

Menstrual Hygiene Practices and Associated Factors among Post-Menarche Primary-School Girls in Semi-Rural Indonesia: A Mixed-Methods Study

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ABSTRACT

Introduction: Menstrual hygiene management (MHM) remains a significant public health issue, particularly among primary school girls in low- and middle-income countries. Poor menstrual hygiene is associated with an increased risk of reproductive tract infections and may increase vulnerability to sexually transmitted infections (STIs). In Indonesia, inadequate practices remain common, including in semi-rural areas such as Garut Regency, where limited sanitation and family dynamics influence menstrual health behaviors.

Methods: This study used a sequential explanatory mixed-methods design. A total of 83 primary school girls who had experienced menarche were included in the quantitative phase and analyzed using multivariate logistic regression. 21 informants were purposively selected for in-depth interviews based on school variation, knowledge level, maternal support level, and menstrual hygiene practice category. All selected informants completed the interviews, and all completed interviews were included in the thematic analysis.

Results: High knowledge was strongly associated with good MHM practices (OR = 13.60; 95% CI: 3.38–54.71; $p < 0.001$). After adjusting for maternal support and sanitary pad availability, girls with adequate knowledge had 13.6 times higher odds of good menstrual hygiene practices. Qualitative findings suggested that maternal support may facilitate the application of menstrual hygiene knowledge through emotional guidance, practical assistance, and the normalization of menstruation.

Conclusion: High knowledge was the only statistically significant factor associated with good MHM practices in the adjusted quantitative model. Maternal support, although not statistically significant in the multivariable analysis, emerged in the qualitative findings as a contextual facilitator that may support the application of menstrual hygiene knowledge in daily practice.

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INTRODUCTION

Menstrual Hygiene Management (MHM) is increasingly recognized as a public health issue within the broader concept of menstrual health, and is closely related to dignity, health, and gender equality. Among the approximately 1.8 billion women who menstruate each month globally, many still face limitations in accessing adequate information, appropriate menstrual products, and necessary social support for hygienic management (1–3). In this study, MHM specifically refers to the practices required to manage menstruation hygienically, including the use and changing of menstrual materials, personal hygiene, disposal of menstrual waste, and the availability of supportive facilities. Recent global evaluations show that only about 39% of schools in the world provide adequate menstrual health education, while many schools still lack adequate sanitation facilities and menstrual waste management systems (4). This condition confirms that menstrual health is not only related to biological processes but is also influenced by social, economic, cultural, and structural factors. This issue becomes more critical among primary school girls because menarche may occur at 9–12 years of age, while reproductive health literacy, psychological readiness, and social confidence to discuss menstruation are often still limited.

Poor menstrual hygiene management practices can increase the risk of reproductive tract infections due to exposure to microorganisms from unhygienic practices (5,6). Furthermore, these unhygienic practices have an impact on school absences, decreased study concentration, and reduced social participation and psychosocial well-being of girls (7,8). In addition, the stigma, shame, and anxiety that accompany menstruation further exacerbate the condition. (9,10). For younger girls who have recently experienced menarche, these consequences may be more pronounced because menstruation is often experienced before they have received sufficient reproductive health information or practical guidance.

Inadequate menstrual hygiene practices remain widespread in low and middle-income countries, with studies from Myanmar, Nigeria, India, and Sub-Saharan Africa showing that more than half of adolescent girls do not practice MHM adequately, a pattern also observed in Indonesia where approximately 47.7–64.1% of adolescent girls report poor menstrual hygiene practices (11–15). In West Java, inadequate menstrual hygiene practices are also relevant to adolescent reproductive health, as regional data indicate a 15.8% prevalence of abnormal vaginal discharge and a high burden of sexually transmitted infections (STIs) (16). The local context of Garut Regency provides an important rationale for examining menstrual hygiene management among primary school girls. Garut is a semi-rural district in West Java with persistent human development and school sanitation challenges. Although its Human Development Index increased from 66.22 in 2019 to 69.91 in 2024, it remained below both the West Java average of 74.92 and the national average of 75.02 (17). School sanitation conditions also remain limited, with only 27% of primary schools having adequate and separate toilets and 72.1% having sufficient water access, both below provincial averages (18). These structural limitations may constrain girls' ability to manage menstruation safely and comfortably at school. Local evidence further indicates persistent menstrual health challenges: 78% of female students at Pondok Pesantren Al-Musaddadiyah Garut had unsupportive attitudes toward menstrual care (19). while 66.13% of adolescent girls had never received reproductive health advice at menarche. Among those who received advice, mothers were the main source, although discussions often focused on restrictions, cultural myths, hygiene, and religious practices (20). Therefore, menstrual hygiene practices in Garut should be understood not only as a matter of individual knowledge, but also as a behavior shaped by maternal communication, sociocultural beliefs, school sanitation, and broader structural conditions (18,19).

Menstrual hygiene management practices are influenced by interrelated factors. At the individual level, menstrual hygiene knowledge, age at menarche, and menstrual cycle characteristics may affect girls' ability to understand and perform hygienic practices. At the interpersonal level, maternal support and maternal co-residence may influence communication, guidance, emotional reassurance, and practical assistance during menstruation. At the environmental level, access to sanitary pads and WASH facilities may determine whether girls are able to apply what they know in daily life (21–25). However, previous studies have more often examined these factors separately, focused predominantly on adolescent girls in secondary school, or used quantitative designs that do not adequately explain the mechanisms behind statistical associations. Therefore, evidence remains limited on how individual knowledge, maternal support, and resource availability interact to shape menstrual hygiene practices among post-menarche primary school girls.

In this context, age at menarche and individual readiness become critical, as a substantial proportion of girls begin menstruation between the ages of 9 and 12 years corresponding to primary school age (grades 4–6) with a prevalence of 38.7% (26). However, reproductive health knowledge among early adolescents remains limited, as only 42.03% are aware of pubertal changes, access to information at the primary school level is low (15.2%), and knowledge indices are lowest among those aged 10–14 years indicating a gap between biological maturation and cognitive readiness in managing menstruation (16,27). This gap is particularly critical at the primary school level, where many girls begin menstruation without adequate knowledge or preparedness. For this reason, post-menarche primary school girls should be treated as a distinct analytical population rather than being grouped broadly with older adolescents.

Based on these gaps, this study aims to analyze the factors associated with menstrual hygiene practices among post-menarche primary school girls in Garut Regency, as well as explore the role of maternal support in bridging the relationship between knowledge and practice. The novelty of this research lies at the intersection of three elements: the focus on post-menarche primary school girls, the semi-rural Indonesian context of Garut, and the use of a sequential explanatory mixed-methods design to explain how menstrual hygiene knowledge is translated into practice through maternal support and resource availability. Rather than claiming a causal pathway or formal mediation effect, this study positions maternal support as a potential interpersonal mechanism that may facilitate the application of knowledge into daily menstrual hygiene practices. This study is expected to make a theoretical and empirical contribution to the development of more effective and contextual family-based menstrual health interventions within a social ecological framework, in which knowledge represents the individual level, maternal support represents the interpersonal level, and sanitary pad availability and school sanitation represent the environmental level.

METHOD

This study employed a sequential explanatory design with quantitative priority (QUAN → qual), integrating quantitative and qualitative approaches to obtain a comprehensive understanding of factors associated with menstrual hygiene practices among primary school girls. The quantitative phase was conducted first to identify statistical associations between individual, family, and resource-related factors and menstrual hygiene practices. The qualitative phase was conducted after preliminary quantitative analysis to explain and contextualize the statistical findings. The point of interface between the two strands occurred during the development of the interview guide and the selection of qualitative participants based on quantitative patterns. Integration was conducted at the interpretation stage through narrative integration supported by a joint display/meta-inference table linking quantitative findings, qualitative themes, and integrated interpretations. The methodology consists of the following components:

The quantitative phase used an analytic cross-sectional study design to examine the relationship between individual, family, and resource availability factors and menstrual hygiene practices. This approach is aligned with the Social Ecological Model framework, which emphasizes that health behaviors are shaped by interactions between individual, interpersonal, and environmental factors. The quantitative component was given priority because the primary objective was to identify factors statistically associated with menstrual hygiene practices, while the qualitative component was used to explain how and why these associations occurred within students' social and school contexts.

The qualitative phase used a descriptive exploratory design, conducted after the quantitative analysis. The results of the quantitative phase informed participant selection and guided the development of interview themes. Specifically, interview domains were developed from the regression findings, the Social Ecological Model, and prior menstrual hygiene management literature. The interviews explored knowledge about menstruation, maternal support, availability of sanitary pads, school sanitation context, privacy, communication barriers, and sociocultural meanings of menstruation. This phase aimed to deepen the interpretation of statistical findings by exploring students' subjective experiences, particularly regarding maternal support and access to menstrual hygiene resources, while also identifying additional contextual factors influencing menstrual hygiene management.

Finally, integration of the quantitative and qualitative findings was conducted at the interpretation stage using a narrative integration approach, enabling a more comprehensive understanding by explaining the mechanisms underlying statistically identified relationships and linking numerical findings with participants' social experiences. Qualitative themes were mapped back to the main quantitative results, particularly knowledge, maternal support, and

sanitary pad availability, to generate integrated meta-inferences. The integration process is presented in a joint display/meta-inference table in the Results/Discussion section.

Population and Sample

The study population consisted of female primary school students in grades 4 to 6 who had experienced menstruation in selected public primary schools in Cikajang District, Garut Regency, West Java. This grade range represents early adolescence, during which most girls begin to experience menarche, as indicated by national survey data, making it a critical period for examining menstrual hygiene practices.

In Cikajang District, a total of 42 primary schools were identified, from which schools were selected based on the following criteria: (a) public school status to ensure relative uniformity of facilities, and (b) having the highest number of female students in grades 4–6. Based on these criteria, ten schools were included to ensure an adequate pool of eligible participants and to support the efficient implementation of total sampling. The schools were selected purposively and were not randomly sampled from all schools in Cikajang District or Garut Regency. Therefore, total sampling applied only to eligible post-menarche girls within the selected schools and should not be interpreted as district-level or regency-level representativeness. This sampling strategy may have favored larger schools with different sanitation facilities, administrative capacity, or exposure to school health programs; therefore, external validity is interpreted cautiously.

The quantitative sample included 83 eligible students who met the inclusion criteria, namely having experienced menarche and providing informed consent to participate in the study. A total sampling technique was applied to include all eligible participants within the selected schools, thereby minimizing selection bias among eligible post-menarche girls in the selected schools. Because only 24 participants were classified as having poor menstrual hygiene practices, the multivariable logistic regression model was restricted to a limited number of theoretically relevant predictors to reduce sparse-data bias and overfitting. The interpretation of odds ratios, particularly estimates with wide confidence intervals, was therefore made cautiously. The sample size rationale was based on the available number of eligible post-menarche girls in the selected schools and an events-per-variable consideration.

For the qualitative phase, 21 participants were selected using purposive sampling until data saturation was achieved. Participants were selected based on quantitative patterns and contextual variation, including differences in menstrual hygiene practice category, level of knowledge, level of maternal support, availability of sanitary pads, and school context. This sampling strategy was intended to capture both confirming and contrasting cases that could explain the quantitative associations. Participants were not drawn from all schools; instead, they were selected from schools with varying characteristics to capture diverse social and environmental contexts. This approach enabled the exploration of a broader range of experiences and enriched the understanding of factors influencing menstrual hygiene practices. Saturation was defined as thematic and explanatory saturation, namely the point at which no new themes, codes, or explanatory patterns emerged from additional interviews. Saturation was assessed after interview number 18 and confirmed through 3 additional interviews. Coding was conducted by two coders, and analytic disagreements were resolved through discussion until consensus was reached. The distribution of respondents across schools for both quantitative and qualitative phases is presented in Table 1

Table 1. Distribution of Quantitative Respondents and Qualitative Informants Across Selected Primary Schools

No	School	Quantitative Respondents	Qualitative Informants
1	Primary School A	12	4
2	Primary School B	6	–
3	Primary School C	13	4
4	Primary School D	6	–
5	Primary School E	8	3
6	Primary School F	5	–
7	Primary School G	5	–
8	Primary School H	6	3

No	School	Quantitative Respondents	Qualitative Informants
9	Primary School I	11	3
10	Primary School J	11	4
	Total	83	21

Source: Primary Data

Research Location

This study was conducted in ten public primary schools located in Cikajang District, Garut Regency, West Java. This area represents a semi-rural setting with limited access to adequate sanitation facilities and strong family-based social structures. The study was conducted between August and September 2025. The location was purposively selected from 42 sub-districts in Garut Regency due to its relatively disadvantaged environmental conditions and its geographical distance from the urban center, making it relevant for examining contextual challenges in menstrual hygiene management. Because the study site was purposively selected, the findings are intended to provide contextual understanding of menstrual hygiene practices in the selected semi-rural school setting rather than statistical generalization to all primary school girls in Garut Regency.

Instrumentation or Tools

The quantitative research instrument was in the form of a structured questionnaire that measured three main groups of associated factors, namely individual factors (knowledge about menstruation, age menarche, and the menstrual cycle), family factors (maternal support and family living status), and resource factors (availability of sanitary pads). Instruments to measure menstrual hygiene practices were developed based on standard indicators of MHM, which include the use of clean absorbent materials, the frequency of changing pads, and personal hygiene practices during menstruation. Knowledge was measured using 10 dichotomous items, scored 1 for correct answers and 0 for incorrect answers, yielding a total score of 0–10. Scores of 6 or higher were categorized as high knowledge, based on a 60% cut-off. Maternal support was assessed using 40 items across four dimensions: informational, emotional, instrumental, and accompaniment support. Each item was scored on a 4-point scale, resulting in a total score of 40–160; scores of 96 or higher were categorized as high maternal support. Each support dimension consisted of 10 items, with scores ranging from 10 to 40, and scores of 24 or higher classified as high support. Menstrual hygiene practice was measured using 11 items scored on a 4-point scale, producing a total score of 11–44. Scores of 27 or higher were categorized as good practice, based on a 60% cut-off of the maximum possible score. Negatively worded items were reverse-coded before total scores were calculated.

The validity of the instrument's content was tested by nine reproductive health and public health experts using the Item Content Validity Index (I-CVI). All items show an I-CVI value of ≥ 0.78 , which indicates the feasibility of the contents of the instrument. The I-CVI values ranged from 0.89 to 1.00 for knowledge and menstrual hygiene practice, and from 0.78 to 1.00 for maternal support, and the S-CVI/Ave values were 0.95 for knowledge, 0.94 for maternal support, and 0.96 for menstrual hygiene practice, indicating acceptable content validity.

The validity of the construct was tested through item-total correlation analysis using the Pearson test with a calculated r-value greater than the r table (0,334) at a significance level of 0.05. The corrected item-total correlation ranged from 0.347 to 0.621 across the retained items. Exploratory factor analysis was not performed because the sample size was limited for stable factor extraction; therefore, construct validity evidence was based on item-total correlation and interpreted as preliminary. Reliability tests using Cronbach's Alpha coefficient showed good internal consistency with values greater than 0.70 on the entire scale. Cronbach's alpha values were 0.864 for knowledge, 0.769 for maternal support, and 0.872 for menstrual hygiene practice.

The qualitative instrument was a semi-structured interview guide designed to explore students' experiences related to menstrual knowledge, maternal support, and access to sanitary napkins during menstruation. The interview guide was developed from quantitative findings, the Social Ecological Model, and prior menstrual hygiene management literature. Core interview domains included understanding of menstruation, sources of menstrual information, communication with mothers, emotional and practical support, access to sanitary pads, school sanitation conditions, privacy, and sociocultural beliefs or taboos related to menstruation. Examples of guiding questions

included: “How did you first learn about menstruation?”, “What kind of help does your mother provide during menstruation?”, and “What difficulties do you experience when managing menstruation at school?”

Data Collection Procedures

Quantitative data collection was carried out through filling out questionnaires directly at school with the assistance of researchers. This assistance was carried out to ensure that respondents who are school-age children could understand each question well. To minimize social desirability bias and response conformity, questionnaire completion was conducted in a private setting without teachers or peers present. Respondents were informed that their answers were confidential, would not affect their school status, and could be skipped if they felt uncomfortable. Researcher assistance was standardized by reading neutral instructions, clarifying only the meaning of questions when needed, and avoiding prompts that could influence responses.

Qualitative data were obtained through in-depth face-to-face interviews lasting approximately 30–45 minutes in a safe and private environment. Interviews were conducted by female interviewers who had received training on interviewing minors and discussing sensitive reproductive health topics. Interviews were conducted in Sundanese language according to participant comfort. When local language was used, translation into Indonesian language was performed during transcription and checked for meaning equivalence. Interview rooms were arranged to ensure privacy, and participants were allowed to pause, skip questions, or stop the interview at any time. All interviews were recorded with the consent of the participants and then transcribed verbatim for analysis purposes.

Data Analysis

Quantitative data analysis was performed using multivariate logistic regression to identify factors associated with related to menstrual hygiene practices. The dependent variable was menstrual hygiene practice, coded as 1 = good practice and 0 = poor practice. Predictor variables included knowledge, age at menarche, menstrual-cycle regularity, maternal co-residence, maternal support, and sanitary pad availability, coded according to the operational definitions presented in the measurement table. Reference categories were defined as low knowledge, low maternal support, and unavailable sanitary pads.

Candidate variables were selected based on theoretical relevance, prior empirical evidence, and the Social Ecological Model rather than solely on bivariate p-values. Bivariate analysis was used only as preliminary information. Missing data were assessed before analysis and handled using complete-case analysis. Multicollinearity was assessed using inter-variable correlation analysis, tolerance values, and variance inflation factor (VIF). A VIF value > 10 or tolerance value < 0.10 was used to indicate problematic multicollinearity. Model fit was evaluated using the Omnibus Test of Model Coefficients, Hosmer–Lemeshow. Because the number of poor-practice outcomes was limited, the final model was kept parsimonious to reduce overfitting. Confounding was assessed using a change-in-estimate approach, in which variables were retained if their removal changed the knowledge–practice odds ratio by more than 10%. The actual percentage change in the odds ratio is reported in the Results section. Qualitative data analysis was conducted using a thematic approach. The analysis process includes the coding stage, the grouping of themes, and the interpretation of the meaning of the participants' experiences. Transcripts were read repeatedly to achieve familiarization, followed by initial coding, grouping of similar codes into categories, development of themes, and interpretation of explanatory patterns. Differences in coding were resolved through discussion and consensus to enhance dependability and confirmability. An audit trail of coding decisions, theme development, and illustrative quotations was maintained.

The integration of quantitative and qualitative results was carried out at the interpretation stage to obtain a more comprehensive understanding of the mechanisms of interaction between individual factors, family support, and resource availability in menstrual hygiene practices.

Ethical Approval

This research has been ethically reviewed and approved by the Health Research Ethics Committee of the Faculty of Public Health, University of Indonesia, under Number Ket-512/UN2.F10.D11/PPM.00.02/2025. Because the study involved minors and sensitive reproductive health topics, written parental or guardian consent and child assent were obtained before participation. Participation was voluntary, and participants were informed of their right

to withdraw at any time without academic or personal consequences. Confidentiality was maintained by using participant codes instead of names, anonymizing transcripts, and storing data securely in password-protected files accessible only to the research team. Interviews were conducted in a private and comfortable setting, and participants were allowed to decline questions or stop the interview if they felt embarrassed, uncomfortable, or distressed.

RESULTS

This study involved 83 primary school girls who had experienced menstruation. Descriptive analysis was conducted to describe the characteristics of respondents based on individual, family, and resource availability related to menstrual hygiene practices. The distribution of respondent characteristics is presented in Table 2

Table 2. The Characteristics of respondents (n=83)

Characteristics	Description	Frequency	Percentage
Classes	5	22	26.5
	6	61	73.5
Age menarche	≤ 10 th	7	8.4
	>10 th	76	91.6
Menstrual cycle	Regular	63	75.9
	Irregular	20	24.1
Maternal Co-residence	Living with mother	77	92.8
	Not living with mother	6	7.2
Sanitary pad availability	Available	71	85.5
	Not available	12	14.5
Knowledge of menstrual hygiene	High	45	54.2
	Low	38	45.8
Maternal Support	High	54	65.1
	Low	29	34.9
Menstrual Hygiene Practices	Good	59	71.1
	Not good	24	28.9

Source: Primary Data

The characteristics of the respondents showed that most participants were in grade 6, had menarche after the age of 10 years, and reported regular menstrual cycles. Most respondents lived with their mothers, and most had access to sanitary pads. The descriptive findings also showed variation in students' knowledge of menstrual hygiene and maternal support.

Bivariate analysis was performed as an initial screening stage to identify potential predictors to be incorporated into a multivariate logistic regression model. Following the methodological framework proposed by Hosmer and Lemeshow, where the $p < 0.25$ value threshold is used to prevent premature exclusion of variables that may show significant independent effects after adjusting for confounders.

Table 3. Bivariate Analysis of Factors Associated with Menstrual Hygiene Practices

Variable	Menstrual Hygiene Practices			OR	95% CI	P Value
	Not Good	Good	Total			
Classes						
5	8(36.4)	14(63.6)	22(100)	1.607	0.568-4.544	0.532
6	16(26.2)	45(73.8)	61(100)			
Age menarche						
≤ 10 th	3(42.9)	4(57.1)	7(100)	1.964	0.405-9.528	0.407
>10 th	21 (27.6)	55(72.4)	76(100)			
Menstrual cycle						
Regular	17(27)	46(73)	63(100)	1.457	0.498-4.265	0.685
Irregular	7 (35)	13(65)	20(100)			

Maternal Co-residence						
Living with mother	23(29.9)	54(70.1)	77(100)	0.470	0.052-4.245	0.667
Not living with mother	1(16.7)	5(83.3)	6(100)			
Sanitary pad availability						
Available	18(25.4)	53(74.6)	71(100)	2.944	0.842-10.293	0.096
Not available	6(50)	6(50)	12(100)			
Student knowledge						
High	3(6.7)	42(93.3)	45(100)	17.294	4.553-65.684	0.000
Low	21(55.3)	17(44.7)	38(100)			
Maternal Support						
H	11(20.4)	43(79.6)	54(100)	3.176	1.184-8.522	0.037
Low	13(44.8)	16(55.2)	29(100)			

Source: Primary Data

Of the seven variables examined, three met the criteria for inclusion in the next multivariate analysis: student knowledge of menstrual hygiene ($p < 0.001$), maternal support ($p = 0.037$), and sanitary pad availability ($p = 0.096$). Student knowledge showed the strongest association, with a substantial odds ratio ($OR = 17.29$), indicating that this factor is a major driver of hygiene practices. Maternal support also showed a statistically significant crude association, while the sanitary pad availability, although outside the conventional significance level of $p < 0.05$, was retained for further modelling due to its conceptual relevance and its p-value remaining within the selection threshold. In contrast, demographic and biological factors, including class, age at menarche, regularity of menstrual cycles, and maternal co-residence, all yielded p-values exceeding the 0.25 threshold. Therefore, these variables were not included in the final model because they were considered to have insufficient evidence of association for inclusion in the multivariable model.

Table 4. Final Multivariable Logistic Regression Model for Menstrual Hygiene Practices

Variables	OR	95% CI Lower	95% CI Upper	P-value
Knowledge	13.601	3.381	54.708	0.001*
Maternal Support	2.398	0.667	8.615	0.180
Sanitary pad availability	4.284	0.818	22.421	0.085

Source: Primary Data

The logistic regression model showed statistical evidence of overall model fit within this study sample. The Omnibus Tests of Model Coefficients showed that the model was statistically significant ($\chi^2 = 29.267$; $p < 0.001$). The Hosmer–Lemeshow test yielded a p-value of 0.748 ($p > 0.05$), indicating no statistically significant difference between observed and predicted values. The Nagelkerke R-squared value of 0.425 indicates that the variables included in the model explained 42.5% of the variability in menstrual hygiene practices. Because no formal prediction-performance assessment, such as discrimination, calibration, or external validation, was conducted, the model should be interpreted as an explanatory model within the study sample rather than as evidence of predictive validity.

In the final model selection process, confounding was assessed using a change-in-estimate approach based on the odds ratio for the association between student knowledge and menstrual hygiene practices. In the full model, the odds ratio for knowledge was 13.601. When maternal support was removed from the model, the odds ratio for knowledge increased to 17.260, representing an approximately 26.9% change. When sanitary pad availability was removed from the model, the odds ratio for knowledge increased to 15.103, representing an approximately 11.0% change. Because both changes exceeded the 10% threshold, maternal support and sanitary pad availability were retained in the final model as conceptually and statistically relevant control variables. The final model showed that knowledge was the only variable significantly associated with menstrual hygiene practices ($p = 0.001$). Students with higher levels of knowledge were 13.6 times more likely to have good menstrual hygiene practices compared to those with lower knowledge ($OR = 13.601$; 95% CI: 3.381–54.708). However, the wide confidence interval indicates considerable imprecision, likely related to the small sample size and limited number of outcome events. Therefore,

the magnitude of this association should be interpreted cautiously and should not be treated as a stable or generalizable effect estimate.

In contrast, maternal support, which showed a significant association at the bivariate stage ($p = 0.037$), was no longer statistically significant after adjustment in the multivariable model ($p = 0.180$). This finding suggests that maternal support may function more as a contextual facilitator and control variable rather than as an independent statistical predictor in the adjusted model. Meanwhile, sanitary pad availability showed a positive association with menstrual hygiene practices ($OR = 4.28$), but this association did not reach statistical significance ($p = 0.085$).

Overall, the quantitative findings indicate that student knowledge was the central factor associated with menstrual hygiene practices in this study sample. Maternal support and sanitary pad availability were not statistically significant independent predictors after adjustment, but the change-in-estimate results indicate that both variables influenced the estimated association between knowledge and practice. Therefore, they were retained in the final model as relevant control variables and should be interpreted as contextual factors that may support the application of knowledge in daily menstrual hygiene practices.

Qualitative Findings

To clarify the analytic process, interview data from 21 participants were analyzed thematically. Coding was conducted through repeated reading of transcripts, generation of initial codes, grouping of related codes, and refinement of themes. The coding process used a hybrid approach, combining concepts informed by the quantitative findings with themes emerging inductively from participants' narratives. Codes and themes were reviewed through discussion within the research team, and discrepancies in interpretation were resolved through consensus. Coding was conducted by the first author and reviewed by two members of the research team. Trustworthiness was strengthened through reflexive memoing, comparison across participant accounts, and the selection of quotations that best represented each theme.

The results of the thematic qualitative analysis revealed that menstrual hygiene practices among primary school students are shaped through the interaction between individual cognitive capacity and family-based social support. Thematic analysis further identified three main themes from the interviews: (1) knowledge as the foundation of hygienic practices, (2) maternal support as contextual facilitator in applying menstrual hygiene knowledge, and (3) availability of resources as a supporting factor rather than a primary determinant of menstrual hygiene practices. The first theme that emerges is the role of knowledge as the basis for hygienic measures. Students with a high level of knowledge demonstrate a clear understanding of the importance of maintaining cleanliness during menstruation and can translate this knowledge into daily practice. They tend to have a preventive awareness of health risks. This is reflected in the statement of one of the students as follows:

"I know that menstrual blood must be cleaned properly and pads must be changed frequently. Otherwise, you can it can become itchy or get infected with germs in that area. I usually change 4-5 times a day" (Participant 1).

In contrast, students with low knowledge tended to practice hygiene reactively, as other participants admitted: *"I only change the sanitary napkins if they feel very full or uncomfortable. I usually change 1-2 times a day" (Participant 4).*

The second theme is maternal support as a contextual facilitator. Maternal support does not directly determine hygiene practices, but plays a role in strengthening understanding and application of knowledge. In the high-support group, mothers play an active role in providing information, reminders, and practical guidance. Mothers are also central figures who remove psychological barriers such as fear and shame that often accompany menarche. In the high-support group, mothers acted as active companions, as one student revealed:

"My mother always provides sanitary napkins in my closet. If I forget, it's my mother who reminds me to change my clothes and sanitary napkins. I am not confused because there is a mother who always guides" (Participant 8).

On the other hand, in the group with low support, female students tended to experience confusion and lack confidence in managing menstruation, as stated by the following participants:

"Mothers rarely talk about this (menstruation). I just studied on my own. Sometimes I was confused if there was a lot of blood, but I was embarrassed to ask, so I just used it as it was" (Participant 15).

These findings suggest that maternal support functions as a contextual reinforcement that helps students apply menstrual hygiene knowledge more consistently in daily practice. The third theme is "Availability of resources as a supporting factor, not a major determinant". Although most schoolgirls have access to sanitary pads, their availability is not always followed by hygienic practices.

"The sanitary napkins are always there, but sometimes I forget or am too lazy to change them if they are not full" (Participant 10).

These findings suggest that material access alone is not enough to shape behavior without adequate understanding.

Overall, the thematic synthesis suggests that knowledge provides direction on what to do. In contrast, maternal support provides context and guidance on how to apply it consistently, and the sanitary pad availability serves as a reinforcing facilitator. This qualitative explanation helps clarify the quantitative findings: although maternal support was not statistically significant in the adjusted model, interviews showed that mothers acted as information sources, reminders, sanitary pad providers, and emotional mediators who reduced shame and uncertainty. Therefore, maternal support should be interpreted as a contextual mechanism that reinforces the application of knowledge, not as evidence of a causal mediation pathway.

A joint display was developed to integrate the quantitative and qualitative findings and to generate meta-inferences regarding factors associated with menstrual hygiene practices. This integration was used to clarify how the qualitative findings explained, complemented, or expanded the quantitative results.

Table 5. Joint Display and Meta-Inference of Quantitative and Qualitative Findings

Quantitative findings	Qualitative explanation	Integration pattern	Meta-inference
Student knowledge was the only statistically significant factor in the final multivariable model (OR = 13.601; 95% CI: 3.381–54.708; $p = 0.001$), although the wide confidence interval indicates imprecision.	Students with higher knowledge were able to explain the importance of cleaning menstrual blood properly and changing pads regularly. Students with lower knowledge tended to change pads only when they felt full or uncomfortable.	Convergence	Knowledge was the central factor associated with menstrual hygiene practices. It provided the cognitive basis for understanding what actions should be taken and why they were important, although the magnitude of the association should be interpreted cautiously.
Maternal support was significant in bivariate analysis but not in the multivariable model (OR = 2.398; 95% CI: 0.667–8.615; $p = 0.180$). Change-in-estimate analysis showed that removing maternal support changed the OR for knowledge by 26.9%.	Mothers provided information, reminders, sanitary pads, practical guidance, and emotional reassurance. Students with limited maternal support reported confusion, embarrassment, and hesitation to ask questions.	Complementarity	Maternal support should be interpreted as a contextual facilitator rather than an independent statistical predictor. It helped students apply menstrual hygiene knowledge more consistently through guidance, reminders, and emotional reassurance.
Sanitary pad availability showed a positive but non-significant association in the final model (OR = 4.284; 95% CI: 0.818–22.421; $p = 0.085$). Removing this variable changed the OR for knowledge by 11.0%.	Although most students had access to sanitary pads, availability alone did not always lead to regular pad changing. Some students delayed changing pads because they forgot, felt lazy, or waited until the pad felt full.	Expansion	Sanitary pad availability functioned as an enabling condition, but it was insufficient without knowledge and supportive guidance. Material access needs to be accompanied by understanding and reminders to shape hygienic practices.
knowledge remained the main associated factor, while maternal support and sanitary pad	Interviews showed that menstrual hygiene practices were shaped by the interaction of knowledge,	Integrated explanation	Menstrual hygiene practices among primary school girls are best understood as the

availability were retained as maternal guidance, emotional support, reminders, and access to pads.

result of cognitive readiness supported by interpersonal and material conditions. Improving menstrual hygiene therefore requires not only increasing students' knowledge but also strengthening maternal support and ensuring access to menstrual hygiene resources.

DISCUSSION

The findings of this study suggest that menstrual hygiene practices among primary school girls are a complex and multidimensional phenomenon, not solely determined by biological factors or resource availability, but associated with the interaction between individual cognitive capacity and interpersonal support within the family. The results of the multivariate analysis showed that knowledge was the only significant independent statistical correlate of MHM practices, while other factors, such as maternal support and sanitary pad availability, were not statistically significant when controlled for together. These findings indicate that knowledge emerged as the strongest statistical correlate in this sample; however, interpersonal and environmental factors may still shape the conditions under which knowledge can be translated into daily menstrual hygiene practices.

The absence of a significant relationship between biological factors such as age at menarche, menstrual cycle regularity, and grade level with menstrual hygiene practices indicates that biological maturation does not automatically confer behavioral preparedness. These results are consistent with the global literature, which shows that menarche, as a biological event, is not automatically followed by readiness in knowledge and skills for managing menstruation (28,29). In many contexts of low- and middle-income countries, girls often enter the menstrual phase with inadequate information, so that even though they are biologically ready, they do not yet have the capacity to implement optimal hygiene practices (30,31). This reinforces the argument that biological readiness is not synonymous with behavioral readiness and supports the need for menstrual health education before menarche, particularly at the primary school level.

Furthermore, the absence of a relationship between the family structure in terms of living with the mother and the practice of menstrual hygiene suggests that the existence of the mother figure is structurally insufficient to influence the behavior of the child. This finding should be interpreted as a distinction between maternal co-residence and functional maternal support. Merely living with one's mother is not necessarily equivalent to receiving active menstrual guidance, emotional reassurance, practical assistance, or normative support in managing menstruation. More decisive is the quality of functional interaction between mother and child, especially in the form of open communication, practical guidance, and emotional support. These findings align with the Social Support theory, which emphasizes that the quality of support is more important than the mere existence of a support source (32).

Knowledge emerged as a key statistical correlate of menstrual hygiene practices, with high and consistent association strength at all stages of analysis. These findings suggest that knowledge is the cognitive foundation that enables individuals to understand the importance of hygienic practices and the consequences of improper practices. This aligns with studies showing that low menstrual health literacy is one of the main obstacles to the implementation of good hygiene practices (33). Therefore, knowledge should not be interpreted as sufficient by itself, but rather as a central behavioral driver whose practical enactment depends on enabling interpersonal, material, and environmental conditions.

Globally, many adolescent girls face their first period without adequate knowledge, leading to fear, confusion, and uncertainty in managing menstruation (28,29). Nevertheless, the literature also shows that knowledge does not always automatically translate into practice. The mismatch between knowledge and practice is often caused by social and structural factors that limit the application of knowledge in daily life (34). Meta-analyses show that despite increasing knowledge, inadequate menstrual hygiene practices remain prevalent, including the frequency of pad changes and the use of unhygienic absorbent materials (35,36).

In the context of this study, the qualitative findings make it clear that knowledge functions as "what to do", but its implementation is strongly influenced by interpersonal factors. Maternal support in this study was not statistically significant in the adjusted quantitative model; however, the qualitative findings suggest that it may function as an enabling interpersonal condition that helps girls apply menstrual knowledge in daily practice. This interpretation should be understood as a qualitative and theoretically plausible explanation, not as evidence of statistical mediation. Qualitative findings show that mothers serve as the main source of information, providers of practical guidance, and figures who normalize the menstrual experience. This role helps reduce psychological barriers such as shame and fear, as well as increase children's confidence in managing menstruation. This aligns with the Social Ecological Model, which considers interpersonal factors an important component in the formation of health behaviors (2).

Several studies have also shown that communication between mothers and daughters significantly improves menstrual hygiene practices. Mothers not only transfer information, but also help translate that knowledge into contextual and culturally relevant practices (37). In addition, open communication can reduce stigma and increase children's comfort in talking about menstruation. However, the findings of the present study also need to be interpreted alongside studies emphasizing stronger roles of WASH infrastructure, affordability of menstrual products, school privacy, menstrual stigma, and caregiver communication. Thus, the prominence of knowledge in this study may reflect the specific Garut context, the structure of the measurement instrument, or broader empirical patterns in which cognitive readiness interacts with social and environmental constraints.

The availability of sanitary pad in this study showed a positive but nonsignificant trend towards improved menstrual hygiene practices. These findings align with the global literature, which suggests that providing menstrual products alone is not sufficient to produce sustained behavioral change (22,38). Quantitatively, this variable was not statistically significant in the adjusted model; therefore, it should not be interpreted as a demonstrated independent effect. Without adequate understanding and strong social support, access to resources is not always optimally utilized.

In addition, environmental factors such as limited sanitation facilities, lack of privacy, and restrictive social norms can also be obstacles in the implementation of menstrual hygiene practices (39,40). These factors may explain why knowledge, although statistically prominent, may still be constrained in practice by material and social conditions. At the same time, alternative explanations should be considered. The strong association between knowledge and practice may partly reflect overlap between knowledge and practice items, social desirability in self-reported responses, reverse association in which girls with better hygiene practices report higher knowledge, or unmeasured family, school, and socioeconomic factors.

Overall, these findings are consistent with multilevel behavioral theories, which emphasize that menstrual hygiene practices are shaped by the interaction of individual, interpersonal, and environmental factors rather than by a single determinant. Thus, the main contribution of this study is not to claim that knowledge alone determines menstrual hygiene behavior, but to show that knowledge is the strongest statistical correlate in this sample, while maternal support, sanitary pad availability, and school environmental conditions may influence whether that knowledge can be consistently enacted in daily menstrual hygiene practices.

Limitations

This study has important methodological limitations that should be considered when interpreting the findings. First, the cross-sectional design limits the ability to establish temporality and precludes causal inference; therefore, the observed associations should not be interpreted as evidence that knowledge, maternal support, or sanitary pad availability directly causes menstrual hygiene practices. Second, the relatively small sample size and sparse outcome events may have reduced statistical power and contributed to wide confidence intervals, thereby limiting the precision and stability of the estimates. Third, purposive school selection from ten schools in one district limits the generalizability of the findings to other geographic, school, and sociocultural settings. Fourth, menstrual hygiene practices were measured using self-reported questionnaires, which may be affected by recall bias and social desirability bias, particularly because menstruation remains a sensitive topic. Researcher-assisted questionnaire completion may also have influenced participants' responses, potentially inflating estimates of good practice. Fifth, insufficiently specified measurement cut-offs may weaken construct validity and should be refined in future studies. Sixth, although the findings and qualitative interpretation suggest a possible pathway through which knowledge may

be translated into practice with support from mothers and available resources, this study did not conduct formal mediation analysis; therefore, mediation cannot be statistically confirmed. The qualitative component was primarily guided by variables identified in the multivariate analysis, which limited the exploration of other potential factors influencing menstrual hygiene practices. As a result, the thematic findings should be interpreted as explanatory and contextual rather than as a complete account of all determinants of menstrual hygiene practices.

Recommendations and Implications

In practice, the results of this study suggest that effective menstrual health interventions should not rely only on knowledge improvement or facility provision. Intervention programs need to be designed comprehensively by integrating early reproductive health education, before menarche active involvement of families, especially mothers, and the provision of a supportive environment. Attention should also be maintained on sanitary pad availability and school sanitation, because these factors may facilitate the enactment of knowledge into daily menstrual hygiene practice. This approach aligns with meta-analysis findings showing that multicomponent interventions are more effective at improving menstrual hygiene practices than single interventions (35,41) (However, these implications should be interpreted as recommendations supported by the present exploratory findings and broader literature, rather than as intervention effects demonstrated by the current study.

Future research is recommended to use longitudinal or experimental designs to better examine causal relationships and to formally test mediation mechanisms between knowledge, maternal support, and behavioral outcomes. Future studies should also evaluate family-school-based interventions that begin before menarche, involve mothers or female caregivers, and incorporate school sanitation and sanitary pad availability as contextual components. Expanding the study population to different socio-cultural geographic, and school settings is also necessary to enhance generalizability. Larger studies with adequate outcome events, clearer measurement thresholds, and formal testing of mediation pathways are needed to determine whether the proposed mechanisms hold across different populations.

CONCLUSION

This study shows that, in this sample of primary school girls, knowledge was the only variable independently associated with reported menstrual hygiene practice in the multivariable model. Meanwhile, maternal support and the availability of sanitary pad did not show a statistically significant direct effect; however, the qualitative findings and conceptual interpretation suggest that these factors may facilitate the translation of knowledge into daily practice. These findings suggest that menstrual hygiene behaviors are shaped by the interaction among individual capacity, interpersonal support, and environmental context, with knowledge as an important associated factor. Importantly, these results highlight that improving knowledge alone may be insufficient without supportive social and environmental conditions that enable its practical application.

The policy implications of these should be framed cautiously because the study was conducted in ten schools within one district and did not test an intervention effect. Menstrual health education should be strengthened from the pre-menarche stage through integration into school curricula, while also actively involving mothers or female caregivers as key actors in the learning and mentoring process. In addition, adequate sanitation facilities remain essential, but should be complemented by educational and social interventions to ensure sustainable behavior change. An integrated, multi-sectoral approach involving education, health systems, and family engagement may help strengthen menstrual hygiene practices among young adolescents, but further longitudinal and intervention studies are needed to confirm its effectiveness across broader settings.

AUTHOR CONTRIBUTION STATEMENT

All authors contributed significantly to this study. R.D.Y. conceptualized the study, developed the research design, conducted data collection, performed data analysis, and drafted the manuscript. S.P., A.K., and E.H. contributed to the study design, supervised the research process, and critically reviewed the manuscript. L.S. assisted in data collection and manuscript preparation. All authors reviewed and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest related to this study. The authors have no financial or personal relationships with any individuals or organizations that could inappropriately influence or bias the content of this research. This statement ensures the integrity, objectivity, and transparency of the study.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

The authors declare that generative artificial intelligence (AI) tools were used solely to support language refinement, improve clarity, and enhance the overall readability and structure of the manuscript. The use of these tools did not replace the authors' intellectual contribution, including study design, data analysis, interpretation of findings, and the development of scientific content. All content remains the responsibility of the authors, who have reviewed and approved the final manuscript.

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BIBLIOGRAPHY

1. Babbar K, Martin J, Ruiz J, Parray AA, Sommer M. Menstrual health is a public health and human rights issue. *The Lancet Public Health*. 2022;7(1):e10–e11. DOI: [https://doi.org/10.1016/S2468-2667\(21\)00212-7](https://doi.org/10.1016/S2468-2667(21)00212-7)
2. UNICEF. Guidance for Monitoring Menstrual Health and Hygiene (Version 1) [Internet]. Poirier P, editor. New York: UNICEF; 2020 [cited 2023 Mar 10]. Available from: <https://www.unicef.org/media/85461/file/MHM-Monitoring-Resource.pdf>
3. Hennegan J, Winkler IT, Bobel C, Keiser D, Hampton J, Larsson G, et al. Menstrual health: a definition for policy, practice, and research. *Sexual and Reproductive Health Matters*. 2021;29(1):1911618. DOI: <https://doi.org/10.1080/26410397.2021.1911618>
4. UNICEF, WHO. Progress on Drinking Water, Sanitation and Hygiene in Schools 2015–2023: Special Focus on Menstrual Health. New York: United Nations Children's Fund and World Health Organization; 2024.
5. Daher A, Albaini O, Siff L, Farah S, Jallad K. Intimate hygiene practices and reproductive tract infections: A systematic review. *Gynecology and Obstetrics Clinical Medicine*. 2022;2(3):129–135. DOI: <https://doi.org/10.1016/j.gocm.2022.06.001>
6. Das P, Baker KK, Dutta A, Swain T, Sahoo S, Das BS, et al. Menstrual hygiene practices, WASH access and the risk of urogenital infection in women from Odisha, India. *PLoS One*. 2015;10(6):e0130777. DOI: <https://doi.org/10.1371/journal.pone.0130777>
7. Bhandari K, Dahal R, Paudel YR. Evaluating menstrual hygiene practices and school absenteeism among adolescent girls in Lumbini Province, Nepal. *International Journal of Health Sciences and Research*. 2024;14(5):144–154. DOI: <https://doi.org/10.52403/ijhsr.20240516>
8. Long JL, Haver J, Mendoza P, Kotasek SMV. The more you know, the less you stress: Menstrual health literacy in schools reduces menstruation-related stress and increases self-efficacy for very young adolescent girls in Mexico. *Frontiers in Global Women's Health*. 2022;3:859797. DOI: <https://doi.org/10.3389/fgwh.2022.859797>

9. MacLean K, Hearle C, Ruwanpura KN. Stigma of staining? Negotiating menstrual taboos amongst young women in Kenya. *Women's Studies International Forum*. 2020;78:102290. DOI: <https://doi.org/10.1016/j.wsif.2019.102290>
10. Shah V, Phillips-Howard P, Hennegan J, Cavill S, Sonko B, Sinjanka E, et al. Puberty health intervention to improve menstrual health and school attendance among adolescent girls in The Gambia: Study methodology of a cluster-randomised controlled trial in rural Gambia (MEGAMBO Trial). *Emerging Themes in Epidemiology*. 2022;19(1):8. DOI: <https://doi.org/10.1186/s12982-022-00114-x>
11. Anbesu EW, Asgedom DK. Menstrual hygiene practice and associated factors among adolescent girls in sub-Saharan Africa: A systematic review and meta-analysis. *BMC Public Health*. 2023;23(1):33. DOI: <https://doi.org/10.1186/s12889-022-14942-8>
12. Sharma M, Sharma K, Bista AP, Subedi S, Lamichhane S. Knowledge on menstruation and menstrual hygiene practices among adolescent girls of selected schools, Chitwan. *Journal of Chitwan Medical College*. 2020;10(1):69–73. DOI: <https://doi.org/10.54530/jcmc.151>
13. Davis J, Macintyre A, Odagiri M, Suriastini W, Cordova A, Huggett C, et al. Menstrual hygiene management and school absenteeism among adolescent students in Indonesia: Evidence from a cross-sectional school-based survey. *Tropical Medicine and International Health*. 2018;23(12):1350–1363. DOI: <https://doi.org/10.1111/tmi.13159>
14. UNICEF. *Menstrual Hygiene Management in Indonesia*. Jakarta: UNICEF Indonesia; 2015.
15. Wihdaturrahmah, Chuemchit M. Determinants of menstrual hygiene among adolescent school girls in Indonesia. *International Journal of Women's Health*. 2023;15:943–954. DOI: <https://doi.org/10.2147/IJWH.S400224>
16. Badan Pusat Statistik (BPS). *Survei Demografi dan Kesehatan Indonesia 2017*. Jakarta: BPS; 2018.
17. Badan Pusat Statistik Kabupaten Garut. *Kabupaten Garut Dalam Angka 2025*. Garut: BPS Kabupaten Garut; 2025.
18. Kementerian Pendidikan Dasar dan Menengah Republik Indonesia. *Profil Sanitasi Sekolah Dasar*. Jakarta: Kemendikdasmen; 2025.
19. Solehati T, Trisyani M, Kosasih CE. Gambaran pengetahuan, sikap, dan keluhan tentang menstruasi di antara remaja putri. *Jurnal Keperawatan Komprehensif (Comprehensive Nursing Journal)*. 2018;4(2):86–91. DOI: <https://doi.org/10.33755/jkk.v4i2.110>
20. Suazini ER. Persepsi remaja mengenai nasehat reproduksi pada saat mengalami menarche di Garut. *Jurnal Medika Cendikia*. 2019;6(1):9–20. DOI: <https://doi.org/10.33482/medika.v6i01.97>
21. Hussein J, Gobena T, Gashaw T. The practice of menstrual hygiene management and associated factors among secondary school girls in Eastern Ethiopia: The need for water, sanitation, and hygiene support. *Women's Health*. 2022;18:17455057221087871. DOI: <https://doi.org/10.1177/17455057221087871>
22. Uwadia RC, Oloruntoba EO, Wada OZ, Aluko OO. Menstrual hygiene management inequalities among school girls in Badagry, Nigeria. *Tropical Medicine and International Health*. 2022;27(11):970–980. DOI: <https://doi.org/10.1111/tmi.13817>
23. Ssemata AS, Ndekezi D, Kansime C, Bakanoma R, Tanton C, Nelson KA, et al. Understanding the social and physical menstrual health environment of secondary schools in Uganda: A qualitative methods study. *PLOS Global Public Health*. 2023;3(11):e0002665. DOI: <https://doi.org/10.1371/journal.pgph.0002665>
24. Ene N, Bolarinwa OA, Adedigba C, Oyeleye J, Boboye I, Nwosu U, et al. “If I use pad, I feel comfortable and safe”: A mixed-method analysis of knowledge, attitude, and practice of menstrual hygiene management among in-school adolescent girls in a Nigerian city. *BMC Public Health*. 2024;24(1). DOI: <https://doi.org/10.1186/s12889-024-19256-5>
25. Mulugeta Demmu Y, Shifera GM, Ayana GM, Adare D, Yazew B, Damtew YT, et al. Menstrual hygiene management and associated factors among adolescent school girls in Gursum District, Eastern Ethiopia: Institution-based cross-sectional study. *BMC Women's Health*. 2023;23(1). DOI: <https://doi.org/10.1186/s12905-023-02461-6>
26. Kementerian Kesehatan Republik Indonesia. *Survei Kesehatan Indonesia 2023*. Jakarta: Kemenkes RI; 2023.

27. Badan Kependudukan dan Keluarga Berencana Nasional (BKKBN). Survei Kinerja dan Akuntabilitas Program KKBPK (SKAP) Remaja Tahun 2019. Jakarta: BKKBN; 2019.
28. Coast E, Lattof SR, Strong J. Puberty and menstruation knowledge among young adolescents in low- and middle-income countries: A scoping review. *International Journal of Public Health*. 2019;64(2):293–304. DOI: <https://doi.org/10.1007/s00038-019-01209-0>
29. Plesons M, Patkar A, Babb J, Balapitiya A, Carson F, Caruso BA, et al. The state of adolescent menstrual health in low- and middle-income countries and suggestions for future action and research. *Reproductive Health*. 2021;18(1):1. DOI: <https://doi.org/10.1186/s12978-021-01082-2>
30. Haider R. Mapping the expertise and understanding of menarche, menstrual hygiene, and menstrual health among adolescent girls in low- and middle-income countries. *International Journal of Integrative Sciences*. 2023;2(7):995–1014. DOI: <https://doi.org/10.55927/ijis.v2i7.4395>
31. Shah V, Nabwera HM, Sosseh F, Jallow Y, Comma E, Keita O, et al. A rite of passage: A mixed methodology study about knowledge, perceptions and practices of menstrual hygiene management in rural Gambia. *BMC Public Health*. 2019;19(1):277. DOI: <https://doi.org/10.1186/S12889-019-6599-2>
32. Uchino BN. Social support and health: A review of physiological processes potentially underlying links to disease outcomes. *Journal of Behavioral Medicine*. 2006;29(4):377–387. DOI: <https://doi.org/10.1007/s10865-006-9056-5>
33. Maimunah, Deviyanti WR. Faktor-faktor yang berhubungan dengan pengetahuan remaja putri kelas XI tentang personal hygiene saat menstruasi untuk mencegah keputihan. *Jurnal Antara Kebidanan*. 2019;2(1):10–15. DOI: <https://doi.org/10.37063/ak.v2i1.31>
34. Holmes K, Curry C, Sherry, Ferfolja T, Parry K, Smith C, et al. Adolescent menstrual health literacy in low-, middle- and high-income countries: A narrative review. *International Journal of Environmental Research and Public Health*. 2021;18(5):2260. DOI: <https://doi.org/10.3390/ijerph18052260>
35. Majeed J, Sharma P, Ajmera P, Dalal K. Menstrual hygiene practices and associated factors among Indian adolescent girls: A meta-analysis. *Reproductive Health*. 2022;19(1):148. DOI: <https://doi.org/10.1186/s12978-022-01453-3>
36. Khound M, Bhattacharyya H, Ghosh S. Menstruation and menstrual hygiene: Analyzing the gaps in knowledge, perception and practices in a rural area of North East India. *Indian Journal of Community Medicine*. 2025;50(5):849–853. DOI: https://doi.org/10.4103/ijcm.ijcm_513_24
37. Parle J, Khatoon Z. Knowledge, attitude, practice and perception about menstruation and menstrual hygiene among adolescent school girls in rural areas of Raigad District. *International Journal of Community Medicine and Public Health*. 2019;6(6):2490–2495. DOI: <https://doi.org/10.18203/2394-6040.ijcmph20192310>
38. Palgunadi NPGS, Wesnawa IGA, Sudiana IK. I bring home my used menstrual pad: Water, sanitation, hygiene, and menstrual hygiene management in middle schools with limited sanitation access. *Edunity: Kajian Ilmu Sosial dan Pendidikan*. 2024;3(11):1052–1063. DOI: <https://doi.org/10.57096/edunity.v3i11.330>
39. Barrington DJ, Robinson HJ, Wilson E, Hennegan J. Experiences of menstruation in high-income countries: A systematic review, qualitative evidence synthesis and comparison to low- and middle-income countries. *PLoS One*. 2021;16(7):e0255001. DOI: <https://doi.org/10.1371/journal.pone.0255001>
40. Njee RM, Imeda CP, Ali SM, Mushi AK, Mbata DD, Kapala AW, et al. Menstrual health and hygiene knowledge among post-menarche adolescent school girls in urban and rural Tanzania. *PLoS One*. 2024;19(3):e0284072. DOI: <https://doi.org/10.1371/journal.pone.0284072>
41. Yang YT, Chen DR. Effectiveness of a menstrual health education program on psychological well-being and behavioral change among adolescent girls in rural Uganda. *Journal of Public Health in Africa*. 2023;14(3). DOI: <https://doi.org/10.4081/jphia.2023.1971>