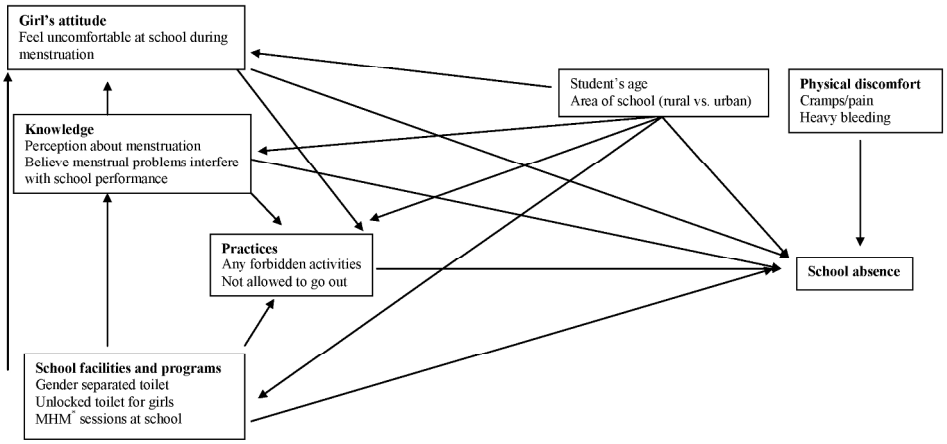

Figure 1: Conceptual framework for school absence during menstruation among schoolgirls where exposures were categorized in four blocks for school absence outcome: (1) girl's attitude, (2) knowledge, (3) school facilities and programs, and (4) practices. Student's age and area of school were considered as confounder. Physical discomfort could be directly linked with school absence.

* MHM: menstrual hygiene management

Conceptual framework for school absence during menstruation among schoolgirls where exposures were categorized in four blocks for school absence outcome: (1) girl's attitude, (2) knowledge, (3) school facilities and programs, and (4) practices. Student's age and area of school were considered as confounder. Physical discomfort could be directly linked with school absence.

244x163mm (300 x 300 DPI)

Appendix-C3: School component study: MHM survey
National Hygiene Survey 2012

1.1 Questionnaire identification number ..... ☐☐☐☐☐☐

1.2 Study Area..... ..... ☐

Rural.....0
Urban 1

1.3 Cluster number..... ..... ☐☐☐

1.3a FRA name & ID..... ☐☐

1.3b. Date of interview..... ☐☐/☐☐/☐☐

Part 1:
Section 1: Adolescent menstrual hygiene

Note: Respondent for this portion is adolescent girl (we will sample four adolescent girls from one school if available where class 2 to 5 for primary and class 6 to 9 for junior/high school)

Definition of adolescent: *Girls who have menstrual experience aged 10- 19 years*

***Interviewer criteria*:** *Only female FRAs are going to ask this section*

1.4 Do the school have available *MHM experienced,* adolescent girl?..... ☐

No..... 0
Yes..... 1

***Skip Note-1.1:* If answer of 1.4 is 0, then finish the interview**

1.4.a If answer of 1.4 is 1 then mention the class (Use code 2 to 9)..... ☐

1.5 Do you have any problem if I ask you to share us regarding your menstrual hygiene practices?..... ☐

No..... 0
Yes..... 1

Skip Note-1.2: **If answer of 1.5 is 1, then finish the interview**

1.6 How old are you? Year: ☐☐ Month: ☐☐

1.6a How old were you when you started menstruating, insert 999 if cannot remember?

Year: ☐☐☐ Month: ☐☐☐

1.6b Where were you when your first menstruation occurred?..... ☐☐☐

At home 1
At schools..... 2

Others: Specify..... 777

1.6c What was your first reaction when you experienced your first menstruation?..... ☐☐☐

Cried..... 1
Scared 2
Embarrassed 3
Happy 4
Told mum, sister, grandmother, friend, teacher)..... 5
Did not tell anyone..... 6
Annoyed..... 7
Others: Specify..... 777

1.6d Did you know about menstruation before you started menstruating?..... ☐☐☐

No..... 0
Yes..... 1

1.6e Where did you get the information about menstruation? (Multiple answers allowed here?..... ☐☐☐

No..... 0
Yes..... 1

1. Mother..... ☐

2. Father ..... ☐

3. Grandmother..... ☐

4. Friend ..... ☐

5. Aunty ..... ☐

6. Teachers..... ☐

7. Sister/ Sister-in law ..... ☐

8. Doctor/Nurse ..... ☐

9. TV/Radio ..... ☐

10. Reading..... ☐

777. Other (Specify): ..... ☐

1.7 Mainly what do you use during menstruation?..... ☐☐☐

Old Cloth (rag).....	1
New cloth.....	2
Pad.....	3
Cotton.....	4
Tissue paper.....	5
Jhute of garments.....	6
Nothing.....	7
Refused to say	666
Other: Specify:	777

Skip Note-1.3: ***If answer of 1.7 is not 1/2, skip to 1.14***

1.8 Generally how many times the cloth used for menstruation you usually change per day? (666=refused to say)

Times:..... ☐☐☐

1.9 How do you clean/ wash this cloth (rag)?..... ☐☐☐

With soap.....	1
With soap & hot water.....	2
With savlon/ detol.....	3
With savlon/ detol & hot water.....	4
With soap, savlon/ detol & water.....	5
With soap, savlon/ detol & hot water.....	6
With hot water.....	7
With only water.....	8
Don't clean.....	9
Other (Specify).....	777

Skip Note-1.4: ***If answer of 1.9 is 9 skip to 1.14***

1.10 Where do you clean/ wash this cloth?..... ☐☐☐

In toilet.....	1
In bathroom.....	2
Public tap.....	3
Under tube well.....	4
Beside pond.....	5
Beside river.....	6
Other (Specify).....	777
DK.....	999

1.11Where do you get the water for washing/ cleaning this cloth (rag)? ..... ☐☐☐

Shallow tube well(<250 feet).....	01
Deep tube well(250+ feet).....	02
Protected ring/dug well.....	03
Unprotected dug well.....	04
Shallow Tara pump.....	05
Deep Tara pump.....	06
Piped water into dwelling.....	07
Piped water into yard/plot.....	08
Public tap/stand pipe.....	09
Arsenic filter	10
Arsenic free treatment plant.....	11
Water from protected spring.....	12
Water from unprotected spring.....	13
Rainwater.....	14

Tanker truck..... 15
Cart with small tank..... 16
Pathogen treatment plant (Pond Sand Filter):
River/dam/lake/ponds/stream/canal/irrigation channel.17
Directly from River/dam/lake/ponds/
stream/canal/irrigation channel.....18
Distiled bottled water..... 19
Boiled water..... 20
Other: specify..... 777
DK..... 999
Not applicable……..... 888

1.12 For repeated use of menstrual cloth, where do you dry the menstrual cloth?

A	In dry season ☐☐☐
B	In winter ☐☐☐
C	In rainy season ☐☐☐

Inside the house but hiding somewhere..... 1
Inside the house but open place..... 2
Outside the house and in sunlight..... 3
Outside the house but hiding somewhere..... 4
In side kitchen over cocking stove.....5
Inside the toilet..... 6
Inside the bathroom..... 7
Other: specify..... 777
DK..... 999
NA…… 888

1.13 Where do you preserve this cloth for next use?..... ☐☐☐

Normally like other clothes..... 1
At a hidden place..... 2
Under bed..... 3
Inside the latrine..... 4
Other: specify..... 777

1.14 Do you have separate room/place in your school to change their disposable pad/cloth during menstruation? ..... ☐

No..... 0
Yes..... 1

Skip Note-1.5: ***If answer of 1.14 is 0 skip to 1.17***

1.15 Is it safe to use?..... ☐

No..... 0
Yes..... 1

1.15a Is it private to use?..... ☐

No..... 0
Yes..... 1

1.15b Is it clean to use?..... ☐

No..... 0
Yes..... 1

1.16 Do you use it? ..... ☐

No..... 0
Yes..... 1

1.17Are there sanitary pad disposal bins in the girl's latrine/ changing room? ..... ☐

No..... 0
Yes..... 1

1.18 Is there soap in the girls' latrine/ changing room? .... ☐

No..... 0
Yes..... 1

1.19 Do you have any hygiene kit (Detol, rag/cotton, soap) in your school for using during menstruation? ..... ☐

No..... 0
Yes..... 1

1.20 Do you have enough water supply or storage in your school for using during menstruation? ..... ☐

No..... 0
Yes..... 1

1.21Do you have to go inside the latrine for menstrual cleaning in your school during menstruation?..... ☐

No..... 0
Yes..... 1
Not applicable……888

1.22 Are there place to dispose the used cloth/pad for menstrual hygiene?..... ☐☐☐

No 0
Yes 1
DK……999
Not applicable……..888

1.23 What do you do if there is no place to dispose the used cloth/pad for menstrual hygiene?..... ☐☐☐

Openly disposed..... 1
Disposed inside toilet pan..... 2
Hiding inside classroom..... 3
Do not change staying at school..... 4
Other: specify..... 777

1.24 If the answer of 1.7 is 3 (pad) then, how much do you pay a month for using your disposable/commercial pads? (Code:

888=Not applicable) Taka..... ☐☐☐

1.25 Do you come to school during menstruation?..... ☐

No..... 0
Yes..... 1

Skip Note-1.6 : ***If answer of 1.25 is 1 skip to 1.27***

1.26 If not, why? (Multiple answers allowed here)

No..... 0
Yes..... 1

1. No place to change the rag/clothes..... ☐

2. No water available..... ☐

3. No soap/liquid soap..... ☐

4. I do not feel comfortable..... ☐

5. I remain sick..... ☐

6. Over bleeding..... ☐

777. Other (specify)..... ☐

1.27 Do you feel comfortable at school during menstruation? ..... ☐

No.....0
Yes.....1
Not applicable…… 888

1.28 Do you feel uncomfortable sitting next to male students during menses? ..... ☐

No..... 0
Yes..... 1
Not applicable…… 888

1.29 Do male students tease you during menses?..... ☐

No.....0
Yes.....1
Not applicable……888

1.30 Do you think menstrual problems interfere with school performance? ..... ☐

No..... 0

Yes..... 1

Skip Note-1.7: ***If answer of 1.30 is 0 skip to 1.32***

1.31 If yes, how? ..... ☐☐☐

Low concentration 1
Missing lessons 2
Other: specify..... 777

1.32. Do you know of any girl who dropped out of schools because of menstruation?..... ☐

No..... 0
Yes..... 1

1.33 Did you miss any class during menstruation in the last three months?..... ☐

No..... 0
Yes..... 1

Skip Note-1.8: ***If answer of 1.33 is 0 skip to 1.35***

1.34 If yes, how often (average of last three months in school days)?..... ☐

One day every cycle 1
Two days every cycle 2
Three days every cycle 3
Four days every cycle 4
Five days every cycle 5
Six days every cycle.....6
Seven days every cycle.....7

1.35 Do you think that the school facilities are appropriate for managing menstrual hygiene?..... ..... ☐

No..... 0
Yes..... 1
Can manage somewhat..... 2

1.36 If school facilities are not appropriate what are the reasons or difficulties? (Multiple answers allowed here)

No.....0
Yes.....1

1. No secret room/change room for girl..... ☐
2. No hygiene kit/soap separate for girl children ..... ☐
3. No water facilities for girl children..... ☐
4. Wash room is common for all ..... ☐
5. We need to go inside the latrine for menstrual cleaning ..... ☐
6. No private disposal/incineration facilities for disposable napkins..... ☐

777. Other (specify)..... ☐

1.37 What the activities are forbidden for you during the menstruation period? (Multiple answers allowed here)

No..... 0
Yes..... 1

a. Not go to certain places..... ☐

b. Not touch certain things (i.e don't get up bed) ..... ☐

c. Not eat certain foods..... ☐

d. Not allowed to cook..... ☐

e. Not allowed to go out..... ☐

f. Not allowed to religious activities..... ☐

g. Nothing..... ☐

h. Others specify..... ☐

Section 2: Knowledge level Questions:

2.1 What is your knowledge on ministration?..... ☐☐☐

A normal phenomenon of reproductive health of a female.....	1
A Illness of a female.....	2
Curse of God.....	3
No idea/No experience…….....	4
DK.....	999

2.2 Do you think menstruation is a female and/or personal matter, to be kept to oneself only, not to talk about it openly?..... ☐

No.....	0
Yes.....	1

2.3 What facilities and programmes are there in the school for promoting safe and private menstrual hygiene for older girls? (Multiple answers allowed here)

No.....	0
Yes.....	1

1. Separate girls latrine……..…..... ☐
2. Separate girls urination facilities……..... ☐
3. Separate change room……...…..… ☐
4. Soap available at change room……..…… ☐
5. Water available at change room..... ☐
6. Girls counseling facilities are available for menstrual hygiene management. ☐

7. Nothing……..……..……...… ☐

999. DK..... ☐

777. Others (specify)……..……..……... ☐

888. Not applicable……..... .. ☐

2.4 What menstrual hygiene education sessions are provided for girls? (Multiple answers allowed here)

No..... 0
Yes..... 1

1. Counseling for girls…… ☐
2. Separate class are arranged for girls……...…… ☐
3. Menstrual hygiene management education are there in the school curriculum ☐
4. NGO/health workers arrange sessions for girls……..……...…… ☐
5. Nothing…… ☐

777. Others (specify)……..…… ☐

888. Not applicable……..... ☐

2.5 Did you receive information regarding menstrual hygiene management in school before the onset of menstruation?

..... ☐☐☐

No 0
Yes 1
DK…….…. 999

2.6 Do you know about the implications of inadequate management of menstrual hygiene?..... ☐☐☐

No..... 0
Yes..... 1
DK..... 999

2.7 What are the implications of inadequate management of menstrual hygiene? (Multiple answers allowed here) ... ☐☐☐

No..... 0
Yes..... 1

1. Pain during urination.. ..... ☐

2. Pains at lower abdomen... ..... ☐

3. Anaemia..... ☐

4. Tired/feel sleepy..... ..... ☐

5. Hampers the regular works..... ☐

6. Itching..... ☐

7. White/gray vaginal discharge..... ☐

8. Mild back pain..... ..... ☐

9. Bleeding between menstrual period..... ☐

10. Appetite loss..... ..... ☐

11. Fever..... ..... ☐

12. Headache and fatigue..... ☐

777. Others(specify)……..… ..... ☐

999. DK……..... ☐

2.8 Is there any kind of napkin distribution programme at your school?..... ☐☐☐

No 0
Yes 1
DK……..…999

2.9 In the last 6 months, have you experienced any of the following symptoms? (multiple answers allowed here)

No..... 0
Yes..... 1

1. Itching..... ☐

2. Irritation/soreness of the vagina..... ☐

3. Redness and swelling..... ☐

4. Lumps and blister..... ☐

5. Smelling discharge..... ☐

6. Unusual discharge..... ☐

7. Nothing happened ..... ☐

666. Refused to say..... ☐

777. Other (Specify:..... ☐

***Skip Note-1.9:* If answer of 2.9 is7/666,then skip to section-3**

2.10 If the answer of 2.9 is 1-6, whom do you talk to? ..... ☐☐☐

Mother.....	1
Father.....	2
Grandmother.....	3
Friend.....	4
Auntie.....	5
Teachers.....	6
Sister/ Sister in-law.....	7
Doctor/nurse.....	8
TV/Radio	9
Nobody.....	10
Other (Specify).....	777

2.11 Where did you get the treatment? ..... ☐

Local/Village clinics.....	1
Private Clinic.....	2
MBBS Doctor.....	3
Pharmacy.....	4
Traditional healer.....	5
Self-treatment at home.....	6
No action taken.....	7
Other (Specify):.....	777

Part 2: SPOT CHECK

Section 3: Water supply:

3.1 Whether there exists platform? (Observe)..... ☐☐☐

No.....	0
Yes.....	1
Not applicable.....	888

3.2 Is the platform broken? (Observe)..... ☐☐☐

No.....….....	0
Yes i.e. broken.....	1
Not applicable.....	888

3.3 Is there water logging in the platform? (Spot check).....☐☐☐

No.....0
Yes.....…1
Not applicable....888

3.4 Did the area surrounding the water source look clean? [Considering presence of cow dung, solid waste etc(Observe only)].....☐☐☐

No..... 0
Yes.....… 1
Not applicable.....888

Sanitation:

3.5 Who uses the latrine(s)? (Ask and spot check).....☐☐☐

Only Girl's latrine..... 1
Girls and female teacher's latrine..... 2
Only Boy's latrine..... 3
Boys and male teacher's latrine..... 4
Only Teacher's latrine..... 5
Non specific/for all..... 6
For all students..... 7
Nothing written on the door..... 8
Other (Specify)..... 777
Not applicable..... 888

3.6. Mention the type of toilet facilities (Observe only)

Toilet code list

Piped sewer system..... 01
Septic tank..... 02
Flush to pit latrine..... 03
Pit latrine with slab & water seal..... 04
Pit latrine with slab & no water seal but with a lid.....05
Pit latrine with slab & flap, no water seal 06
Ventilated Improved Pit (VIP) latrine..... 07
Composting toilet, *(Composting toilet ensure separation of urine, water and excreta*)..... 08

Flush or pour flush toilet connected to somewhere else (canal, ditch, river, etc..... 09
Pit latrine without slab/open pit..... 10
Pit latrine with slab & no water seal/broken water seal and no lid..... 11
Hanging toilet/latrine]..... 12
Open defecation:
No facility/bush/field..... 13
Others: Specify..... 777
Not Applicable..... 888

3.7. Is there a door on the latrine?(Observe only).....☐☐☐

No..... 0

Yes..... 1
Not applicable..... 888

3.8. Is the door of the latrine(s) open?(Observe only)..... ☐☐☐

No..... 0
Yes..... 1
Not applicable..... 888

3.9. Is the latrine(s) functional (usable)? (Observe only..... ☐☐☐

No..... 0
Yes……..... 1
Not possible to observe..... 2
Not applicable..... 888

Skip note 1.10: If the answer of 3.9 is not 2 then skip to 3.10

3.10. Why observation was not possible?..... ☐☐☐

Locked]..... 1
Other: specify 777
Not applicable..... 888

3.11. Visit each latrine and If there is visible stool in any of the functional toilet facilities (in the pan) of this school?..... ☐☐☐

No..... 0
Yes..... 1
Not possible to observe..... 2
Not applicable..... 888

3.12. Visit each latrine and see if there is stool visible on the slab or floor of the toilet facility?]..... ☐☐☐

No..... 0
Yes..... 1
Not possible to observe..... 2
Not applicable..... 888

3.13. Visit each latrine and see if there is any fecal smell in the toilet facility? (Observe only)..... ☐☐☐

No..... 0
Yes..... 1
Not possible to observe..... 2
Not applicable..... 888

3.14. Provision of hand cleaning agent in or near latrine(<30feet)..... ☐☐☐

Soap..... 1
Detergent..... 2
Ash..... 3
Mud..... 4
Nothing..... 5
Other: specify 777
N/A..... 888

3.15. Are there any anal cleansing materials available in the functional student's toilet facilities? (Observe only)..... ☐☐☐

Water..... 1
Toilet paper..... 2
Cloth..... 3
Piece of mud..... 4
Nothing..... 5
Water & Toilet paper..... 6
Water & Cloth..... 7
Water & Piece of mud..... 8
Other (Specify)..... 777
N/A..... 888
Not possible to observe..... 999

Hand washing

3.16. What are the devices for hand washing? (Observe only)..... ☐☐☐

Specially designed hand
washing system (A drum with a tap)].....1
Basin 2
Water container (e.g. bucket, mug). 3
There is not any device 4
Other: (specify)..... 777
N/A..... 888

Skip note 1.11: ***[If 3.16 is 4 then skip to question no 3.19]***

3.17 If are they functional handwashing device then how many?.. ..... ☐☐

3.18 Observation only: Is there water available for hand washing in the Hand washing device?..... ☐☐☐

No..... 0
Yes..... 1
Not applicable..... 888

3.19. Where is the soap for hand washing usually located? (Ask to show the location of the soap, and fill out response according to observation)..... ☐☐☐

Next to hand washing device (<30 feet)..... 1
Next to or outside the toilet…..... 2
Away from hand washing device(>30 feet)..... 3
In the teacher's room/office room.....4
In the classroom..... 5
Inside the toilet..... 6
None..... 7
Other: (specify)..... 777
N/A.....888

3.20. Observation only: Soap or detergent brought by the interviewee within 30 feet's?

No..... 0
Yes..... 1
Not applicable…... 888

a. Soap..... ☐

b. Detergent..... ☐

c. Other: specify..... ☐

Solid Waste disposal

3.21. How do the school children dispose solid waste there?[Observe only]..... ☐

Completely/rightly (no waste outside) …..... 1
Partially (Wastes are disposed partly inside and partly outside) 2
Do not (no garbage inside and no symptoms of waste disposal on the way or inside)..... 3
Non specific place..... 4

Environmental Cleanliness

3.22. Whether class rooms are clean (Considering the presence of waste paper, soot, food, dust, leaves). ..... ☐

Waste is not visible/clean..... 1
Some waste is visible..... 2
Not clean..... 3

3.23. Whether school compound is clean (Considering presence of cow dung, solid waste and human feces)..... ☐

Clean (waste is not visible)..... 1
Not quite clean (some waste is visible)..... 2
Not clean (waste is seen here and there)..... 3

3.24. End time (Hour: Minute)..... ☐☐:☐☐

Question for FRA:

3.25. Have you checked the questionnaire once you have completed it?..... ☐

No..... 0
Yes..... 1

Thank you.

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Menstrual hygiene management among Bangladeshi adolescent schoolgirls and risk factors affecting school absence: results from a cross-sectional survey

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Abstract

Background: Many adolescent girls in low and middle-income countries lack appropriate facilities and support in school to manage menstruation. Little research has been conducted on how menstruation affects school absence. This study examines the association of menstrual hygiene management knowledge, facilities, and practice with absence from school during menstruation among Bangladeshi schoolgirls.

Methods: We conducted a nationally representative, cross-sectional study in Bangladeshi schools from March to June, 2013 among 11 to 17-year-old girls who reached menarche. We sampled 700 schools from 50 urban and 50 rural clusters using a probability proportional to size technique. We interviewed 2,332 schoolgirls and conducted spot checks in each school for menstrual hygiene facilities. To assess factors associated with reported school absence, we estimated adjusted prevalence difference (APD) for controlling confounders' effect using generalized estimating equations to account for school-level clustering.

Results: Among schoolgirls, who reached menarche, 41% (931) reported missing school, an average of 2.8 missed days per menstrual cycle. Students who felt uncomfortable at school during menstruation (99% vs. 32%; APD=58%; CI: 54, 63) and who believed menstrual problems interfere with school performance (64% vs. 30%; APD=27; CI: 20, 33) were more likely to miss school during menstruation than who did not. School absence during menstruation was less common among girls attending schools with unlocked toilet for girls (35% vs. 43%; APD=-5.4; CI: -10, -1.6). School absence was more common among girls who were forbidden from any activities during menstruation (41% vs. 33%; APD=9.1; CI: 3.3, 14).

Conclusion: Risk factors for school absence included girl's attitude, misconceptions about menstruation, insufficient and inadequate facilities at school, and family restriction. Enabling girls to manage menstruation at school by providing knowledge and management methods prior to menarche, privacy and a positive social environment around menstrual issues has the potential to benefit students by reducing school absence.

Abstract word count: 300 words

ARTICLE SUMMARY

Strengths and limitations of this study

- We attempted to quantify the complex ways by which menstruation affects girls at school
- We conducted a nationally representative, cross-sectional study in Bangladeshi schools and interviewed 2,332 students from 700 schools
- We used a sampling weight to determine national estimates which might over represents small schools
- With the help of female teachers at school, we identified adolescent schoolgirls who reached menarche, and so our sample might be non-representative because teachers might be more likely to have suggested including girls who have difficulty with menstruation.

BACKGROUND

Menstrual hygiene management (MHM) at school is constrained by poor access to water and sanitation, lack of privacy, and limited education about menstrual hygiene[1] as well as social stigma and cultural restrictions on activities[2]. Menstruation poses a set of physical, socio-cultural and economic challenges to adolescent girls that may interfere with their ability to attend school or to participate fully in classroom[3].

Girls' education has a long-term positive impact on personal welfare and health as well as economic and social development, especially in low-income communities[4]. Better educated women are more likely to be healthier than uneducated women, participate more in the formal labor market, earn higher incomes, get married at a later age, have fewer children, potentially ensuring better health status and education for their children[5] which can reduce poverty and contribute to a country's development. However, a number of small-scale, mostly qualitative studies have found that many school-age girls do not attend school during menstruation[2, 6-8]due to shame, fear of having visible stains on their clothing, absence of a private place to manage menstruation in school[2, 7, 9, 10]or dysmenorrhoea[11, 12]. In an Ethiopian study, about 90% of girls stated that their academic performance or class rank declined after menarche[7]. However, little attempt has been made to quantify the complex ways by which menstruation affects girls at school[13]. The present study measured school absence reported by students and used this to quantify its relationship with MHM.

Barriers to menstrual hygiene management among Bangladeshi girls may hamper progress toward Sustainable Development Goals 3 (ensure healthy lives and well being for all at all ages), 4 (ensure inclusive and equitable quality education and promote lifelong learning opportunities for all), 5 (promote gender equality and empower all women and girls) and 6 (ensure the availability and sustainable management of water and sanitation for all)[14]. This study aims to describe the current state of MHM among student from Bangladeshi schools and examine the association between menstrual hygiene knowledge, facilities and practice and absence from school during menstruation.

METHODS

Study design and school sampling

We conducted a national, cross-sectional study in Bangladeshi schools from March to June 2013 among girls who had reached menarche and were enrolled in grades two to nine as

part of a study to examine water, sanitation and hygiene facilities, knowledge and practices[15]. We used probability proportional to size sampling to select 50 rural villages and 50 urban areas as clusters so that we would have sufficient power across the national hygiene survey to compare rural and urban prevalence. For the selection of rural clusters we used National Population and Housing Census 2011 data[16], and for the urban sampling frame we used the 2006 Urban Health Survey data[17] as primary data from National Population and Housing Census 2011 on the urban area were not available during the design phase of our study.

As part of the Bangladesh National Hygiene Baseline Survey[15], we determined the sample size required to estimate the national coverage of handwashing with soap in school. We assumed 80% power, and α of 0.05 with a design effect of 12, and based our calculations on the indicator 'schools having soap and water at handwashing location' from a recent rural schools survey[18]. We assumed a 10% difference in this indicator between rural and urban schools and estimated that 672 schools would be required to measure this difference. We sampled the seven government and non-government schools, at both primary and secondary level, nearest to the midpoint of each cluster and thus selected 700 schools.

Selection of participants

Field staff asked female teachers to mark on the attendance registry which of the girls present in school on the day of the survey had reached menarche. Students had to seek permission from teachers before leaving school due to any urgent matter and usually girls inform female teachers about issues related to menstruation. The field staff then numbered the eligible girls and used a random number generator to select four of these girls from grades two to five in primary schools and from grades six to nine in secondary schools to take the survey. If any students selected from the register were not interested in participating in the survey, the team interviewed those who consented and then continued to the next school.

Data collection

Trained female data collectors conducted facility spot checks then administered the survey verbally and recorded responses using a computer tablet-based structured questionnaire. Visits to schools were unannounced and surveys were conducted after obtaining informed consent from the school authority. During spot checks, the team looked for menstrual hygiene facilities, particularly the presence and type of toilet, the presence of soap inside or within 10 meters of the toilet, presence of water, and a disposal bin inside the

toilet, and whether the door was unlocked from the outside and therefore accessible to students. We designed data collection instruments during group discussions with all stakeholders and included questions to collect data on variables reported in published studies of menstrual hygiene[2, 13, 19-21].

The girls were asked if they missed class during their last three menstrual cycles, the average number of days they were absent per cycle during their last three cycles and whether they thought menstrual hygiene management problems impacted school performance. Finally, we reviewed the national education curriculum for grades two to nine to understand the current menstrual hygiene education syllabus and textbook material.

Outcome and exposures

The primary outcome variable was reported average number of school absence days in the last three menstrual cycles. The interviewer asked girls "Did you miss any class during menstruation in the last three months?" If the respondents answered yes, the interviewer asked "how often (average of last three months in school days)?" The girls' attitude and knowledge about menstruation, reason for school absence during menstruation and practices related to menstruation were collected by asking open ended, multiple-choice questions. The interviewer coded the response into categories with an option for other if an appropriate category was not listed. The full questionnaire is included as supplementary file.

Statistical analysis

We conducted statistical analysis according to a predefined conceptual model (Figure 1) that reflected our hypothesis about how school absence could be affected by a range of factors. First, we performed descriptive analysis to determine student characteristics, students' attitude and knowledge about menstruation, school facilities and programs for menstrual hygiene management, and student's menstrual hygiene practice. We reported means and standard deviations for continuous variables that were normally distributed. Because we used a probability proportional to size technique to select clusters among 86,925 rural clusters and 10,552 urban clusters, we used a sampling weight to calculate national estimates adjusting for rural/urban balance, calculated as f=1/F, where F is the total number of urban or rural clusters. We also weighted for school size to calculate national estimates, calculated as s=1/S, where S is the total number of the students in the school. All percentages and means reported are weighted national estimates.

We calculated the prevalence difference for school absence among school students for our exposures of interest using generalized estimating equations (GEE) with robust standard errors to account for school-level clustering and adjust over-dispersion. Exposures were grouped in four blocks by following the conceptual model: (1) attitude, (2) knowledge, (3) school facilities and programs, and (4) practices. We performed bivariate analysis between exposures and outcome to calculate crude association. We further considered only those exposures associated with outcomes with a $p<0.2$. We then conducted multivariable analysis among the exposures within each block including confounders identified in the conceptual model. We retained exposure within each block associated with outcome at the $p<0.05$ level. We then built an overall multivariate model by using exposure variables from each block that were associated with school absence at the $p<0.05$ level and which captured most of the measurement. We identified 'feel uncomfortable at school during menstruation' variable from girl's attitude block; 'believe menstrual problems interfere with school performance' variable from knowledge block; 'gender separated unlocked toilet for girls at school' variable form school facilities block and 'forbidden from any activities during menstruation' variable from practice block for overall multivariable analysis. We calculated the adjusted prevalence difference for the outcome with the exposures of interest identified in the previous step by controlling for potential confounders identified in the conceptual model. We identified the student's age and area of the school (rural or urban) as confounders, as we would expect these factors to be associated with menstruation-related attitude, knowledge, facilities and practices as well as predict school absence (Figure 1).

We used the WHO/UNICEF Joint Monitoring Program definitions for improved water source and improved toilet[22]. We defined a toilet as 'functional' if students could use it on the day of the survey, if it had a working door and if it was lockable from the inside with a latch. We calculated the 'school year' based on the academic calendar for primary and secondary schools of Bangladesh, with weekends and holidays excluded.

Ethical consideration

The data collectors obtained informed verbal assent from participants and informed written consent from their guardians as well as the consent of the head teacher. We obtained approval from icddr,b's Ethical Review Committee and the Policy Support Unit of the Ministry of Local Government.

RESULTS

School and student characteristics

Seventy-six percent of schools included in the study were primary schools and 24% were secondary. Primary schools had an average of 310 students and secondary schools 559. In primary schools 61% of teachers were women whereas in secondary schools only 22% of teachers were women. The mean age of interviewed girls was 13 among 2,332 participants. Average age at menarche was 12 (Table 1) and 98% of students started menstruation before age 14.

Table 1 Characteristics of Bangladeshi schools, and girl students, 2013

Indicators	n/N	% * or mean (SD)	95% CI %
Type of school by grade level:			
Primary	511/700	76	(73, 80)
Secondary	189/700	24	(20, 27)
Type of school by management:			
Government	466/700	67	(64, 70)
Non-government	234/700	33	(29, 37)
Mean number of students per school			
Primary	N=511	310 (288)	-
Secondary	N=189	559 (389)	-
Female teacher present at school:			
Primary	2,419/3,297	61	(57, 65)
Secondary	1,456/3,753	22	(19, 25)
Mean age of interviewed students	N=2,332	12.8 (1)	-
Mean grade level of respondents	N=2,332	6 (1.6)	-
Mean age at menarche (years)	N=2,326	11.9 (0.9)	-

*Weighted percentage for rural/urban balance and school size

Knowledge, attitude, facilities, and practices

Sixty-four percent of girls reported they had no knowledge of menstruation before reaching menarche. Twenty-six percent of girls received information on menstruation prior to menarche from their female relatives before menarche and <1% from their teachers. Thirty-two percent of respondents stated that menstrual problems interfered with school performance. Only 9% of girls reported that schools provided menstrual hygiene education sessions for girls. On average, schools provided menstrual hygiene education sessions at grade eight, when girls were around 14 years old (Table 2).

Table 2 Menstrual hygiene knowledge, practices and school facilities for Bangladeshi schoolgirls, 2013

Indicators	n/N	%* or mean (SD)	95% CI %
Current perception about menstruation:			
No idea	1132/2,332	49	(44, 55)
A normal biological process for women	959/2,332	40	(34, 45)
A female illness	229/2,332	10	(7, 14)
Curse of God	12/2,332	1	(0.1, 1)
Knew/ heard about menstruation before menarche	862/2,332	36	(33, 39)
Knew/heard about menstruation issues before menarche from:			
Mother/sister/aunt/grandmother	592/2,332	26	(23, 29)
Friend	255/2,332	11	(8, 14)
Teacher	15/2,332	0.64	(0.32, 0.91)
Believe menstrual problems interfere with school performance	756/2,332	32	(27, 37)
Materials used during menstruation:			
Re-used cloth	1,904/2,332	86	(84, 88)
Disposable pad	355/2,332	10	(8.5, 12)
Other†	43/2,332	2	(1.2, 3)
Mean number of menstrual cloth changes per day	N=1,898	3 (1)	
Washed cloth with soap and improved water source for repeated use	1,225/1,904	57	(50, 63)
Washed cloth with soap and improved source of water and dried in sunlight for repeated use	525/1,904	25	(21, 29)
School has a place‡ to change menstrual materials	733/2,332	31	(27, 35)
Schools with separate improved toilet for girls	602/700	82	
Schools with separate improved and unlocked toilet for girls	671/2,332	28	(24, 33)
Mean number of female students per improved and unlocked toilet for girls	N=363	98 (48)	-
School has improved toilet with soap and water available	213/2,332	9	(6.9, 12)
Perceived that school facilities were inappropriate for managing menstrual hygiene	1,906/2,332	82	(77, 88)
Disposal location of absorbent materials at school:			
Did not change and dispose at school	1,935/2,332	83	(79, 86)
Inside toilet pan	85/2,332	4	(2.6, 4.8)
Hidden inside classroom	73/2,332	3	(1.8, 4.6)
In the open	71/2,332	3	(2, 4)
Menstrual hygiene education session had ever been provided at school	213/2,332	9	(6.8, 11)
Mean grade level for which menstrual hygiene education sessions were provided at school	N=213	8 (1.7)	
Family enforced prohibitions during menstruation:			
Not allowed to go out/to certain places	1096/2,332	71	(68, 74)
Not allowed to perform religious activities	1,185/2,332	54	(49, 60)
Not allowed to cook/eat certain food	741/2,332	32	(29, 34)
No restriction	362/2,332	16	(13, 19)
Instructed not to walk fast/run	160/2,332	7	(5, 8)

*Weighted for rural/urban balance and school size;

[†]Cotton/Tissue paper/ waste fabrics from garment factories;
[‡]Unlocked toilet for girls or change room

Textbooks addressed some issues related to adolescence i. e. what is puberty, when it starts and what happens after this. However, the menstrual hygiene content mainly described menstruation as a biological process, and did not provide practical information about how to manage changes to girls' bodies.

Eighty-two percent of girls judged school facilities as inappropriate for managing menstrual hygiene. Eighty-two percent of schools had an improved toilet for girls, but only 28% of schools had one or more improved toilet that was unlocked from the outside and therefore accessible to students. Thus, 54% of schools did not have an improved, unlocked toilet that students could access and only 9% of schools among all had a toilet with soap and water inside. Thirty one percent of schools had a designated private unlocked toilet or change room to change menstrual materials. Among the schools that had a private unlocked toilet, there were a mean of 98 girls for each toilet.

Eighty-six percent of girls used cloth during menstruation; 10% used disposable pads. Girls attending urban schools were more likely to use disposable pads (urban: 21%, rural: 9%, APD: 12; CI: 8.1, 16). Among cloth users, 64% washed their cloths with soap. Only 3% of girls washed their cloths with soap, dried them in sunlight and stored them with other cloth for repeated use, which is identified as the best cloth cleansing practice in the Bangladesh National Hygiene Promotion Strategy[23]. Eighty-six percent of girls reported that they did not change their menstrual cloth during school hours, which spanned approximately four hours for primary and seven hours for secondary schools. School students reported family-imposed restrictions during menstruation: 71% reported that they were 'not allowed to go out/to certain places', 51% reported that they were 'not allowed to perform religious activities', 32% reported that they were 'not allowed to cook/eat certain food' and 7% reported that they were 'instructed not to walk fast' during menstruation (Table 2).

School absence

Forty-one percent of girls reported missing school during menstruation, 42% (449/1,106) in rural schools and 38% (482/1,226) in urban schools. Absentee girls missed an average of 2.8 days each menstrual cycle, constituting approximately 16% of the academic year. When asked why they missed school, 59% reported that they felt uncomfortable sitting beside boys during menstruation, 31% reported that they felt embarrassed at school during

menstruation, 5% reported that there was no place to change menstrual materials in school and 4% said their guardians forbade them to go to school (Table 3).

Table 3 School absence among Bangladeshi schoolgirls, 2013

Indicators	n/N	%* or mean (SD)	95% CI %
Reported missing school during menstruation	931/2332	41	(36, 46)
Mean number of days per menstrual cycle that adolescent school girls reported missing school	N=931	2.8 (1.4)	-
Reasons for missing school (multiple responses):			
Feel uncomfortable sitting beside boys during menstruation	547/931	59	(56, 63)
Feel uncomfortable at school during menstruation	287/931	31	(26, 34)
Remain sick	186/931	20	(16, 24)
Heavy bleeding	83/931	9	(6, 15)
No place to change rag/cloths	48/931	5	(3, 7)
Forbidden by guardian	40/931	4	(2, 9)

*Weighted percentage for rural/urban balance and school size

After controlling for confounders, school absence during menstruation were more common among girls who felt uncomfortable at school during menstruation (99% vs. 32%; APD=58%; CI: 54, 63) and who perceived menstrual hygiene management interferes with school performance than who did not (64% vs. 30%; APD=27; CI: 20, 33) (Table 4).

Table 4 Factors associated with school absence during menstruation among Bangladeshi schoolgirls, 2013

	Absent during menstruation n (%*)	PD† (%)	95% CI %	p-value	APD‡ %	95% CI %	p-value
Feel uncomfortable at school during menstruation							
Yes	284/287 (99)	66	(61, 71)	0.000	58	54, 63	0.000
No	647/2,045 (32)	-	-	-	-	-	
Current perception about menstruation:							
A normal biological process	357/959 (38)	-	-	-	-	-	
No idea	455/1,132 (40)	0.5	(-5.7, 6.7)	0.998	-	-	
A female illness	115/229 (52)	10	(0.2, 18)	0.015	-	-	
Believe menstrual problems interfere with school performance							
Yes	480/756 (64)	36	(29, 44)	0.000	27	(20, 33)	0.000
No	4511,576 (30)	-	-	-	-	-	

Gender separated toilet at school							
Yes	400/1,036 (36)	-5.0	(-11, 0.5)	0.075	-	-	
No	531/1,296 (43)	-	-	-	-	-	
Gender separated unlocked toilet for girls at school							
Yes	355/945 (35)	-5.5	(-11, -0.5)	0.039	-5.4	(-10, -1.6)	0.049
No	576/1,387 (43)	-	-	-	-	-	
School provided menstrual hygiene education session for girls							
Yes	72/213 (40)	-1.5	(-11, 14)	0.816	-	-	
No	859/2,119 (42)	-	-	-	-	-	
Forbidden from any activities during menstruation							
Yes	801/1,970 (41)	10	(2.3, 18)	0.011	9.1	(3.3, 14)	0.008
No	130/362 (33)	-	-	-	-	-	
Not allowed to go out during menstruation							
Yes	263/604 (46)	5.9	(-0.6, 12)	0.076	-	-	
No	668/1,728 (38)	-	-	-	-	-	

* Weighted percentage for rural/urban balance and school size;
† Prevalence difference;
‡ Adjusted prevalence difference calculated by adjusting for 'feel uncomfortable at school during menstruation', 'believe menstrual problems interfere with school performance', 'unlocked toilet for girls at school', 'student's age' and 'area of school (rural vs. urban)

School absence during menstruation was less common among girls where the schools had an unlocked or open gender separated toilet for girls than when toilet was found locked and unavailable to girls during the spot check (35% vs. 43%; APD=-5.4; CI: -10, -1.6). Girls who were forbidden from any activities during menstruation were more likely to miss schools (41% vs. 33%; APD=9.1; CI: 3.3, 14) compared to those who did not face such restrictions (Table 4).

Girls who used cloth that was washed with water only or washed with soap and not dried in sunlight were just as likely to miss school compared to girls who used pads (42% vs. 40%; APD= -2.1;CI: -9.1, 5.1) or who used cloth washed with soap and water and dried in sunlight (42% vs. 38%; APD= -4.4; CI: -12, 3.4).

DISCUSSION

In a nationally representative sample of school children across Bangladesh, 41% of girls post menarche reported usually missing school during menstruation[2, 6]. Assuming the number of days reported missed by the study subject is accurate, we estimated they were absent for 16% of the school year, a quantity of missed classroom work that would be expected to substantially impact school performance[2, 6]. In our study school absence during menstruation was independently associated with negative attitudes and perceptions about menstruation, not having a gender separated unlocked toilet for girls at schools and being forbidden from activities during menstruation, factors that are similar to other studies[7, 9, 10, 21, 24-27].

Other studies have noted marked difficulties in measuring school attendance[13, 20, 28]. In some qualitative studies girls reported missing school because of menstruation[2, 6, 9], but when investigators attempted to quantify this effect systematically they have not always replicated these findings[28-30]. Attendance is difficult to measure. Schools are often compensated based on the number of students enrolled, so there is a strong incentive to over-report attendance on routine monitoring, thus making official records invalid measures[31]. Various investigators have used different approaches to address this issue including diaries of girls[28, 32], and assessing attendance by study personnel on unannounced visits[31, 32]. It is also difficult to attribute absence to menstruation. Girls might be unwilling to mention menstruation as a reason they missed school because of stigma associated with menstruation[6, 29]. Girls also may leave school early and miss hours of a school day due to menstruation, that would not be counted as absence[21].

Nevertheless, several studies support the idea that menstruation affects attendance. Multiple intervention trials that have improved facilities for menstrual hygiene have measurably improved girls' attendance[27, 31-37]. In Bangladesh, a six-month educational intervention among 416 girl students aged 11- 16 years from three schools demonstrated a 31% increase in students' knowledge about menstruation and a 5.1% decrease in self-reported school absence among participants from baseline[35]. In Ghana, a menstrual hygiene education program increased girls' school attendance where attendance data were collected from teachers' register book, by around 6 days per 65 days term (9% of a girls' school year)[32]. A study conducted in Kenyan schools found that toilet access was more effective in reducing absence among girls than among boys due to its impact on menstrual hygiene management[31].

Not all studies have found a convincing relationship between menstruation and absenteeism. Oster and Thornton collected daily data on school attendance and menstrual calendars, and found that menstruation had only limited impact on school attendance[20]. That study included 198 schoolgirls from seventh and eighth grade of four schools and the mean age of girls was 14.2 years which was 1.4 years older than our surveyed girls. At the beginning of menarche, girls may miss more school days as they may not have fully developed strategies for coping with menstruation[20, 38]. An intervention trial providing a menstrual cup or sanitary pads compared to puberty and hygiene training was unable to measure evidence of impact on school absence among girls receiving the menstrual cup or pads [30]. This study, however, only enrolled schools with gender specific girls' toilet, while in our study we found the absence of an available gender specific toilet was one reason for school absence during menstruation. In addition, puberty and hygiene training may also have better prepared schoolgirls to manage menstruation in the control schools.

The 41% absence rate during menstruation in our study was higher than that reported in a smaller-scale study in Maharashtra, India where data were collected using a pre-tested, self-administered structured questionnaire among girls aged 10-19 years old (561 girls, 14% absent)[11], but similar to those reported in Habru, Ethiopia (595 girls, 55% absent)[7], and West Bengal, India (190 girls, 39% absent)[39] that also used a self-administered questionnaire for collecting school absence data. Considering both the global experience as well as local context within Bangladesh, we consider the self-report of Bangladeshi schoolgirls in our survey to be a credible assessment of their experience.

Girls were more likely to report absence from school if they also reported negative attitudes about menstruation, such as perceiving it as something unhealthy, shameful, or obstructive to learning. Such attitudes may arise from the prevalent patriarchal culture in the society[26] and that around two-thirds of girls did not know about menstruation before they reached menarche. Some studies reported that girls who didn't receive any information about menstruation before menarche were more stigmatized about menstruation contributing to a culture of shame among them[40-42]. Increasing the knowledge and changing attitudes about menstruation among adolescent schoolgirls in Pakistan increased girls' confidence to manage menstruation hygienically[43].

This study identified several weaknesses in the current school curriculum on menstruation. The strict biological focus of school textbooks provided no opportunity for constructive discussion of healthy attitudes[44] or salient social and religious issues.

Moreover, teaching reproductive health is not mandated by the government. Even where schools had some course material on menstruation, 91% of girls reported that they had never received menstrual hygiene education sessions at school. Students who did receive formal education sessions usually participated in such classes after commencing menstruation. Less than 1% of students cited school teachers as a source of information regarding menstruation. Our study suggest several reasons why schools in Bangladesh provide so little useful education on menstruation. First, the national education curriculum and textbooks do not address the important social and cultural issues regarding menstruation. Second, the lack of timely information contributes to poor menstrual hygiene practices[45] and increased risk of urinary tract infection[46]. Third, only 22% of secondary school teachers are female in Bangladesh, compared to 61% of primary school teachers. Girls may not feel comfortable discussing menstruation with men[26, 45, 46]. Improving menstrual education to Bangladeshi girls requires two steps: first, schools and the education board need to be persuaded to consider menstrual hygiene as part of their educational mission. Second, the timing, content, and delivery of the menstrual curriculum need to be revised to better address the needs of girls.

Lack of a gender-separated improved accessible or open toilet at school for girls was another reason for the absence. In Bangladesh, the number of girls per toilet was two times higher than the national recommended standard of 50 girls per toilet[23]. Simply ensuring that toilets in schools are unlocked from the outside may increase the number of the accessible toilet for girls as more than half of the separate toilets for girls were locked when the study team visited during school hours. In our study lack of gender-separated open toilets was associated with missing school, similar to a finding in a recent systematic review[34] suggesting that simply ensuring gender-separated toilets for girls to change menstrual materials is important. Studies from other countries also report similar findings[27, 32, 33, 36, 37]. A study from India reported that 28% of girls missed school during menstruation due to lack of facilities[36], and in Nepal, 41% of students reported a lack of privacy for cleaning and washing as a major reason for absence during menstruation[27]. In Ghana, girls missed school due to inadequate sanitation facilities at school during menstruation[32].

Disposable sanitary napkin use was uncommon among schoolgirls in Bangladesh, and was not associated with school attendance. This finding contrasts with a similar study conducted in Ethiopia, where students “who did not use disposable sanitary napkins were 5.4 times more likely to be absent from school than their counterparts”[7] but supports a recent

systematic review[47]. In Bangladesh, and some other settings, access to gender separated toilet might be a more effective intervention than provision of menstrual hygiene supplies.

Restrictions imposed by guardians were independently associated with school absence in our study. Guardians may impose such restriction due to cultural norms and stigma related to menstruation[26, 27] which should be addressed by menstrual health and education programs[48]. The issue of restrictions impacting girls education also indicated the importance of a broader discussion on menstrual hygiene within the community.

In addition to difficulties with measuring attendance discussed above, this study has other important limitations. We identified adolescent schoolgirls who reached menarche with the help of a female teacher, and so our sample might be non-representative as teachers might have suggested including girls who have difficulty with menstruation. Conversely, those who were absent on the survey day may have been menstruating and so may have been under-represented. We did not explore the reasons behind schools keeping toilets locked from outside or why most schools taught about menstruation after girls reach menarche, because this study did not include a qualitative investigation.

CONCLUSION

In a nationally representative sample, 41% of schoolgirls in Bangladesh reported missing16% of school days because of menstruation. The risk factor analysis suggests several modifiable factors contributed to school absence. Although further research to assess the effectiveness of interventions to address these problems would be productive, the current data suggest that: schools should ensure that toilets are open during school hours; the school curriculum should be revised in a way that menstruation is taught three years earlier than currently presented so that girls can learn about menstruation from female teachers before they experience menarche. A broader discussion within the community might also create a more supportive environment for girls to attend school during menstruation. Efforts are also required to develop the capacity of teachers to teach menstrual hygiene education. We recommend conducting further exploratory studies to better understand beliefs and norms about menstruation, use and preference of absorbents and issues related to discomfort at school and a better way to capture school attendance. We also recommend further research on the impact of gender-separated toilets and menstrual hygiene education on school attendance and girls' educational outcomes.

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Author's contribution

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Contributors: MA, SPL, AKH, KI, AO and LU conceived and designed the original protocol. All authors except TM were involved in amending the protocol. MA, AKH, MR and LU coordinated the study throughout. Data entry, cleaning and analysis was carried out by AKS, PKG and MA. AKS cleaned the data and ran preliminary analysis with input from MA, AKH, LU, MR, SPL and TM. MA carried out advanced analysis and AKH, LU, MR, SPL, PKG, AO, KI and TM provided advice on data interpretation. MA wrote the first draft of the manuscript with LU and AKH. All authors contributed to subsequent and final drafts.

Data sharing statement

No additional data are available.

Figure 1: Conceptual framework for school absence during menstruation among schoolgirls where exposures were categorized in four blocks for school absence outcome: (1) girl's attitude, (2) knowledge, (3) school facilities and programs, and (4) practices. Student's age and area of school were considered as confounder. Physical discomfort could be directly linked with school absence.

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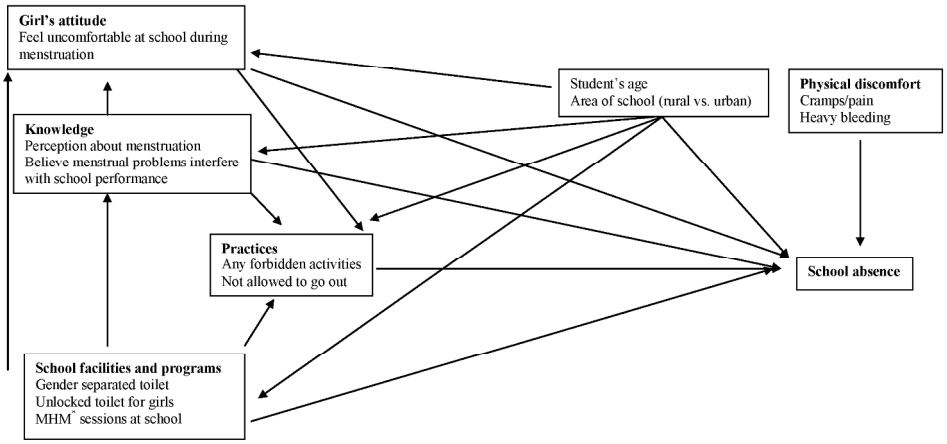

Figure 1: Conceptual framework for school absence during menstruation among schoolgirls where exposures were categorized in four blocks for school absence outcome: (1) girl's attitude, (2) knowledge, (3) school facilities and programs, and (4) practices. Student's age and area of school were considered as confounder. Physical discomfort could be directly linked with school absence.

* MHM: menstrual hygiene management

Conceptual framework for school absence during menstruation among schoolgirls where exposures were categorized in four blocks for school absence outcome: (1) girl's attitude, (2) knowledge, (3) school facilities and programs, and (4) practices. Student's age and area of school were considered as confounder. Physical discomfort could be directly linked with school absence.

244x163mm (300 x 300 DPI)

Appendix-C3: School component study: MHM survey
National Hygiene Survey 2012

1.1 Questionnaire identification number ..... ☐☐☐☐☐☐

1.2 Study Area..... ..... ☐

Rural.....0
Urban 1

1.3 Cluster number..... ..... ☐☐☐

1.3a FRA name & ID..... ☐☐

1.3b. Date of interview..... ☐☐/☐☐/☐☐

Part 1:
Section 1: Adolescent menstrual hygiene

Note: Respondent for this portion is adolescent girl (we will sample four adolescent girls from one school if available where class 2 to 5 for primary and class 6 to 9 for junior/high school)

Definition of adolescent: *Girls who have menstrual experience aged 10- 19 years*

***Interviewer criteria*:** *Only female FRAs are going to ask this section*

1.4 Do the school have available *MHM experienced,* adolescent girl?..... ☐

No..... 0
Yes..... 1

***Skip Note-1.1:* If answer of 1.4 is 0, then finish the interview**

1.4.a If answer of 1.4 is 1 then mention the class (Use code 2 to 9)..... ☐

1.5 Do you have any problem if I ask you to share us regarding your menstrual hygiene practices?..... ☐

No..... 0
Yes..... 1

Skip Note-1.2: **If answer of 1.5 is 1, then finish the interview**

1.6 How old are you? Year: ☐☐ Month: ☐☐

1.6a How old were you when you started menstruating, insert 999 if cannot remember?

Year: ☐☐☐ Month: ☐☐☐

1.6b Where were you when your first menstruation occurred?..... ☐☐☐

At home 1
At schools..... 2

Others: Specify..... 777

1.6c What was your first reaction when you experienced your first menstruation?..... ☐☐☐

Cried..... 1
Scared 2
Embarrassed 3
Happy 4
Told mum, sister, grandmother, friend, teacher)..... 5
Did not tell anyone..... 6
Annoyed..... 7
Others: Specify..... 777

1.6d Did you know about menstruation before you started menstruating?..... ☐☐☐

No..... 0
Yes..... 1

1.6e Where did you get the information about menstruation? (Multiple answers allowed here?..... ☐☐☐

No..... 0
Yes..... 1

1. Mother..... ☐

2. Father ..... ☐

3. Grandmother..... ☐

4. Friend ..... ☐

5. Aunty ..... ☐

6. Teachers..... ☐

7. Sister/ Sister-in law ..... ☐

8. Doctor/Nurse ..... ☐

9. TV/Radio ..... ☐

10. Reading..... ☐

777. Other (Specify): ..... ☐

1.7 Mainly what do you use during menstruation?..... ☐☐☐

Old Cloth (rag).....	1
New cloth.....	2
Pad.....	3
Cotton.....	4
Tissue paper.....	5
Jhute of garments.....	6
Nothing.....	7
Refused to say	666
Other: Specify:	777

Skip Note-1.3: ***If answer of 1.7 is not 1/2, skip to 1.14***

1.8 Generally how many times the cloth used for menstruation you usually change per day? (666=refused to say)

Times:..... ☐☐☐

1.9 How do you clean/ wash this cloth (rag)?..... ☐☐☐

With soap.....	1
With soap & hot water.....	2
With savlon/ detol.....	3
With savlon/ detol & hot water.....	4
With soap, savlon/ detol & water.....	5
With soap, savlon/ detol & hot water.....	6
With hot water.....	7
With only water.....	8
Don't clean.....	9
Other (Specify).....	777

Skip Note-1.4: ***If answer of 1.9 is 9 skip to 1.14***

1.10 Where do you clean/ wash this cloth?..... ☐☐☐

In toilet.....	1
In bathroom.....	2
Public tap.....	3
Under tube well.....	4
Beside pond.....	5
Beside river.....	6
Other (Specify).....	777
DK.....	999

1.11Where do you get the water for washing/ cleaning this cloth (rag)? ..... ☐☐☐

Shallow tube well(<250 feet).....	01
Deep tube well(250+ feet).....	02
Protected ring/dug well.....	03
Unprotected dug well.....	04
Shallow Tara pump.....	05
Deep Tara pump.....	06
Piped water into dwelling.....	07
Piped water into yard/plot.....	08
Public tap/stand pipe.....	09
Arsenic filter	10
Arsenic free treatment plant.....	11
Water from protected spring.....	12
Water from unprotected spring.....	13
Rainwater.....	14

Tanker truck..... 15
Cart with small tank..... 16
Pathogen treatment plant (Pond Sand Filter):
River/dam/lake/ponds/stream/canal/irrigation channel.17
Directly from River/dam/lake/ponds/
stream/canal/irrigation channel.....18
Distiled bottled water..... 19
Boiled water..... 20
Other: specify..... 777
DK..... 999
Not applicable……..... 888

1.12 For repeated use of menstrual cloth, where do you dry the menstrual cloth?

A	In dry season ☐☐☐
B	In winter ☐☐☐
C	In rainy season ☐☐☐

Inside the house but hiding somewhere..... 1
Inside the house but open place..... 2
Outside the house and in sunlight..... 3
Outside the house but hiding somewhere..... 4
In side kitchen over cocking stove.....5
Inside the toilet..... 6
Inside the bathroom..... 7
Other: specify..... 777
DK..... 999
NA…… 888

1.13 Where do you preserve this cloth for next use?..... ☐☐☐

Normally like other clothes..... 1
At a hidden place..... 2
Under bed..... 3
Inside the latrine..... 4
Other: specify..... 777

1.14 Do you have separate room/place in your school to change their disposable pad/cloth during menstruation? ..... ☐

No..... 0
Yes..... 1

Skip Note-1.5: ***If answer of 1.14 is 0 skip to 1.17***

1.15 Is it safe to use?..... ☐

No..... 0
Yes..... 1

1.15a Is it private to use?..... ☐

No..... 0
Yes..... 1

1.15b Is it clean to use?..... ☐

No..... 0
Yes..... 1

1.16 Do you use it? ..... ☐

No..... 0
Yes..... 1

1.17Are there sanitary pad disposal bins in the girl's latrine/ changing room? ..... ☐

No..... 0
Yes..... 1

1.18 Is there soap in the girls' latrine/ changing room? .... ☐

No..... 0
Yes..... 1

1.19 Do you have any hygiene kit (Detol, rag/cotton, soap) in your school for using during menstruation? ..... ☐

No..... 0
Yes..... 1

1.20 Do you have enough water supply or storage in your school for using during menstruation? ..... ☐

No..... 0
Yes..... 1

1.21Do you have to go inside the latrine for menstrual cleaning in your school during menstruation?..... ☐

No..... 0
Yes..... 1
Not applicable……888

1.22 Are there place to dispose the used cloth/pad for menstrual hygiene?..... ☐☐☐

No 0
Yes 1
DK……999
Not applicable……..888

1.23 What do you do if there is no place to dispose the used cloth/pad for menstrual hygiene?..... ☐☐☐

Openly disposed..... 1
Disposed inside toilet pan..... 2
Hiding inside classroom..... 3
Do not change staying at school..... 4
Other: specify..... 777

1.24 If the answer of 1.7 is 3 (pad) then, how much do you pay a month for using your disposable/commercial pads? (Code:

888=Not applicable) Taka..... ☐☐☐

1.25 Do you come to school during menstruation?..... ☐

No..... 0
Yes..... 1

Skip Note-1.6 : ***If answer of 1.25 is 1 skip to 1.27***

1.26 If not, why? (Multiple answers allowed here)

No..... 0
Yes..... 1

1. No place to change the rag/clothes..... ☐

2. No water available..... ☐

3. No soap/liquid soap..... ☐

4. I do not feel comfortable..... ☐

5. I remain sick..... ☐

6. Over bleeding..... ☐

777. Other (specify)..... ☐

1.27 Do you feel comfortable at school during menstruation? ..... ☐

No.....0
Yes.....1
Not applicable…… 888

1.28 Do you feel uncomfortable sitting next to male students during menses? ..... ☐

No..... 0
Yes..... 1
Not applicable…… 888

1.29 Do male students tease you during menses?..... ☐

No.....0
Yes.....1
Not applicable……888

1.30 Do you think menstrual problems interfere with school performance? ..... ☐

No..... 0

Yes..... 1

Skip Note-1.7: ***If answer of 1.30 is 0 skip to 1.32***

1.31 If yes, how? ..... ☐☐☐

Low concentration 1
Missing lessons 2
Other: specify..... 777

1.32. Do you know of any girl who dropped out of schools because of menstruation?..... ☐

No..... 0
Yes..... 1

1.33 Did you miss any class during menstruation in the last three months?..... ☐

No..... 0
Yes..... 1

Skip Note-1.8: ***If answer of 1.33 is 0 skip to 1.35***

1.34 If yes, how often (average of last three months in school days)?..... ☐

One day every cycle 1
Two days every cycle 2
Three days every cycle 3
Four days every cycle 4
Five days every cycle 5
Six days every cycle.....6
Seven days every cycle.....7

1.35 Do you think that the school facilities are appropriate for managing menstrual hygiene?..... ..... ☐

No..... 0
Yes..... 1
Can manage somewhat..... 2

1.36 If school facilities are not appropriate what are the reasons or difficulties? (Multiple answers allowed here)

No.....0
Yes.....1

1. No secret room/change room for girl..... ☐
2. No hygiene kit/soap separate for girl children ..... ☐
3. No water facilities for girl children..... ☐
4. Wash room is common for all ..... ☐
5. We need to go inside the latrine for menstrual cleaning ..... ☐
6. No private disposal/incineration facilities for disposable napkins..... ☐

777. Other (specify)..... ☐

1.37 What the activities are forbidden for you during the menstruation period? (Multiple answers allowed here)

No..... 0
Yes..... 1

a. Not go to certain places..... ☐

b. Not touch certain things (i.e don't get up bed) ..... ☐

c. Not eat certain foods..... ☐

d. Not allowed to cook..... ☐

e. Not allowed to go out..... ☐

f. Not allowed to religious activities..... ☐

g. Nothing..... ☐

h. Others specify..... ☐

Section 2: Knowledge level Questions:

2.1 What is your knowledge on ministration?..... ☐☐☐

A normal phenomenon of reproductive health of a female.....	1
A Illness of a female.....	2
Curse of God.....	3
No idea/No experience…….....	4
DK.....	999

2.2 Do you think menstruation is a female and/or personal matter, to be kept to oneself only, not to talk about it openly?..... ☐

No.....	0
Yes.....	1

2.3 What facilities and programmes are there in the school for promoting safe and private menstrual hygiene for older girls? (Multiple answers allowed here)

No.....	0
Yes.....	1

1. Separate girls latrine……..…..... ☐
2. Separate girls urination facilities……..... ☐
3. Separate change room……...…..… ☐
4. Soap available at change room……..…… ☐
5. Water available at change room..... ☐
6. Girls counseling facilities are available for menstrual hygiene management. ☐

7. Nothing……..……..……...…. ☐

999. DK..... ☐

777. Others (specify)……..……..……... ☐

888. Not applicable……..... .. ☐

2.4 What menstrual hygiene education sessions are provided for girls? (Multiple answers allowed here)

No..... 0
Yes..... 1

1. Counseling for girls…… ☐
2. Separate class are arranged for girls……...…… ☐
3. Menstrual hygiene management education are there in the school curriculum ☐
4. NGO/health workers arrange sessions for girls……..……...…… ☐
5. Nothing…… ☐

777. Others (specify)……..…… ☐

888. Not applicable……..... ☐

2.5 Did you receive information regarding menstrual hygiene management in school before the onset of menstruation?

..... ☐☐☐

No 0
Yes 1
DK……..… 999

2.6 Do you know about the implications of inadequate management of menstrual hygiene?..... ☐☐☐

No..... 0
Yes..... 1
DK..... 999

2.7 What are the implications of inadequate management of menstrual hygiene? (Multiple answers allowed here) ... ☐☐☐

No..... 0
Yes..... 1

1. Pain during urination.. ..... ☐

2. Pains at lower abdomen... ..... ☐

3. Anaemia..... ☐

4. Tired/feel sleepy..... ..... ☐

5. Hampers the regular works..... ☐

6. Itching..... ☐

7. White/gray vaginal discharge..... ☐

8. Mild back pain..... ..... ☐

9. Bleeding between menstrual period..... ☐

10. Appetite loss..... ..... ☐

11. Fever..... ..... ☐

12. Headache and fatigue..... ☐

777. Others(specify)……..… ..... ☐

999. DK……..... ☐

2.8 Is there any kind of napkin distribution programme at your school?..... ☐☐☐

No 0
Yes 1
DK……..…999

2.9 In the last 6 months, have you experienced any of the following symptoms? (multiple answers allowed here)

No..... 0
Yes..... 1

1. Itching..... ☐

2. Irritation/soreness of the vagina..... ☐

3. Redness and swelling..... ☐

4. Lumps and blister..... ☐

5. Smelling discharge..... ☐

6. Unusual discharge..... ☐

7. Nothing happened ..... ☐

666. Refused to say..... ☐

777. Other (Specify:..... ☐

***Skip Note-1.9:* If answer of 2.9 is7/666,then skip to section-3**

2.10 If the answer of 2.9 is 1-6, whom do you talk to? ..... ☐☐☐

Mother.....	1
Father.....	2
Grandmother.....	3
Friend.....	4
Auntie.....	5
Teachers.....	6
Sister/ Sister in-law.....	7
Doctor/nurse.....	8
TV/Radio	9
Nobody.....	10
Other (Specify).....	777

2.11 Where did you get the treatment? ..... ☐

Local/Village clinics.....	1
Private Clinic.....	2
MBBS Doctor.....	3
Pharmacy.....	4
Traditional healer.....	5
Self-treatment at home.....	6
No action taken.....	7
Other (Specify):.....	777

Part 2: SPOT CHECK

Section 3: Water supply:

3.1 Whether there exists platform? (Observe)..... ☐☐☐

No.....	0
Yes.....	1
Not applicable.....	888

3.2 Is the platform broken? (Observe)..... ☐☐☐

No.....0	
Yes i.e. broken.....	1
Not applicable.....	888

3.3 Is there water logging in the platform? (Spot check).....☐☐☐

No.....0
Yes.....…1
Not applicable....888

3.4 Did the area surrounding the water source look clean? [Considering presence of cow dung, solid waste etc(Observe only)].....☐☐☐

No..... 0
Yes.....… 1
Not applicable.....888

Sanitation:

3.5 Who uses the latrine(s)? (Ask and spot check).....☐☐☐

Only Girl's latrine..... 1
Girls and female teacher's latrine..... 2
Only Boy's latrine..... 3
Boys and male teacher's latrine..... 4
Only Teacher's latrine..... 5
Non specific/for all..... 6
For all students..... 7
Nothing written on the door..... 8
Other (Specify)..... 777
Not applicable..... 888

3.6. Mention the type of toilet facilities (Observe only)

Toilet code list

Piped sewer system..... 01
Septic tank..... 02
Flush to pit latrine..... 03
Pit latrine with slab & water seal..... 04
Pit latrine with slab & no water seal but with a lid.....05
Pit latrine with slab & flap, no water seal 06
Ventilated Improved Pit (VIP) latrine..... 07
Composting toilet, *(Composting toilet ensure separation of urine, water and excreta*)..... 08

Flush or pour flush toilet connected to somewhere else (canal, ditch, river, etc..... 09
Pit latrine without slab/open pit..... 10
Pit latrine with slab & no water seal/broken water seal and no lid..... 11
Hanging toilet/latrine]..... 12
Open defecation:
No facility/bush/field..... 13
Others: Specify..... 777
Not Applicable..... 888

3.7. Is there a door on the latrine?(Observe only).....☐☐☐

No..... 0

Yes..... 1
Not applicable..... 888

3.8. Is the door of the latrine(s) open?(Observe only)..... ☐☐☐

No..... 0
Yes..... 1
Not applicable..... 888

3.9. Is the latrine(s) functional (usable)? (Observe only..... ☐☐☐

No..... 0
Yes……..... 1
Not possible to observe..... 2
Not applicable..... 888

Skip note 1.10: If the answer of 3.9 is not 2 then skip to 3.10

3.10. Why observation was not possible?..... ☐☐☐

Locked]..... 1
Other: specify 777
Not applicable..... 888

3.11. Visit each latrine and If there is visible stool in any of the functional toilet facilities (in the pan) of this school?..... ☐☐☐

No..... 0
Yes..... 1
Not possible to observe..... 2
Not applicable..... 888

3.12. Visit each latrine and see if there is stool visible on the slab or floor of the toilet facility?]..... ☐☐☐

No..... 0
Yes..... 1
Not possible to observe..... 2
Not applicable..... 888

3.13. Visit each latrine and see if there is any fecal smell in the toilet facility? (Observe only)..... ☐☐☐

No..... 0
Yes..... 1
Not possible to observe..... 2
Not applicable..... 888

3.14. Provision of hand cleaning agent in or near latrine(<30feet)..... ☐☐☐

Soap..... 1
Detergent..... 2
Ash..... 3
Mud..... 4
Nothing..... 5
Other: specify 777
N/A..... 888

3.15. Are there any anal cleansing materials available in the functional student's toilet facilities? (Observe only)..... ☐☐☐

Water..... 1
Toilet paper..... 2
Cloth..... 3
Piece of mud..... 4
Nothing..... 5
Water & Toilet paper..... 6
Water & Cloth..... 7
Water & Piece of mud..... 8
Other (Specify)..... 777
N/A..... 888
Not possible to observe..... 999

Hand washing

3.16. What are the devices for hand washing? (Observe only)..... ☐☐☐

Specially designed hand
washing system (A drum with a tap)].....1
Basin 2
Water container (e.g. bucket, mug). 3
There is not any device 4
Other: (specify)..... 777
N/A..... 888

Skip note 1.11: ***[If 3.16 is 4 then skip to question no 3.19]***

3.17 If are they functional handwashing device then how many?.. ..... ☐☐

3.18 Observation only: Is there water available for hand washing in the Hand washing device?..... ☐☐☐

No..... 0
Yes..... 1
Not applicable..... 888

3.19. Where is the soap for hand washing usually located? (Ask to show the location of the soap, and fill out response according to observation)..... ☐☐☐

Next to hand washing device (<30 feet)..... 1
Next to or outside the toilet…..... 2
Away from hand washing device(>30 feet)..... 3
In the teacher's room/office room.....4
In the classroom..... 5
Inside the toilet..... 6
None..... 7
Other: (specify)..... 777
N/A.....888

3.20. Observation only: Soap or detergent brought by the interviewee within 30 feet's?

No..... 0
Yes..... 1
Not applicable…... 888

a. Soap..... ☐

b. Detergent..... ☐

c. Other: specify..... ☐

Solid Waste disposal

3.21. How do the school children dispose solid waste there?[Observe only]..... ☐

Completely/rightly (no waste outside) …..... 1
Partially (Wastes are disposed partly inside and partly outside) 2
Do not (no garbage inside and no symptoms of waste disposal on the way or inside)..... 3
Non specific place..... 4

Environmental Cleanliness

3.22. Whether class rooms are clean (Considering the presence of waste paper, soot, food, dust, leaves). ..... ☐

Waste is not visible/clean..... 1
Some waste is visible..... 2
Not clean..... 3

3.23. Whether school compound is clean (Considering presence of cow dung, solid waste and human feces)..... ☐

Clean (waste is not visible)..... 1
Not quite clean (some waste is visible)..... 2
Not clean (waste is seen here and there)..... 3

3.24. End time (Hour: Minute)..... ☐☐:☐☐

Question for FRA:

3.25. Have you checked the questionnaire once you have completed it?..... ☐

No..... 0
Yes..... 1

Thank you.

STROBE 2007 (v4) Statement—Checklist of items for the manuscript titled " Menstrual hygiene management among Bangladeshi adolescent schoolgirls and risk factors affecting school absence: results from a cross-sectional survey"

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7 and 8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8
Bias	9	Describe any efforts to address potential sources of bias	*8*
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	8
		(*e*) Describe any sensitivity analyses	

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15
Generalisability	21	Discuss the generalisability (external validity) of the study results	16
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.