

Effectiveness of health belief model-based reproductive health education on menarche preparedness: A systematic review

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Abstract

Background: Menarche preparedness is an important component of adolescent reproductive health because inadequate knowledge, negative perceptions, and anxiety may hinder girls' ability to adapt to their first menstruation. Health education based on the Health Belief Model (HBM) has been increasingly used to improve adolescent readiness by addressing beliefs, perceptions, and preventive behaviors related to reproductive health.

Objective: This systematic review aimed to evaluate the effectiveness of HBM-based reproductive health education on menarche preparedness among adolescent girls.

Methods: Literature searches were conducted in ProQuest, Scopus, ScienceDirect, and SAGE Journals, with additional searching through grey literature and reference lists. The search covered publications from 2015 to 2025 in English and Indonesian. Eligible studies included quantitative intervention studies examining HBM-based reproductive health education in relation to menarche preparedness or closely related outcomes among adolescent girls. Data were extracted using a structured form and synthesized narratively because of heterogeneity in study design, intervention format, and outcome measures.

Results: A total of 30,651 records were identified, of which 42 studies met the eligibility criteria for inclusion. The reviewed evidence consistently showed that HBM-based reproductive health education improved menstrual knowledge, increased positive attitudes, reduced anxiety, and enhanced emotional and behavioral readiness for menarche. Several studies also demonstrated improved menstrual hygiene practices and stronger preparedness when family support and culturally sensitive approaches were incorporated. Although the included studies varied in design and measurement, the overall direction of evidence indicated a beneficial effect of HBM-based educational interventions on adolescent girls' preparedness for menarche.

Conclusion: HBM-based reproductive health education is effective in improving adolescent girls' preparedness for menarche across cognitive, emotional, and behavioral domains. The integration of theory-based, culturally appropriate, and family-supported educational strategies into school and community health programs may strengthen adolescent reproductive health outcomes.

Background

Menarche is a critical milestone in female adolescence because it marks the beginning of reproductive maturity and introduces new physical, emotional, and behavioral challenges that require adequate preparation through health education (Rizkia et al., 2019; Rakkini & Hema, 2023). Many adolescent girls still enter menarche with limited knowledge, fear, confusion, and negative emotional responses, which may affect their readiness to manage menstruation appropriately in everyday life (Rizkia et al., 2019; Mohammed & Larsen-Reindorf, 2020). Inadequate menstrual knowledge also interacts with sociocultural restrictions and poor menstrual hygiene practices, which can create additional barriers to healthy adaptation during early reproductive development (Mohammed & Larsen-Reindorf,

2020; Jahan et al., 2024). Schools and families often provide fragmented reproductive health information, so many girls remain insufficiently prepared for their first menstrual experience despite the importance of timely education (Rakkini & Hema, 2023; Tsuda & Takada, 2024). This condition indicates that menarche preparedness should be understood not only as knowledge acquisition but also as a multidimensional outcome involving perception, confidence, and behavioral readiness before menarche occurs (Rizkia et al., 2019; Barkhordari-Sharifabad et al., 2020).

Reproductive health education has been widely recognized as an effective strategy to improve adolescent girls' understanding of puberty, menstruation, and self-care practices during early reproductive transitions (Saputra et al., 2024; Je et al., 2025). Educational interventions that address puberty health concepts have

shown positive effects on awareness, health practices, and psychosocial adjustment among adolescents in different settings (Barkhordari-Sharifabad et al., 2020; Eghbal et al., 2023). Comprehensive menstrual health education also contributes to better menstrual hygiene management and may reduce school absenteeism by strengthening girls' capacity to respond to menstruation in a practical and informed manner (Jahan et al., 2024; Tsuda & Takada, 2024). In addition, reproductive health education supports adolescents in understanding related reproductive problems, including vaginal discharge, anemia, and dysmenorrhea, which frequently accompany menstrual and pubertal experiences (Astriana et al., 2025; Heriani, 2025; Destiana et al., 2025). These findings suggest that educational preparation before or around menarche has substantial value for adolescent reproductive health promotion and for preventing avoidable distress during puberty (Eghbal et al., 2023; Je et al., 2025).

Although health education is important, the effectiveness of educational programs often depends on the theoretical framework that guides the intervention design, message delivery, and behavioral targets (Mohammadkhah et al., 2022; Khalilzadeh et al., 2023). The Health Belief Model provides a useful framework because it explains health behavior through perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy, which are all relevant to adolescent reproductive health learning (Barkhordari-Sharifabad et al., 2020; Eghbal et al., 2023). HBM-based educational interventions have improved puberty health concepts, body image, and health-related lifestyle behaviors among adolescent girls, which indicates that this model may strengthen preparedness for menarche through cognitive and motivational pathways (Barkhordari-Sharifabad et al., 2020; Khalilzadeh et al., 2023).

Similar benefits have also been reported in mobile-based puberty education for adolescent boys and in reproductive health promotion programs for late adolescent women, which further supports the adaptability of theory-based approaches across reproductive health contexts (Salahshouri et al., 2024; Je et al., 2025). Therefore, HBM-based reproductive health education deserves closer examination

as a potentially effective approach for preparing girls to face menarche with better knowledge, confidence, and behavioral readiness (Eghbal et al., 2023; Salahshouri et al., 2024).

Evidence from other areas of women's health also strengthens the argument for using HBM-based interventions because this model has produced favorable outcomes in breast self-examination, oral health, and pregnancy-related preventive behavior (Saputra et al., 2024; Altunkurek et al., 2026; El Maghawry, 2022). HBM-based education has increased awareness, beliefs, and health practices among women and adolescent girls in breast health promotion programs, which demonstrates the model's ability to influence both perception and action (Saputra et al., 2024; Altunkurek et al., 2026; Mahar et al., 2026). In oral and dental health research, HBM-guided interventions have improved self-care behavior among school-aged girls and pregnant women through structured educational content that targets risk perception and preventive benefits (Mohammadkhah et al., 2022; Nickbin Poshtamsary et al., 2020; Kheirandish et al., 2026).

Studies on pregnancy care also show that behavior change models can support preventive practices in maternal health when educational messages align with perceived vulnerability and expected outcomes (Bashirian et al., 2023; Chen et al., 2026; Al Agili & Khalaf, 2023). This broader evidence base suggests that HBM may be a robust framework for reproductive health education on menarche preparedness, yet the available findings remain dispersed across populations, interventions, and outcomes (Altunkurek et al., 2026; Bashirian et al., 2023; Je et al., 2025).

Despite growing interest in adolescent reproductive health education, the current evidence on the effectiveness of HBM-based reproductive health education specifically for menarche preparedness has not been synthesized comprehensively in a focused review (Rizkia et al., 2019; Eghbal et al., 2023). Existing studies often examine puberty health, menstrual hygiene, premenstrual symptoms, or general reproductive health promotion, but they do not always isolate menarche preparedness as a distinct outcome of educational intervention (Barkhordari-Sharifabad et al., 2020; Khalilzadeh et al., 2023; Je et al., 2025). In addition, differences in intervention format,

participant age, setting, and measured outcomes make it difficult for researchers and practitioners to determine which educational characteristics are most relevant for promoting preparedness before first menstruation (Tsuda & Takada, 2024; Salahshouri et al., 2024). A systematic review is therefore needed to integrate the available evidence, identify patterns of effectiveness, and clarify the contribution of HBM constructs to reproductive health education for adolescent girls (Singh et al., 2026; Yao et al., 2024). Such synthesis will be valuable for educators, nurses, and school health professionals who need evidence-based guidance to design developmentally appropriate and theory-driven interventions for girls approaching menarche (Akbar, 2024; Eghbal et al., 2023).

Based on these considerations, this review positions menarche preparedness as an important reproductive health outcome that requires structured, theory-based educational support during adolescence (Rizkia et al., 2019; Mohammed & Larsen-Reindorf, 2020). The Health Belief Model offers a promising conceptual basis for strengthening adolescent readiness because it links beliefs, motivation, and preventive action within a coherent behavioral framework (Barkhordari-Sharifabad et al., 2020; Eghbal et al., 2023). However, the absence of a focused synthesis creates uncertainty regarding the overall effectiveness of HBM-based reproductive health education on menarche preparedness and the intervention components that may contribute most strongly to positive outcomes (Khalilzadeh et al., 2023; Je et al., 2025).

Therefore, the aim of this systematic review is to evaluate the effectiveness of Health Belief Model-based reproductive health education on menarche preparedness among adolescent girls and to synthesize the available evidence on its impact across educational contexts and outcome domains.

Methods

Study Design

This study employed a systematic review design to examine the effectiveness of Health Belief Model (HBM)-based reproductive health education on menarche preparedness among adolescent girls. The review was designed and

reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guideline, which is recommended by the EQUATOR Network for the transparent and rigorous reporting of systematic reviews. The use of a systematic review design was considered appropriate because the topic required the integration of findings from multiple primary studies in order to generate a comprehensive and evidence-based understanding of how HBM-based educational interventions influence readiness for menarche. This approach also enabled the reviewers to apply explicit and reproducible procedures for searching, selecting, appraising, and synthesizing the available literature. A review protocol was developed before the review process began to guide each methodological step, including the formulation of the research question, eligibility criteria, literature search, study selection, data extraction, quality appraisal, and synthesis strategy. The protocol-based approach was intended to strengthen methodological consistency, reduce subjective decision-making during the review process, and improve the scientific accountability of the findings.

Research Question

The review was guided by a focused research question developed to explore whether reproductive health education based on the Health Belief Model is effective in improving menarche preparedness among adolescent girls. The question was formulated to capture the intervention of interest, the target population, and the expected outcomes. In conceptual terms, the population in this review consisted of adolescent girls who were approaching menarche or were in the early phase of pubertal transition, while the intervention consisted of educational programs explicitly developed using the Health Belief Model as the theoretical basis. The primary outcome was menarche preparedness, which could include cognitive, emotional, and behavioral readiness to face first menstruation. Secondary outcomes included knowledge related to menstruation and puberty, anxiety or fear associated with menarche, and preventive health behaviors relevant to menstrual and

reproductive well-being, such as anemia prevention. This research question was formulated because menarche preparedness is a multidimensional construct that may be influenced by belief-based education through changes in perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy. By focusing the review question in this way, the study was able to examine not only whether the intervention worked, but also how the reported outcomes reflected the behavioral logic of the HBM framework.

Inclusion and Exclusion Criteria

The eligibility criteria were defined a priori to ensure that only studies relevant to the review objective were included in the analysis. Studies were included if they were original quantitative intervention studies, particularly quasi-experimental designs, that examined the effectiveness of HBM-based reproductive health education in relation to menarche preparedness or closely related outcomes. Eligible studies had to be published in either English or Indonesian between 2015 and 2025, and the full text had to be accessible so that the methodology and findings could be assessed comprehensively. The target population was adolescent girls, as this population directly corresponds to the phenomenon of interest, namely preparation for first menstruation and adaptation to pubertal changes.

The review included studies that measured outcomes such as menarche readiness, menstrual knowledge, anxiety related to menarche, and preventive behaviors associated with adolescent reproductive health, provided that these outcomes were clearly linked to an HBM-based educational intervention. Studies were excluded if they were editorials, opinion papers, theses, dissertations, case reports, conference abstracts without sufficient data, or other forms of non-research publication. Articles were also excluded if they did not specifically address HBM-based education, did not focus on the context of menarche or adolescent reproductive health preparedness, or lacked full-text availability. These criteria were established to enhance conceptual

relevance, methodological comparability, and the overall validity of the synthesis.

Search Strategy

A systematic literature search was conducted across major electronic databases to identify relevant studies. The databases used in this review were ProQuest, Scopus, ScienceDirect, and SAGE Journals, selected because they provide broad coverage of health sciences, nursing, behavioral health, and educational intervention research. The search strategy used a combination of controlled vocabulary and free-text keywords to maximize retrieval sensitivity while maintaining topical specificity. The main search terms included “Health Belief Model,” “reproductive health education,” “menarche readiness,” and “adolescent girls.”

These terms were combined using Boolean operators such as AND and OR to structure the search logic according to the indexing format of each database. In databases that support subject headings or structured indexing, the search incorporated terms analogous to Medical Subject Headings where appropriate, while in Scopus and other multidisciplinary databases, keyword combinations were entered as free-text search strings. The search was limited to studies published from 2015 to 2025 in order to capture contemporary evidence and reflect current educational and adolescent health contexts.

The search was also restricted to articles published in English and Indonesian and to studies with full-text access, because full methodological appraisal and data extraction required access to the complete report. The final search was conducted in June 2025 to ensure that the review included the most recent studies available within the selected time frame. In addition to database searching, supplementary searching was performed through grey literature sources available in ProQuest and by manually screening the reference lists of included articles. This additional step was important to reduce the possibility of missing relevant studies that were not retrieved through database indexing alone.

Study Selection Process

The study selection process followed the PRISMA 2020 flow structure and was conducted in several sequential stages to ensure transparency and methodological rigor. First, all records identified through database searching and additional sources were compiled into a reference management system. A total of 30,651 records were identified in the initial search. Duplicate records were then removed before the title and abstract screening stage, leaving 25,602 records for preliminary assessment. During title and abstract screening, studies that were clearly unrelated to the review topic, did not involve HBM-based education, did not focus on adolescent reproductive health, or did not represent original intervention research were excluded. The remaining 5,049 articles proceeded to full-text assessment, where each article was examined in detail against the predefined inclusion and exclusion criteria. Following full-text review, 42 studies were found to meet the eligibility criteria and were included in the final systematic review. To minimize selection bias, the screening process was conducted independently by two reviewers. Each reviewer evaluated titles, abstracts, and full texts separately using the same eligibility framework. When disagreements occurred, these were resolved through discussion and consensus until a final agreement was reached. This multi-stage and independent selection procedure was intended to improve reliability, reduce subjective judgment, and ensure that the final sample of studies accurately reflected the review objective (See Figure 1).

Quality Appraisal

The methodological quality of the included studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist, with the specific checklist chosen according to the design of each included study. The JBI tools were selected because they are widely used in evidence synthesis and provide structured criteria for evaluating methodological rigor, internal validity, and the risk of bias across different study designs. The appraisal focused on several important domains, including the clarity of the study question, appropriateness of

the research design, adequacy of participant selection, validity and reliability of measurement methods, completeness of outcome reporting, and the handling of confounding factors or methodological limitations.

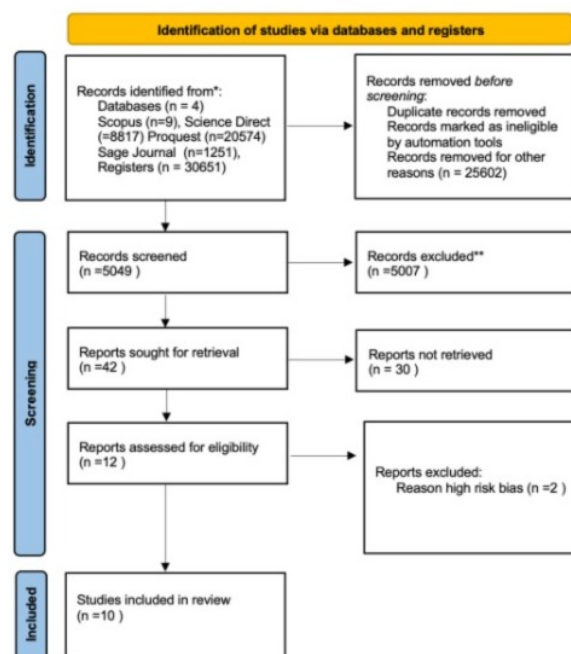


Figure 1. PRISMA flowchart of the article selection process in a systematic review

The quality appraisal was conducted independently by two reviewers in order to enhance consistency and reduce the influence of individual interpretation. Studies were not excluded solely on the basis of quality score; however, the appraisal findings were taken into account during data interpretation and synthesis. This means that studies with stronger methodological quality were given greater interpretive weight when drawing conclusions, while limitations in weaker studies were acknowledged in the discussion of the evidence. The purpose of this appraisal process was not only to identify bias, but also to improve the credibility of the final conclusions by ensuring that the synthesis was grounded in a critical assessment of the available evidence.

Data Extraction and Synthesis

Data from all included studies were extracted using a structured data extraction form developed specifically for this review. The

extraction form was designed to capture key information systematically and consistently across studies. The extracted items included study characteristics such as author, year of publication, country, and research design; participant characteristics such as age group, sample size, and setting; intervention characteristics such as educational content, duration, delivery method, and HBM constructs applied; outcome variables such as menarche preparedness, knowledge, anxiety, and preventive behaviors; measurement instruments; and the main findings reported in each study. Two reviewers conducted the extraction process independently to minimize error and bias. Any inconsistencies in the extracted data were discussed until consensus was achieved. For data synthesis, the review used a narrative and integrative approach because the included studies were expected to vary in terms of design, intervention format, outcome measures, and reporting style. Quantitative findings were summarized narratively by presenting the direction and magnitude of effects, including effect sizes such as odds ratios or mean differences when reported, along with 95% confidence intervals where available. Because of the anticipated methodological and clinical heterogeneity across studies, statistical meta-analysis was not prioritized as the primary synthesis method. Instead, the review emphasized comparative interpretation of intervention effects across studies. Where relevant, findings were grouped according to outcome domains and HBM-related mechanisms to identify recurring patterns. This synthesis strategy was chosen to provide a comprehensive understanding of how HBM-based reproductive health education influences adolescent girls' preparedness for menarche across different educational contexts, populations, and intervention models.

Results

A total of 30,651 records were identified through database searching and supplementary searching procedures. After duplicate removal, 25,602 records remained for title and abstract screening, and 5,049 articles were assessed in full text. Of these, 42 studies met the eligibility criteria and were included in the systematic

review. The screening process indicated that most excluded full-text articles did not specifically evaluate Health Belief Model (HBM)-based educational interventions, did not focus on menarche preparedness or related reproductive health outcomes, or did not meet the predefined study design criteria. These findings demonstrate that although adolescent reproductive health education is widely studied, only a limited subset of studies directly addresses the effectiveness of HBM-based education in relation to menarche preparedness.

Table 1 presents the core characteristics of the studies most directly relevant to the review objective. Overall, the included evidence was dominated by quasi-experimental and randomized controlled designs conducted in school settings, primarily among adolescent girls aged 10 to 18 years. Most interventions evaluated structured health education programs grounded in HBM constructs, including perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and cues to action. The main outcomes assessed across studies were menarche readiness, menstrual knowledge, emotional response, anxiety reduction, menstrual hygiene practices, and attitude change. The included studies were conducted across diverse cultural contexts, including Iran, India, South Korea, Japan, Uganda, Ghana, and Croatia, suggesting that the topic has broad international relevance.

The synthesis showed a consistent positive trend in the effectiveness of HBM-based reproductive health education on adolescent preparedness for menarche. Studies that directly measured menarche readiness reported statistically significant improvements in the intervention groups compared with baseline conditions or control groups. Improvements were observed not only in cognitive readiness, such as knowledge of menstruation and pubertal changes, but also in psychological readiness, including reduced fear, lower anxiety, and more positive perceptions toward menarche. In several studies, the intervention also improved menstrual hygiene understanding and self-care behavior, indicating that HBM-based education

influenced both belief formation and practical preparedness. These findings support the view that theory-based reproductive health

education can strengthen adolescent readiness through simultaneous improvement in knowledge, beliefs, and behavioral orientation.

Table 1. Summary of Key Studies Included in the Review

Author, Year, Country	Design / Sample	Intervention Focus	Main Outcomes	Key Findings
Barkhordari-Sharifabad et al., 2020, Iran	Quasi-experimental; adolescent girls aged 12–16 years; n=200	HBM-based puberty and menstruation education	Menstrual knowledge, mental readiness	Significant improvement in menstrual knowledge and mental preparedness after intervention
Eghbal et al., 2023, Iran	Controlled educational study; adolescent girls; n=300	HBM-based puberty health education	Puberty health concepts, anxiety, attitude	Education improved puberty health understanding and reduced negative emotional responses
Je et al., 2025, South Korea	RCT / pretest-posttest; adolescent girls aged 10–12 years; n=160	HBM-based reproductive health education	Menarche readiness, attitude	Intervention significantly increased readiness and knowledge, with better attitudes toward menstruation
Khalilzadeh et al., 2023, Iran	Quasi-experimental; adolescent girls aged 10–13 years; n=140	HBM-based health education	Menarche readiness, knowledge, psychological preparedness	Significant gains in readiness, knowledge, and positive perception of menstruation
Rakkini & Hema, 2023, India	Experimental study; adolescent girls aged 11–15 years; n=300	Teaching module on early menarche	Knowledge, perception of menarche	Adequate knowledge increased markedly and emotional perception became more positive after intervention
Mohammed & Larsen-Reindorf, 2020, Ghana	Cross-sectional; adolescent girls aged 12–16 years; n=250	Menstrual education context	Menstrual knowledge, hygiene practices	Better menstrual knowledge was associated with better hygiene practices; maternal education was influential
Nakić Radoš, 2020, Croatia	Cross-sectional survey; adolescent girls aged 12–15 years; n=246	Emotional preparedness context	Emotional readiness, family support	Emotional readiness was better among girls with stronger parental support
Sewanyana, 2023, Uganda	Quasi-experimental; adolescent girls; n=150	HBM-based reproductive health education	Knowledge, attitude, menarche readiness	Significant increase in knowledge and readiness, with improved positive attitudes
Tsuda, 2022, Japan	Quasi-experimental; adolescent girls aged 11–14 years; n=200	School-based reproductive health education	Readiness, knowledge, anxiety	Intervention group showed significantly higher readiness and improved knowledge compared with controls
Salahshouri et al., 2024, Iran*	RCT; adolescent boys; n=148	Mobile HBM-based puberty education	Puberty knowledge, healthy behavior	Showed positive HBM effect on puberty education, but population was not directly aligned with girls' menarche preparedness

The strongest and most recurrent outcome across studies was the increase in menstrual and reproductive health knowledge after the intervention. Barkhordari-Sharifabad et al. reported that HBM-based puberty education significantly improved menstrual knowledge and mental preparedness among adolescent girls in Iran. Je et al. and Khalilzadeh et al.

similarly found that HBM-guided programs improved knowledge and readiness scores while also encouraging more positive attitudes toward menstruation. Rakkini and Hema showed a particularly marked educational effect, with the proportion of girls demonstrating adequate knowledge increasing substantially after the teaching module,

accompanied by a shift toward more positive perceptions of early menarche. Collectively, these results indicate that HBM-based education functions effectively as a knowledge-to-readiness pathway in adolescent reproductive health promotion.

The review also found that emotional and social dimensions played an important role in menarche preparedness. Several studies showed that educational interventions reduced anxiety and stigma related to menstruation, thereby improving adolescents' emotional adaptation to first menstruation. Mohammed and Larsen-Reindorf demonstrated that better menstrual knowledge was associated with improved hygiene practices, while family-related factors such as maternal education contributed to healthier preparedness patterns. Nakić Radoš further highlighted that parental support was closely associated with better emotional readiness, suggesting that educational effectiveness may be amplified when family support is present. These findings indicate that menarche preparedness is not solely an individual cognitive outcome, but also a psychosocial process shaped by education, family support, and contextual influences.

Although most studies demonstrated favorable outcomes, the magnitude and focus of effect varied across intervention models and outcome domains. Some studies emphasized direct readiness outcomes, while others concentrated on menstrual hygiene, emotional response, or general puberty health behavior. This variation suggests that HBM-based education is flexible and effective across multiple dimensions of adolescent reproductive health, but it also indicates heterogeneity in operational definitions and measurement approaches. As a result, the findings were synthesized narratively rather than statistically pooled. Nevertheless, the direction of evidence remained largely consistent, showing that HBM-based reproductive health education improves knowledge, attitudes, emotional readiness, and preparedness for menarche across different school-based adolescent populations.

Discussion

This systematic review found that Health Belief Model-based reproductive health education consistently improved adolescent girls' preparedness for menarche across cognitive, emotional, and behavioral domains. The review showed that educational interventions increased menstrual knowledge and strengthened girls' understanding of pubertal changes before menarche. The review also showed that these interventions reduced fear, anxiety, and negative perceptions related to menstruation. Several studies demonstrated that theory-based education improved menstrual hygiene awareness and promoted more positive attitudes toward reproductive health. The synthesis further indicated that family support and sociocultural context influenced the degree to which adolescents benefited from educational interventions. Overall, the findings suggest that HBM-based education provides a relevant and effective framework for preparing adolescent girls to face menarche in a more informed, confident, and adaptive manner.

The present review shows that HBM-based education improves menarche preparedness because the model strengthens adolescents' health beliefs before the first menstrual experience (Barkhordari-Sharifabad et al., 2020; Eghbal et al., 2023). HBM-based interventions increase girls' perceived understanding of bodily changes and perceived benefits of preparation through structured reproductive health messages in school settings (Khalilzadeh et al., 2023; Je et al., 2025). Educational programs also improve readiness because they connect knowledge acquisition with belief formation and anticipated self-care behavior during puberty (Salahshouri et al., 2024; Mohammadkhah et al., 2022). Similar theory-driven interventions in women's health have improved preventive beliefs and practices in breast health and oral health contexts, which supports the broader applicability of HBM for adolescent reproductive education (Altunkurek et al., 2026; Mahar et al., 2026; Nickbin Poshtamsary et al., 2020). This pattern indicates that HBM does not merely transmit information but also modifies the psychological

determinants of health behavior that underlie preparedness for menarche (El Maghawry, 2022; Bashirian et al., 2023). Therefore, the effectiveness observed in this review is theoretically plausible and empirically aligned with prior educational intervention research across multiple health domains (Astria et al., 2025; Kheirandish et al., 2026).

The review also indicates that improved menstrual knowledge represents the most consistent pathway through which HBM-based education enhances preparedness for menarche (Rizkia et al., 2019; Rakkini & Hema, 2023). Knowledge-based improvement is important because adolescent girls often enter puberty with incomplete understanding of menstruation and with inaccurate beliefs about menstrual processes (Mohammed & Larsen-Reindorf, 2020; Tsuda & Takada, 2024). Educational interventions that explain menstruation, hygiene, and bodily changes in a structured format help girls interpret menarche as a normal developmental event rather than as a frightening or shameful experience (Barkhordari-Sharifabad et al., 2020; Eghbal et al., 2023). Better knowledge also supports healthier menstrual practices and may reduce school disruption associated with poor menstrual management and social embarrassment (Jahan et al., 2024; Mohammed & Larsen-Reindorf, 2020). Evidence from adolescent reproductive health studies further shows that education improves understanding of menstruation-related conditions such as leukorrhea, anemia, and dysmenorrhea, which strengthens overall reproductive awareness during adolescence (Anisa Yulianti et al., 2024; Heriani, 2025; Destiana et al., 2025). Thus, the present review confirms that knowledge is not an isolated educational outcome but a foundational mechanism that supports emotional readiness and practical adaptation during menarche (Saputra et al., 2024; Anggaraini & Lestari, 2025).

In addition to knowledge, the review demonstrates that HBM-based education reduces anxiety and improves emotional readiness toward menarche (Rizkia et al., 2019; Je et al., 2025). Emotional readiness is important because girls frequently interpret

menarche through fear, embarrassment, and uncertainty when prior preparation is inadequate (Mohammed & Larsen-Reindorf, 2020; Rakkini & Hema, 2023). Interventions grounded in HBM may reduce anxiety because they clarify the meaning of menstruation, frame bodily change as manageable, and strengthen girls' sense of control over their responses (Barkhordari-Sharifabad et al., 2020; Khalilzadeh et al., 2023). Similar educational effects have been observed in broader adolescent health studies, where targeted learning improves emotional regulation and positive health attitudes during developmental transitions (Sharm & Kappor, 2025; Soleha et al., 2025). Research on stress and menstrual experience also suggests that psychological factors influence menstrual adaptation, which makes emotional preparation a central component of menarche readiness (Melia Rahma et al., 2023). Therefore, the present findings support the interpretation that HBM-based reproductive health education can function as both an informational and emotional intervention for girls approaching first menstruation (Eghbal et al., 2023; Tsuda & Takada, 2024).

The review further suggests that behavioral and hygiene-related outcomes form an important extension of menarche preparedness after education is delivered (Jahan et al., 2024; Mohammed & Larsen-Reindorf, 2020). Preparedness becomes more meaningful when adolescent girls translate knowledge and attitudes into concrete self-care practices during menstruation (Astria et al., 2025; Heriani, 2025). HBM-based education appears to support this translation because the model encourages girls to recognize health risks, appreciate preventive benefits, and overcome perceived barriers to action (Mohammadkhah et al., 2022; Kheirandish et al., 2026). Evidence from studies on oral health, breast self-examination, and pregnancy-related preventive behavior also shows that HBM-based interventions improve practical health behaviors when educational content is linked to personal belief systems (Altunkurek et al., 2026; Bashirian et al., 2023; Chen et al., 2026). In adolescent reproductive health, this mechanism

may explain why improved knowledge often coincides with better hygiene behavior, stronger self-protection, and more constructive engagement with menstruation (Saputra et al., 2024; Astriana et al., 2025). Accordingly, the findings of this review indicate that preparedness for menarche should be conceptualized not only as awareness but also as the capacity to perform healthy menstrual behavior in real contexts (Tsuda & Takada, 2024; Jahan et al., 2024).

Another important finding of this review is that family support and sociocultural environment influence how adolescents respond to reproductive health education (Mohammed & Larsen-Reindorf, 2020; Nakić Radoš, 2020). Girls who receive parental guidance, especially maternal communication and reassurance, often demonstrate better emotional readiness and healthier menstrual adaptation (Nakić Radoš, 2020; Rizkia et al., 2019). HBM-based education may achieve stronger effects when families reinforce cues to action and normalize discussion about menstruation in the home environment (Khalilzadeh et al., 2023; Barkhordari-Sharifabad et al., 2020). Cross-cultural evidence also shows that sociocultural restrictions, stigma, and silence can weaken menstrual preparedness when education is absent or fragmented (Mohammed & Larsen-Reindorf, 2020; Jahan et al., 2024). This issue is particularly relevant in adolescent reproductive health because local norms often shape whether girls interpret menstruation as a natural event or as a source of shame and social limitation (Tsuda & Takada, 2024; Ridwan et al., 2025). Therefore, educational strategies should incorporate family participation and cultural sensitivity so that HBM-based interventions can produce stronger and more sustainable preparedness outcomes across settings (Amin, 2026; Akbar, 2024).

Although the review supports the value of HBM-based education, the evidence base still presents several methodological and conceptual limitations that should be acknowledged (Singh et al., 2026; Yao et al., 2024). The included studies vary in intervention format, outcome definitions, instruments, and follow-up periods, which limits direct comparability across studies

and reduces the feasibility of statistical pooling (Je et al., 2025; Khalilzadeh et al., 2023). Some studies focus specifically on menarche readiness, while others assess related constructs such as puberty knowledge, menstrual hygiene, anxiety, or broader reproductive health behavior (Barkhordari-Sharifabad et al., 2020; Eghbal et al., 2023). This heterogeneity suggests that the field still lacks a standardized operational definition of menarche preparedness and a unified measurement approach for evaluating educational effectiveness (Rizkia et al., 2019; Tsuda & Takada, 2024). Future research should therefore employ more rigorous comparative designs, standardized readiness instruments, and longer-term follow-up to determine whether the effects of HBM-based education remain stable over time (Salahshouri et al., 2024; Je et al., 2025). Future studies should also examine how school systems, family engagement, and local cultural adaptation interact with HBM constructs to optimize the delivery of reproductive health education for adolescent girls (Amin, 2026; Akbar, 2024).

Taken together, the findings of this review carry important implications for school health policy, adolescent nursing practice, and community-based reproductive health promotion (Akbar, 2024; Saputra et al., 2024). Schools should position menarche education as an essential component of early adolescent health promotion rather than as an optional or incidental topic in puberty education (Tsuda & Takada, 2024; Je et al., 2025). Nurses and health educators should use HBM-informed content because the model helps adolescents understand menstrual risk, benefit, and self-care in a structured and behavior-oriented way (Astriana et al., 2025; Mohammadkhah et al., 2022). Community and school programs should also integrate family-oriented educational components because social reinforcement appears to strengthen girls' preparedness and emotional confidence (Nakić Radoš, 2020; Khalilzadeh et al., 2023). Intervention developers should adapt educational materials to local language, cultural norms, and adolescent developmental stage so that messages remain acceptable and effective in

diverse contexts (Mohammed & Larsen-Reindorf, 2020; Jahan et al., 2024). In this way, the current review supports the integration of HBM-based reproductive health education into routine adolescent health services as a practical strategy for improving menarche preparedness at both institutional and community levels (Amin, 2026; Akbar, 2024).

Conclusion and Recommendation

This systematic review concludes that Health Belief Model-based reproductive health education is effective in improving adolescent girls' preparedness for menarche by increasing knowledge, strengthening positive attitudes, reducing anxiety, and supporting healthier behavioral readiness. The review also indicates that family support and sociocultural sensitivity enhance the effectiveness of educational interventions. These findings suggest that menarche preparedness should be addressed through structured, theory-based education delivered before the onset of menstruation. Schools, nurses, and community health providers should integrate HBM-based reproductive health education into adolescent health programs in order to promote better cognitive, emotional, and behavioral adaptation to menarche. Future studies should use more standardized outcome measures and stronger study designs to clarify the long-term effectiveness of these interventions across diverse settings.

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