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Consensus-Based Model for Adolescent Breast Cancer Prevention Education in Indonesia: A Three-Round Delphi Study Informed by Self-Care Theory and Social Cognitive Theory

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ABSTRACT

Background: The burden of breast cancer has increased among younger age groups, while literacy and preventive behaviors among adolescent girls remain low. Existing educational interventions are often unidirectional and do not explicitly integrate behavior change theories. This study aimed to develop a theory-based breast cancer prevention educational model for adolescent girls using Self-Care Theory and Social Cognitive Theory (SCT) through a Delphi consensus process.

Methods: A three-round Delphi study was conducted in Majene Regency, Indonesia. Round 1 used a semi-structured questionnaire to generate candidate items. Rounds 2 and 3 evaluated item relevance using a 4-point Likert scale. Consensus was defined *a priori* as I-CVI ≥0.80 in Round 3, with strict consensus requiring *modified kappa (k) ≥0.74**. Stability was assessed using median and interquartile range (IQR) across rounds.

Results: Fifteen experts participated in Round 1, and 11 experts completed Rounds 2 and 3. Of 67 initial items, 59 achieved final consensus, indicating excellent content validity (S-CVI/Ave = 0.952; 94% of items had IQR ≤1.0). Six core themes emerged: preventive self-care behaviors; adolescent breast cancer literacy; interactive, skill-based education supported by schools and digital media; cultural and psychological barriers; SCT-based reinforcement and social support; and multi-stakeholder involvement.

Conclusion: The content-validated model emphasizes skill development, self-efficacy, and social contextual support. It provides a practical framework for school and primary health care–based breast cancer prevention programs for adolescents, although effectiveness testing and cross-context validation are required.

INTRODUCTION

Adolescence is a critical phase in the formation of long-term health behavior, marked by rapid biological, psychological, and social changes. [1,2] During this period, teenagers start to build behavioral patterns that can contribute to chronic disease risk in adulthood, including breast cancer. Although breast cancer is extremely rare in adolescents, prevention-relevant behaviors and health literacy formed

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in adolescence can shape long-term adult breast cancer risk and early help-seeking. The latest Global Burden of Disease (GBD) evidence shows that the burden of breast cancer in women aged 15-49 years continues to increase globally, both in terms of incidence and Disability-Adjusted Life Years (DALYs).[3] At the global level, breast cancer remains the most common cancer in women in 2022, with approximately 2.3 million new cases and 670,000 deaths.[4] In Indonesia, GLOBOCAN 2022 places breast cancer as the most common cancer in women, contributing to approximately 16.2% of all new national cancer cases and becoming the main cause of cancer-related deaths.[5] If this trend continues, the global burden of breast cancer is projected to increase to around 3.2 million new cases and 1.1 million deaths per year by 2050, with the largest increase occurring in high-income countries and developing countries.[6]

These conditions underscore the importance of early, life-course–oriented prevention strategies aimed at improving health literacy, self-efficacy, and risk-reduction behaviors during adolescence; however, adolescents' breast cancer–related literacy and preventive practices remain insufficient relative to the growing long-term disease burden. Global evidence shows that teenagers' knowledge about breast cancer, risk factors, and prevention practices, especially breast awareness and familiarity with normal breast changes (often operationalized in studies as BSE/self-check), is still very limited. A systematic review of international students' school media identified that of 1,916 publications, only six studies met the requirements criteria, and all showed low breast cancer literacy as well as lack of BSE practices among teenagers.[7] A study in Saudi Arabia on 6,380 female students showed that only 39.6% had ever heard of BSE, and more than 80% could not answer half of the questions related to breast cancer.[7] The limitations of literacy are similar to those seen in other countries in Asia and Africa. For example, only 29.1% of 1,043 middle school students in Ghana had adequate knowledge about breast cancer, and only 9.8% had knowledge regarding BSE and screening.[8] In Iran, more than 87% of high school students have information that is either inadequate or incorrect regarding breast cancer screening (which is not age-indicated for adolescents).[9] In Nigeria, breast cancer prevention literacy among adolescent girls is also low, as indicated by only 6.1% performing monthly BSE and 25.4% correctly understanding BSE techniques.[10,11]

This knowledge gap is also evident in Indonesia. A study of 206 adolescent girls aged 15-18 years showed that knowledge of breast cancer risk factors was very low (1.95 ± 0.69), as was knowledge and practice of BSE (1.81 ± 0.78).[12] These findings are consistent with a meta-analysis national report that the prevalence of BSE practice is only 43.14% in women in general and 42.51% in adolescent daughters.[13] Low practice is not only a consequence of limited information, but also influenced by psychosocial and socio-cultural norms. Self-efficacy, social norms, and perceived barriers have been shown to significantly predict BSE intentions and behaviors.[14]

To address this gap, various educational interventions have been implemented; however, many remain one-directional, non-interactive, and insufficiently tailored to adolescents' psychosocial characteristics. Effective educational models should not only transfer information but also enhance motivation, self-efficacy, and social support to contribute to sustained, life-course preventive behaviors. This perspective aligns with Self-Care Theory, which emphasizes individuals' capacity to manage their own health[15], as well as SCT, which highlights the dynamic interaction between personal, environmental, and behavioral factors in shaping health actions.[16]

Nevertheless, few breast cancer prevention educational models explicitly integrate both theories within adolescent populations, particularly in developing countries such as Indonesia, where social and cultural contexts differ substantially.[17,18] Given these gaps, this study aimed to develop and validate the components of a breast cancer prevention educational model for adolescent girls based on Self-Care Theory and Social Cognitive Theory through a Delphi consensus study.

METHODS

Study Design and Reporting

We conducted a three-round Delphi study to develop a theory-based educational model for breast cancer prevention in adolescents based on expert consensus.[18] The primary objective of the Delphi process was content validation (i.e., assessing the relevance and appropriateness of proposed model components), rather than item prioritization, ranking, or weighting. The Delphi approach was chosen because it enables the structured synthesis of expert judgment when empirical evidence is limited or fragmented, making it suitable for formulating intervention model components in adolescent health.[18–20] Reporting followed the Conducting and Reporting of Delphi Studies (CREDES) guidelines (https://www.equator-network.org/reporting-guidelines/), which emphasize clarity of objectives, panel selection, iterative procedures, a priori consensus definition, controlled feedback mechanisms, stability indicators, and termination rules. [21] A completed CREDES checklist is provided as Supplementary File S1.

Setting and Scope

The study targeted school-based and primary health care educational components for adolescent girls aged 15–19 years in the Regency of Majene, Indonesia. The Delphi panel included oncology professionals (physicians and nurses), health promotion academics, health service practitioners, representatives of breast cancer survivor communities, and representatives of relevant community and religious organizations involved in adolescent breast cancer prevention.

Expert Panel Recruitment and Eligibility

Experts were recruited purposively through professional networks and reference institutions to ensure disciplinary heterogeneity and stakeholder role diversity. Inclusion criteria were: (1) relevant professional experience of at least 2 years; (2) ability to complete all Delphi rounds; and (3) absence of conflicts of interest related to the study objectives. There is no fixed numerical standard for Delphi panel size; adequacy is primarily determined by the quality of expertise, relevance, diversity, and retention across rounds. In health-related Delphi studies, heterogeneous panels commonly include 7–12 experts to balance diversity and response burden, while anticipating attrition between the rounds. Attrition rates of approximately 10–30% are considered acceptable in health Delphi research. Based on these considerations, 15 experts were recruited in Round 1, resulting in 11 experts completing Rounds 2 and 3, thereby maintaining panel adequacy. We acknowledge that small panels can inflate I-CVI estimates; therefore, modified kappa (k) was used to adjust for chance agreement and to support cautious interpretation of item-level content validity.*

Procedure and Rounds

Round 1 used a semi-structured questionnaire (online and offline) to generate candidate items related to educational content, SCT-based behavior change constructs, and delivery strategies. Two researchers independently reviewed the responses and synthesized the initial item pool, grouping items into three domains: (1) self-care, (2) SCT enablers, and (3) delivery strategies. Discrepancies were resolved through discussion, and items were editorially refined for clarity and contextual relevance to adolescents.

In Rounds 2 and 3, panelists evaluated the relevance of each item using a 4-point Likert scale (1 = not relevant to 4 = very relevant), consistent with recommended practice for content validity index (CVI) assessment in health Delphi studies.[22] After Round 2, controlled, aggregated feedback (median, IQR, percentage agreement, I-CVI, and anonymized comments) was provided to support re-evaluation in Round 3, while maintaining panelist anonymity.[21,23]

Consensus, Stability, and Rules Termination

The primary consensus criterion, defined *a priori*, was I-CVI ≥0.80 in Round 3 (i.e., ≥80% of experts rated the item as 3 or 4), a commonly accepted threshold for good content validity.[22] In addition to I-CVI, S-CVI/Ave and modified kappa (k*) were calculated to adjust for chance agreement.[22] Items meeting the I-CVI threshold but not achieving the strict kappa criterion (k ≥0.74) were retained in the model with interpretive caution and were not classified as "final-strict" consensus items. Inter-round stability was assessed using changes in median and IQR from Round 2 to Round 3, while Kendall's W was examined as an additional indicator of inter-rater agreement.[24,25] Kendall's W was used descriptively to support assessment of rating convergence rather than as a formal criterion for item retention. The Delphi process was terminated after Round 3 when item ratings demonstrated stability and minimal likelihood of further change.[25]

Data Management and Analysis

Data analysis was conducted using R (version 4.x) and Python (version 3.11). For each item and round, the number of raters (N), percentage agreement (score ≥3), I-CVI, Wilson 95% confidence intervals, modified kappa (k*), median, and IQR were calculated. Given the small number of raters, the Wilson 95% confidence intervals were relatively wide, which should be considered when interpreting item-level validity estimates. Missing data were not imputed; denominators reflected the number of experts providing ratings in each round. The extent of missing ratings across rounds is summarized in the Results section to improve transparency. The analysis code and de-identified dataset are available upon reasonable request.

RESULTS

A total of 11 experts completed Rounds 2 and 3, with an age range of 34–71 years (mean 45.3 ± 11.4 years). The panel was multidisciplinary and predominantly female (72.7%), comprising oncology clinicians (physicians and nurses), health promotion academics, health service practitioners, and representatives from breast cancer survivor communities and community or religious organizations. Most panelists had more than 10 years of professional experience (54.5%) and were affiliated with hospitals, health service institutions, and educational organizations, indicating adequate diversity of perspectives for consensus development (Table 1).

Table 1. Panel Characteristics

Characteristics	n (%)	Min– Max	Mean ± SD
Age (years)	—	34–71	45.3 ± 11.4
Sex			
Male	3 (27.3)	—	—
Female	8 (72.7)	—	—
Highest education			
Bachelor's degree	4 (36.4)	—	—
Master's degree	6 (54.5)	—	—
Doctoral degree	1 (9.1)	—	—
Institution/Primary workplace			
Hospital	5 (45.5)	—	—
District health office	2 (18.2)	—	—
University/academic institution	2 (18.2)	—	—
Other organizations	2 (18.2)	—	—
Years of professional experience			
5–10 years	5 (45.5)	—	—
>10 years	6 (54.5)	—	—
Expertise/role			
Oncologist	2 (18.2)	—	—
Oncology nurse	3 (27.3)	—	—
Public health/health promotion academic	1 (9.1)	—	—
Health office practitioner/policymaker	1 (9.1)	—	—
Religious leader	1 (9.1)	—	—
Community leader	1 (9.1)	—	—
Breast cancer survivor/advocate	1 (9.1)	—	—
Breast cancer survivor community representative	1 (9.1)	—	—

Delphi Process and Panel Retention Across Rounds

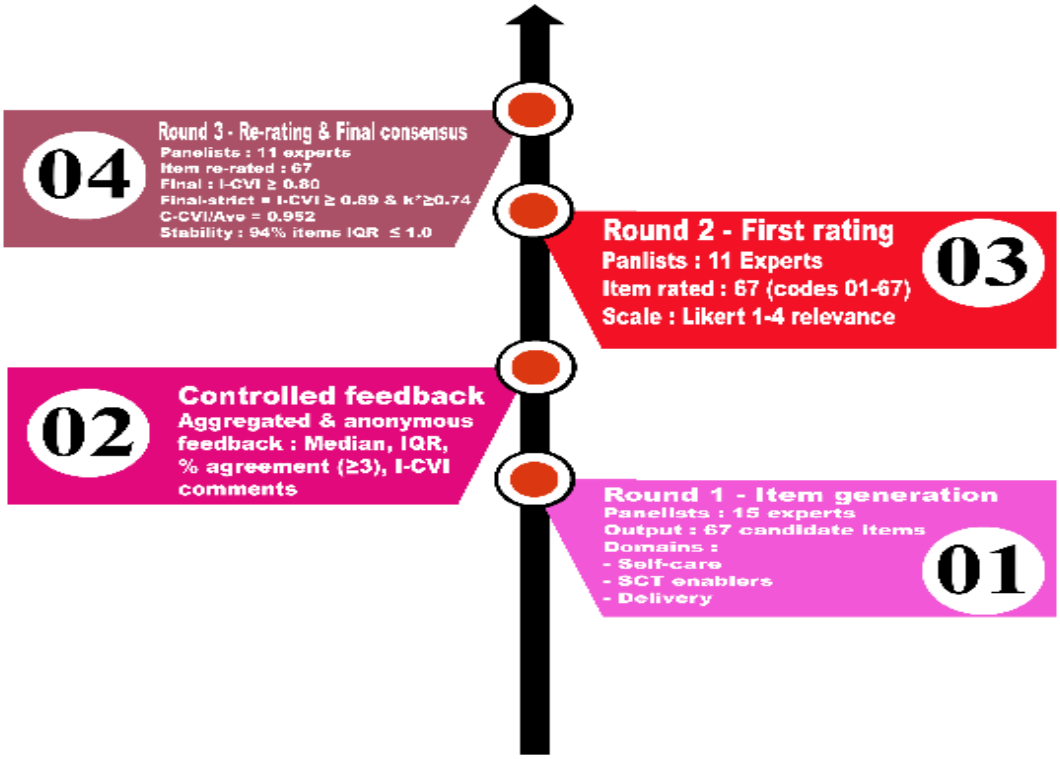

Figure 1. Delphi Flow Diagram Across Three Rounds

The flowchart depicted in Figure 1 illustrates the three-round Delphi process used to achieve expert consensus on the components of an adolescent breast cancer prevention educational model. In

Round 1, 15 multidisciplinary experts generated items through a semi-structured questionnaire, yielding 67 candidate items categorized into self-care, Social Cognitive Theory (SCT)–based enablers, and educational delivery strategies. In Round 2, 11 experts evaluated all 67 items using a four-point Likert scale to assess relevance. Panelists then received controlled, aggregated, and anonymous feedback, including median, interquartile range (IQR), percentage agreement, item-level content validity index (I-CVI), and summarized comments, to inform reassessment. In Round 3, the same 11 experts re-evaluated 59 items requiring further consensus. The consensus was finalized based on an I-CVI threshold of ≥ 0.80, with the strictest set requiring an additional modified kappa (k*) of ≥ 0.74. Items meeting I-CVI ≥0.80 were retained as final consensus components, while k ≥ 0.74 indicated higher-confidence ("final-strict") agreement.* Overall, this process demonstrated excellent content validity (S-CVI/Ave = 0.952) and high stability in ratings during the third round (94% of items had an IQR ≤ 1.0), confirming that the resulting model components reflect a strong and stable expert consensus.

Table 2. Final themes and components of the Adolescent Breast Cancer Prevention Education Model (Delphi Round-3 consensus)

Main theme	Subtheme	Example of a consensus item (Final-strict = Yes)
1. Self-care preventive behavior	Breast awareness & early detection	Conduct BSE in a regular way for early detection (02, 39); do clinical inspection when there is a suspicious symptom (03); know appropriate time and correct BSE technique (38).
	Healthy lifestyle risk reduction	Do regular physical activity suitable for teenagers (01, 40); guard ideal body weight through a balanced diet & physical activity (06); improve consumption of fruits & vegetables (10, 40); limit fast food/ processed food (09); avoid smoking and alcohol (07, 08, 40).
	Self-regulation & wellbeing	Manage stress / mental health (04); maintain spiritual health as coping / motivation healthy behavior (05); avoid using gadgets excessively; avoid sleep-disturbing activities for self-care (17).
2. Breast cancer literacy for adolescents	Basic breast cancer knowledge	Understand anatomy & physiology of breasts (29); understand cancer prevalence / cancer burden (30); understand risk factors (31); recognize breast cancer type (32); recognize signs and symptoms (33); understand complications (34).
	Screening & consequences	Understand main therapy choice (35); understand consequences of delayed detection (36); understand screening methods for early detection (37).
3. Recommended educational approach & delivery	Interactive skill-based learning	Live and practical demonstration of BSE (25); live BSE training as well as educational videos (45).
	School- and digital-supported channels	Prevention education through a program based on schools, social media, and mass media (43).
	Peer & role-model strategy	Forming peer groups and role models for education / prevention (44).
4. Key barriers acknowledged by experts	Cultural-psychological barriers	Teenager facing shame and cultural taboos talk about breasts / reproductive organs (28); topic of breast seen as taboo in social norms (47); teenagers are sensitive to breast cancer (46).
5. SCT enablers & social support to sustain behavior	Supportive environment	Build connection with each other and believe teenagers (56); emotional support (57); peer group support including WA groups / similar platforms (58); reinforcement/ appreciation of preventive behavior (59).
	Habit formation & program continuity	Training directly and pushing BSE on time and in an easily remembered way (60); routine school–health center programs to promote BSE (61); ensure sustainability through training, recurring & continuous campaigns (62).
6. Stakeholder roles in implementation	Multi-stakeholder engagement	Health workers as main educators / facilitators (63); parents / family as role models and emotional support (64); friends and peers as role models (65); teachers as gatekeepers/ facilitators at school (66); breast cancer survivors as credible role models sharing their experience (67).

Thematic synthesis of final Delphi items

After Round 3 consensus was established, and all final-strict items were synthesized using thematic analysis to facilitate interpretation and clarify the overall structure of the educational model. This process generated main themes and subthemes

reflecting the core components of adolescent breast cancer prevention education, including self-care behaviors, breast cancer literacy, educational delivery strategies, social support, and stakeholder roles. A summary of the thematic synthesis is presented in Table 2. For transparency, items meeting I-CVI ≥0.80 but not k ≥0.74 were retained as consensus components but were not classified as "final-strict" in the thematic synthesis.

Table 2 summarizes the final-strict consensus results from Round 3 and presents the thematic structure of the adolescent breast cancer prevention educational model. Experts agreed that the model should prioritize preventive self-care behaviors, including breast awareness, and familiarity with normal breast changes, regular breast self-examination–related skills framed as awareness rather than a formal screening tool (not as a mortality-reducing screening tool), healthy lifestyle–based risk reduction (physical activity, balanced diet, weight control, and avoidance of smoking and alcohol), and self-regulation to sustain healthy behaviors. The second theme emphasizes the need for adequate breast cancer literacy among adolescents, covering breast anatomy, disease burden, risk factors, warning signs and symptoms, and screening/early detection concepts as future-oriented knowledge rather than age-indicated clinical practice and consequences of delayed detection. From an implementation perspective, experts emphasized that educational strategies should be interactive, skill-based, and youth-centered, with emphasis on direct, skills-based breast awareness/self-check demonstrations, peer learning, and school-based delivery supported by digital media. Experts also identified cultural and psychological barriers, such as stigma, shame, and taboos surrounding breast health discussions, that must be addressed within interventions. Consistent with Social Cognitive Theory, the model underscores multi-stakeholder support, involving teachers, school health units, primary health care providers, parents, peers, and breast cancer survivors, to strengthen self-efficacy, behavioral modeling, and program sustainability.

Integrated Self-Care–SCT education model for adolescents

Based on the thematic synthesis of final strict Round 3 items, the expert panel reached consensus on an integrated educational model framework grounded in Self-Care Theory and Social Cognitive Theory (SCT), as illustrated in Figure 2. The model comprises four interrelated pillars: (1) preventive self-care behaviors, including breast awareness, breast self-check as a breast awareness skill (rather than age-indicated screening), risk reduction through healthy lifestyles, and self-regulation to sustain healthy behaviors; (2) breast cancer literacy, encompassing breast anatomy, disease burden, risk factors, warning signs and symptoms, screening options, and consequences of delayed detection; (3) youth-centered delivery strategies, featuring interactive, skill-based learning through breast awareness/self-check demonstrations and practice peer and role-model approaches, and utilization of school and digital channels, complemented by reinforcement and reminder sessions; and (4) SCT-based enablers and multi-stakeholder support, emphasizing self-efficacy, behavioral modeling, reinforcement, and social support from teachers and school health units, primary health care providers, parents, peers, and breast cancer survivors. The model explicitly accounts for cultural and psychological barriers, including stigma, shame, taboos, and low perceived vulnerability, to guide context-sensitive adaptation of educational strategies for adolescents.

DISCUSSION

This three-round Delphi study produced an adolescent breast cancer prevention educational model integrating Self-Care Theory and Social Cognitive Theory (SCT) and demonstrated high content validity and expert consensus. Because breast cancer is extremely rare in adolescents, the intended preventive value of this model lies primarily in shaping long-term adult prevention pathways (health literacy, breast awareness, and sustained healthy behaviors), rather than reducing short-term adolescent cancer risk. Conceptually, this model addresses gaps in the existing literature, which over the past decade has been dominated by knowledge-oriented interventions targeting adult women or university students rather than school-aged adolescents. Systematic reviews on cancer awareness among adolescents indicate that school-level breast cancer literacy remains low, existing interventions are highly heterogeneous, and few focus on sustainable preventive skill formation. [26] Thus, the primary contribution of this study is the development of an adolescent-specific model that integrates cognitive, skill-based, and social support components into a single operational intervention framework with an explicit life-course orientation (strengthening breast awareness, health literacy, and long-term risk-reducing behaviors rather than immediate oncologic outcomes). First, expert consensus positioned preventive self-care behaviors including breast awareness, correct and routine BSE practice as a component of breast awareness (rather than a mortality-reducing screening tool), healthy

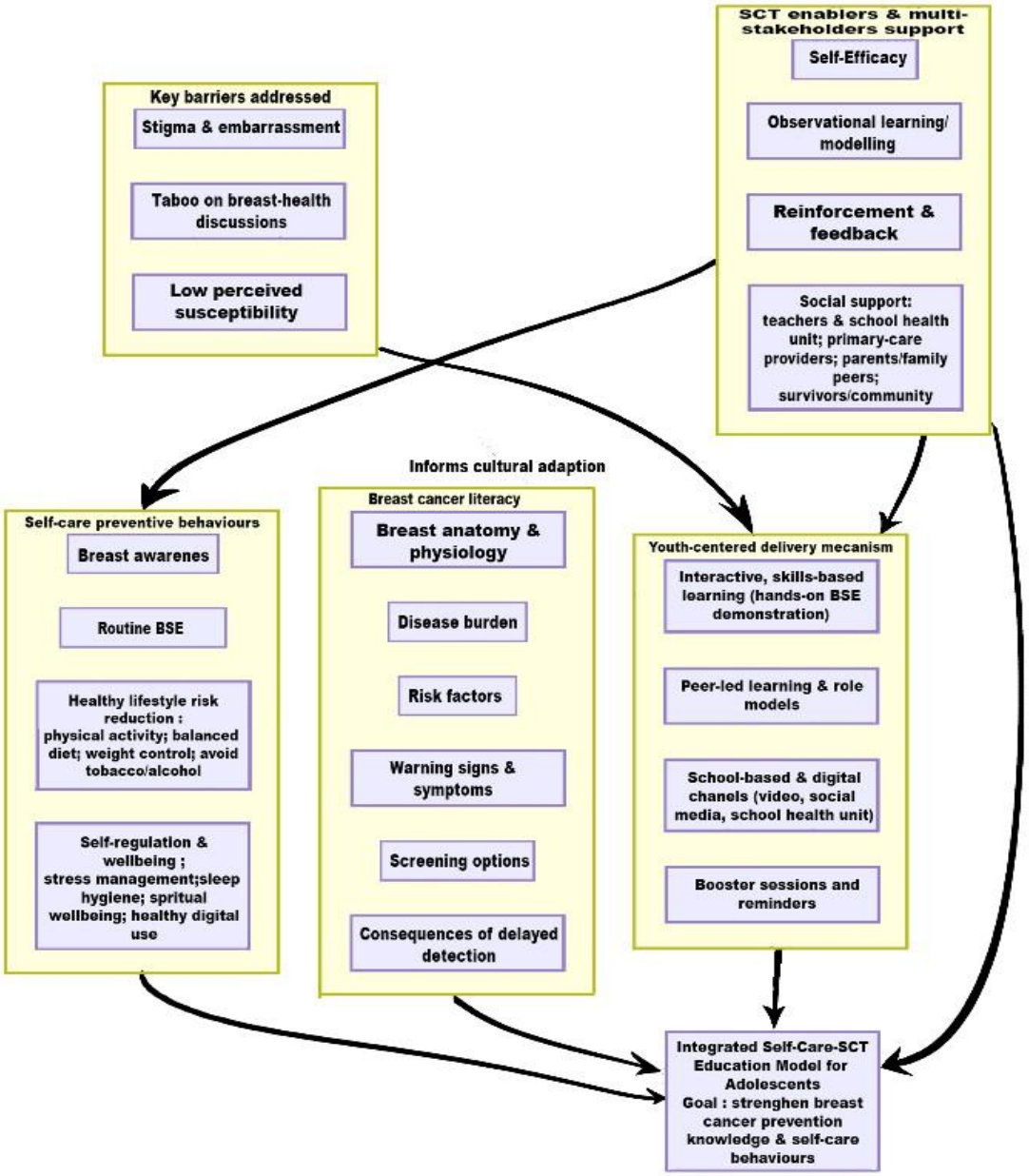

Figure 2. Integrated Self-Care–SCT education model for adolescents

lifestyles, and self-regulation as the core of the model. This emphasis aligns with global perspectives that recognize adolescence as a critical life stage for long-term health behavior formation. School-based intervention studies across multiple countries have shown that breast health education among adolescents improves breast awareness, knowledge, attitudes, and intentions; however, effects are stronger when programs emphasize skill practice and habituation rather than information alone.[27] What distinguishes this model from many previous interventions is the explicit integration of Self-Care Theory, positioning adolescents as active agents capable of maintaining breast health through independent skills and self-regulation. This approach extends earlier intervention literature that predominantly applied the Health Belief Model (HBM) or Theory of Planned Behavior (TPB) without emphasizing self-care as a daily life skill.[28]

Second, the breast cancer literacy domain endorsed by the panel was comprehensive, encompassing anatomy and physiology, disease burden, risk factors, warning signs and symptoms, and screening/early detection concepts framed as future-oriented knowledge (given that adolescents are not candidates for routine breast cancer screening), and the consequences of delayed detection. This is consistent with evidence indicating that low breast cancer and breast awareness/self-check literacy among adolescents constitutes a major barrier to preventive behavior adoption. Recent systematic reviews of breast cancer knowledge among secondary school students show that many adolescents hold misconceptions regarding risk factors, warning signs,

and self-check/BSE procedures, underscoring the need for education that integrates clinical and practical knowledge.[7] Compared with traditional curricula that tend to emphasize disease facts alone, this model balances "what breast cancer is" with "how it can be prevented and detected early", while avoiding overmedicalization by clarifying that adolescents are not candidates for routine breast cancer screening. Third, the expert panel emphasized the importance of interactive, skill-based learning strategies, including direct breast awareness/BSE demonstrations, structured practice, feedback mechanisms, peer modeling, and digital support. These recommendations are consistent with recent intervention trials demonstrating that hands-on practice and simulation or hybrid approaches are more effective in improving BSE-related skills and confidence than traditional lecture-based methods.[29] Digital and virtual approaches have also been shown to enhance breast awareness /BSE skills and self-efficacy by providing private learning spaces and repeatable instructional materials, which are particularly suitable for adolescents. [30] An important distinction of this model is that these delivery strategies are positioned as structural components of the theoretical model, rather than merely technical methods, thereby enabling clearer theoretical tracking of behavior change mechanisms.

Fourth, the explicit inclusion of cultural and psychological barriers such as taboo, shame, and stigma related to discussing breast health represents a key strength of this model compared with many international interventions. Qualitative studies and sociocultural reviews from South Asia and other low- and middle-income countries indicate that stigma and norms of modesty often delay early detection learning, limit adolescents' willingness to ask questions, and reduce self-efficacy for performing breast awareness/BSE. By explicitly addressing these barriers, the model enables the design of culturally adaptive educational strategies, such as the use of female facilitators, culturally sensitive language, and framing breast health as self-care rather than a sexual issue. This is particularly important because much of the previous literature implicitly assumes cultural neutrality, despite strong evidence that sociocultural context shapes intervention acceptability and effectiveness.

Fifth, consensus regarding SCT-based enablers and multi-stakeholder social support indicates that the panel did not view preventive behavior as a purely individual process. SCT emphasizes reciprocal determinism, whereby behavior emerges from interactions among personal factors (knowledge, outcome expectations, self-efficacy), behavioral practices (breast awareness/BSE and lifestyle behaviors), and the environment (parental support, schools, health workers, and peers).[31]

Theory-based intervention studies in breast cancer prevention consistently show that self-efficacy enhancement and social reinforcement are key mediators for sustaining preventive health behaviors and appropriate help-seeking.[32] This model extends existing evidence by explicitly structuring the roles of teachers and school health units, primary health care providers, parents, peers, and breast cancer survivors as role models, with messaging adapted to adolescents to avoid fear-based or overly clinical narratives while maintaining credibility, an approach that has been rarely formalized in adolescent-focused studies. When involving survivors, narratives should be developmentally appropriate and empowerment-focused, avoiding fear-based or overly clinical messaging to minimize anxiety and overmedicalization among adolescents.

From a methodological perspective, the Delphi technique is widely used in the development of health education curricula and cancer-related indicators to ensure content relevance and cross-professional applicability, particularly when empirical intervention evidence remains heterogeneous.[33] Supported by a multidisciplinary expert panel, this model demonstrates strong content validity and enhanced potential for program adoption. However, consistent with the limitations of Delphi-based research, expert consensus does not guarantee real-world effectiveness. Accordingly, future research should focus on implementation and effectiveness testing in school and primary health care settings, assessing impacts on breast cancer literacy, self-efficacy, breast awareness/BSE skills and appropriate help-seeking, and healthy lifestyles using quasi-experimental or cluster-randomized designs. Given that lifestyle risk factors differ in the strength of evidence for long-term breast cancer risk modification, future evaluations should consider which behaviors are most plausibly mediating life-course risk reduction when initiated in adolescence. Existing literature further indicates that the success of adolescent cancer education is strongly influenced by program duration, repetition, and environmental support, underscoring the importance of medium- to long-term evaluations to assess behavioral sustainability.[26]

CONCLUSION

This study successfully developed an adolescent breast cancer prevention educational model based on expert consensus and theoretically integrated with Self-Care Theory and Social Cognitive Theory. The final model positions preventive self-care behaviors-

including breast awareness, routine BSE practice as a breast awareness skill (not a screening tool for mortality reduction), healthy lifestyles, and self-regulation-together with comprehensive breast cancer literacy as the foundation for behavior change. Interactive, skill-based, and youth-centered delivery strategies, supported by peers and role models, digital media, and the strengthening of SCT mechanisms through multi-stakeholder social support, constitute the key pathways for enhancing self-efficacy and sustaining preventive behaviors. This model provides a relevant implementation framework for school-based programs and primary health care services in Indonesia, with explicit attention to adolescents' cultural and psychological barriers. Further studies are required to test the effectiveness of the model in improving breast cancer knowledge, self-efficacy, and life-course prevention pathways (breast awareness, appropriate help-seeking, and sustained risk-reducing behaviors), and to evaluate its adaptability across diverse sociocultural contexts.

ETHICAL CONSIDERATIONS

The study protocol received ethical approval from the Ethics Committee of the Faculty of Public Health, Hasanuddin University (FKM-Unhas), Makassar, Indonesia (Approval No.3455/UN4.14.1/TP.01.02/2024, dated December 2, 2024; Protocol No. 281024093075). All Delphi panelists received written study information and provided written or electronic informed consent prior to participation in each round. Participation was voluntary, and panelists could withdraw at any time without consequences. Data were analyzed in aggregate, all responses were fully anonymized, and no patient data or data from adolescent participants were collected. The study was conducted in accordance with the Declaration of Helsinki and relevant institutional regulations for human research.

DATA AVAILABILITY

The corresponding author can be contacted directly for access to the data.

CONFLICT OF INTERESTS

The authors declare that there are no conflicts of interest related to this study.

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AI DISCLOSURE

The authors declare that no artificial intelligence (AI) tools or language models were used in the preparation, writing, or analysis of this manuscript.

AUTHOR CONTRIBUTION

N: Conceptualization, study design, data collection, data curation, formal analysis, interpretation of findings, and drafting of the manuscript. AR, AAA, ELS, MS, and S: Supervision, methodological review, critical revision of the manuscript, and intellectual input on the study framework and interpretation. B and ES: Contribution to data interpretation, manuscript review, and refinement of the final draft.

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