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Effect of a Single-Session Health Education Intervention on Breast Cancer Literacy Among Rural Women in Punjab

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A B S T R A C T

Background: Breast cancer is the most common malignancy among women worldwide and represents a major public health burden in low- and middle-income countries such as India. Rural populations frequently experience delayed diagnosis because of limited awareness, sociocultural barriers, and poor access to screening services.

Methods: A pre–post interventional study was conducted among 300 women aged 25–60 years in rural Punjab. Baseline knowledge, attitudes, and practices related to breast cancer and early detection were assessed using structured questionnaires. A culturally tailored community-based awareness program was implemented, followed by postintervention evaluation using the same instrument. Outcomes were compared to assess changes in knowledge and preventive behaviors.

Results: Postintervention findings demonstrated significant improvements in breast cancer literacy and practices. Mean knowledge scores increased from 9.82 to 18.45. Monthly breast self-examination practice rose from 8% to 40%, and recognition of breast cancer symptoms improved markedly. Persistent barriers included stigma, limited health-care access, and gender-related sociocultural constraints.

Conclusion: Culturally appropriate, community-based education interventions can substantially improve breast cancer awareness and early detection practices among rural women and may help reduce disparities in breast cancer outcomes.

Background

Global Burden of Breast Cancer

One of the major global health concerns that is current and whose prevalence rate is rapidly rising is breast cancer in both developed and developing countries. The World Health Organization stated that every year, over 2.3 million women are affected by breast cancer, and approximately 685,000 women die annually because of it (World Health Organization, 2023). It has also overtaken lung cancer as the most commonly diagnosed cancer among women globally, reflecting its high prevalence and health-care burden (Ginsburg et al., 2017; Youlden et al., 2012).

In the United States, the United Kingdom, Germany, and other high-income countries (HICs), population-based mammographic screening and sustained public awareness campaigns have contributed to a significant reduction in breast cancer mortality. These countries report 5-year survival rates between 85% and 90%, largely due to early diagnosis and timely access to comprehensive health-care services (Ginsburg et al., 2017; Youlden et al., 2012).

Low- and middle-income countries (LMICs), particularly in South Asia, Africa, and Latin America, continue to face a rising burden of breast cancer. In LMICs, breast cancer is frequently diagnosed at advanced stages (stage III or IV), limiting treatment options and effectiveness (Anderson et al., 2008). Late-stage presentation substantially reduces survival rates, with averages ranging between 40% and 60% (Ginsburg et al., 2017).

Numerous systemic and sociocultural factors underlie these disparities. Limited availability of screening services, particularly mammography, remains a major barrier to early diagnosis in LMICs (Harford, 2011). Access to early diagnosis and treatment is further

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constrained by inadequate health-care infrastructure and shortages of trained health-care professionals, especially female oncologists and breast health specialists (Sankaranarayanan et al., 2022). Cultural beliefs, stigma, and misconceptions surrounding cancer also discourage women from seeking early medical consultation, resulting in delayed presentation and advanced disease at diagnosis (Akram et al., 2017).

In addition, not only have no national screening programs regarding breast cancer but also those that do encounter it when the symptoms manifest, meaning that the disease may grow to a massive proportion (Jedy-Agba et al., 2016). This fact also explicated the eventual contribution of educational interventions and community-based awareness campaigns in the early diagnosis and survival rates.

Some evidence suggests that health-seeking behavior among the underserved group of women with breast cancer can be significantly improved with the help of specific health education, focusing on the symptoms and risks of the breast cancer and early detection practices (Dandekar and Gupte, 2021; Fernandes and Raikar, 2021).

Community-based programs like health campaigns, self-help education, mobile screening, and culturally appropriate communication have been established to be effective in enhancing the early diagnosis and subsequent therapy. In the context of the situation when the infrastructure of the modern health care is not as developed as it could be, the empowerment of women in rural and semi-urban areas with the knowledge of breast self-examination (BSE), clinical breast examination (CBE), and the need to have regular health check-ups can lead to improved results (Nair et al., 2000; Rehman and Yadav, 2022).

Indian Context

India is currently witnessing a steady rise in breast cancer cases, making it the most common cancer affecting Indian women, having overtaken cervical cancer (Gupta et al., 2015; Indian Council of Medical Research ICMR, 2022). According to data from the Indian Council of Medical Research ICMR, 2022 and the National Cancer Registry Program (2022), breast cancer remains a major health concern in India, with an incidence of approximately 25.8 per 100,000 women.

Each year, over 178,000 new cases are diagnosed, making it the most common cancer among Indian women (NCRP, 2022). Alarmingly, more than 60% of these cases are detected at an advanced stage (stage III or IV), significantly reducing the chances of successful treatment and long-term survival (Gupta et al., 2015; Sankaranarayanan et al., 2022). As a result, the 5-year survival rate in India remains around 60%, which is considerably lower than in high-income countries that have established, of population-based mammographic screening programs and robust early detection strategies (Ginsburg et al., 2017).

Several factors contribute to the high burden and late-stage diagnosis of breast cancer in the Indian context. Low public awareness about the early symptoms and risk factors of breast cancer remains a significant barrier, especially in rural areas (Dey & Mishra, 2020; Gupta et al., 2015). Additionally, cultural taboos and stigma associated with discussing breast health often discourage women from seeking timely medical advice (Akram et al., 2017; Choudhry & Bokharey, 2013). Gender-based health disparities further exacerbate the problem, as many women tend to prioritize the health and well-being of their families over their own (Gupta et al., 2020; Linsell et al., 2008). The lack of comprehensive public health education, coupled with the absence of a national mammographic screening program, leaves many cases undetected until they progress to later stages (Harford, 2011; Sankaranarayanan et al., 2022). Furthermore, there is a shortage of trained female health-care professionals, particularly in rural and semi-rural settings, limiting women's access to comfortable, culturally sensitive CBEs and guidance on breast self-examination (Kaur et al., 2019; Rai & Rai, 2021). Together, these challenges highlight the urgent need for targeted awareness campaigns, health system strengthening, and culturally appropriate community-level interventions to improve early detection and outcomes for breast cancer in India.

Regional Focus: Punjab

Key concerns in rural Punjab include limited health-care access, low health literacy, delayed screening, and sociocultural barriers (Gupta et al., 2020; Sharma et al., 2020). Over 63% of the state's population live in rural areas, where infrastructure development in health care has not kept pace with urban centers (Census of India, 2011; Kaur et al., 2019). Key concerns in rural Punjab include the following.

Low Health Literacy and Breast Cancer Illiteracy

Studies conducted in Punjab indicate that less than 30% of rural women have ever heard of BSE (Kaur et al., 2019; Sharma et al., 2020). Among those who have heard of it, only a small fraction practice it correctly or regularly (Kaur et al., 2019). Misunderstandings of basic breast cancer symptoms—such as a breast lump, skin dimpling, or nipple discharge—are widespread, with many women attributing these signs to noncancerous conditions, hormonal changes, or superstitions (Abraham & Mohanraj, 2019; Babu et al., 2019; Bhatt & Arora, 2023; Gupta et al., 2020; Sharma et al., 2020).

Cultural and Social Barriers

Cultural and societal factors significantly delay breast cancer diagnosis and treatment in low-resource settings. Modesty norms and stigma around breast health often prevent open discussions about symptoms, even within families, leading to misinformation and delayed health-seeking behavior (Sharma et al., 2020). Many women perceive breast cancer as a “death sentence,” which fosters fear, denial, and avoidance of medical consultation (Kaur et al., 2019; Menhas & Umer, 2015; Rajpal et al., 2021). In male-dominated households, women may lack autonomy in health decisions, requiring permission or financial support from male family members, further delaying diagnosis and treatment (Sharma et al., 2020). These combined cultural, emotional, and economic barriers highlight the need for community-level interventions that educate women and engage families to address gender-based disparities in health-care access.

Health-Care Infrastructure Gaps

In rural regions of Punjab, the existing health-care infrastructure presents significant challenges to effective breast cancer detection and management. Most primary health centers (PHCs) lack essential facilities such as mammography units, trained female medical professionals, and standardized cancer screening protocols, severely limiting early detection efforts at the grassroots level (Sharma et al., 2020). Furthermore, many villages are situated far from tertiary care centers, making access to specialized oncology services difficult. Factors such as transportation costs, time constraints, and limited health awareness act as additional deterrents, preventing women from traveling to urban hospitals for diagnostic evaluations or follow-up care (Kaur et al., 2019; Narayana et al., 2013; Ozsoy & Ardahan, 2008). Moreover, although Accredited Social Health Activists (ASHAs) and

Anganwadi workers serve as the frontline of rural health-care delivery, many lack formal training in breast cancer awareness, detection techniques, and health communication, resulting in a critical gap in community-level education and prevention (Muthoni & Miller, 2010; Sharma et al., 2020). Strengthening these local health systems and equipping frontline workers with appropriate knowledge and tools are essential for improving breast cancer outcomes in rural Punjab.

Superstition and Misinformation

Deep-rooted cultural beliefs and misconceptions significantly influence how breast cancer is perceived and managed in many rural communities. In several areas, breast cancer is often attributed to past sins, bad karma, or divine punishment, reflecting a strong spiritual interpretation of illness (Sharma et al., 2020). Such beliefs not only create fear but also stigmatize the disease, making it harder for women to seek help openly. In addition, myths that breast cancer is contagious or that discussing breast-related health issues brings shame or dishonor to the family remain widespread (Kaur et al., 2019). These cultural taboos foster an environment of silence and secrecy around breast health. As a result, women diagnosed with breast cancer may face social ostracization, discrimination, or isolation, leading to emotional distress and further deterring others from seeking timely diagnosis or treatment. Addressing these culturally ingrained perceptions is crucial through culturally sensitive education, community engagement, and the inclusion of local influencers or religious leaders in awareness efforts (Gupta et al., 2020; Saluja et al., 2020; Taran et al., 2018).

Demographic and Socioeconomic Disadvantages

Educational and economic barriers further exacerbate the challenges faced by rural women in accessing breast cancer care. A significant proportion of women in rural areas are uneducated or semi-literate, making it difficult for them to comprehend conventional written health education materials or navigate the healthcare system independently. This limitation reduces the effectiveness of text-based awareness campaigns and underscores the need for visual, oral, and culturally appropriate communication methods. Additionally, economic dependence on spouses or male family members restricts women's ability to make autonomous health decisions, including whether to seek medical consultation or adhere to treatment. In many households, women require both permission and financial support from male guardians, which can lead to delays or complete neglect of medical attention. These intertwined educational and socioeconomic constraints highlight the importance of empowering women through targeted health literacy initiatives and community-based interventions that promote both awareness and autonomy (Kaur et al., 2019; Sharma et al., 2020).

In sum, the triple burden of ignorance, stigma, and poor infrastructure leads to late-stage diagnosis and high mortality among rural women in Punjab. Despite policy-level efforts by the government and NGOs, there remains a critical need for grassroots, culturally appropriate interventions that can empower women with the knowledge and confidence to detect symptoms early and seek timely treatment (Gupta et al., 2020; Thomas et al., 2002; Verma et al., 2021).

Materials and methods

Study Design

This study used a community-based pre-post interventional design to assess the impact of a health education intervention on breast cancer awareness among women residing in rural areas of Punjab, India. A mixed-method approach was used, combining both quantitative and qualitative techniques to provide a comprehensive understanding of the participants' knowledge, perceptions, and behavioral intentions before and after the intervention. The quantitative component consisted of structured questionnaires and knowledge assessments, while the qualitative component included focus group discussions and feedback sessions to capture the depth of participants' experiences and attitudes.

Sampling and Population

The study included women aged 25 to 60 years from selected rural communities of Punjab, India. This age group was deliberately selected to align with the preventive focus of the intervention, aimed at improving breast cancer literacy, early symptom recognition, and BSE practices before the onset of advanced disease. Although breast cancer risk increases after 60 years, women above this age were not included due to anticipated challenges related to participation in group-based educational activities, comorbidities, and comprehension of structured questionnaires. Women below 25 years were excluded due to their comparatively lower risk and limited relevance to the intervention objectives.

Purposive sampling was used to recruit willing participants. The exclusion criteria included women below 25 years or above 60 years of age, those with a prior diagnosis of breast cancer, and individuals unable or unwilling to provide informed consent. Written informed consent was obtained from all participants before enrollment, and participation was entirely voluntary.

Intervention

The intervention comprised a single-day health education session conducted across eight community-based camps in rural Punjab. Each session lasted approximately 3 to 4 hr and included 25 to 30 women per camp. The educational content was based on standard, evidence-based breast cancer awareness materials and covered early warning signs, risk factors, common myths, the importance of early detection, and correct BSE techniques. The curriculum was adapted to the local context using simple language and visual aids.

The sessions were delivered by trained female health educators, including registered nurses and community health workers. These educators received standardized preintervention training conducted by the study investigators to ensure uniform content delivery and effective communication. Focused group discussions were conducted immediately after the educational sessions on the same day to reinforce key messages and address participant queries.

Tools Used

Data collection involved both quantitative and qualitative instruments. A structured questionnaire comprising 25 items was administered to assess knowledge levels related to breast cancer risk factors, symptoms, early detection methods, and prevention strategies. These questionnaires were administered before and after the educational session to measure changes in awareness and understanding. In addition, presession and postsession knowledge tests were specifically designed to evaluate the immediate learning outcomes of the intervention. To gain deeper insights into the participants' perspectives, focus group discussions (FGDs) were conducted with randomly selected subgroups. Feedback logs maintained by facilitators captured observations about participant

engagement, emotional responses, and areas of confusion or concern expressed during the session.

Data Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics (means, standard deviations, frequencies, and percentages) summarized demographic and baseline characteristics. Paired sample t-tests were used to compare between preintervention and postintervention scores for breast cancer knowledge, awareness, and perceptions. Normality assumptions were assessed before analysis. A two-tailed p value <.05 was considered statistically significant, and effect sizes (Cohen's d) were calculated where applicable. The results were presented in tables and figures.

Implementation of Awareness Camps

Between February and May 2024, eight breast cancer awareness camps were conducted across rural and semi-urban areas of Punjab. These community-based camps served as the primary intervention platforms for delivering breast cancer education and promoting preventive practices.

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki. Participation was voluntary, and written informed consent was obtained from all participants. The intervention focused solely on awareness and early help-seeking behavior; no diagnostic claims were made. Participants were informed that the sessions were for awareness only and did not replace medical evaluation. Women reporting symptoms or concerns were guided to appropriate referral pathways, including nearby primary health centers and tertiary care hospitals for further assessment.

Results

The results of the study provide compelling evidence that a structured, culturally sensitive health education intervention can significantly improve breast cancer awareness, understanding, and behavioral practices among rural women in Punjab. The data are categorized into four main sections: demographic characteristics, preintervention findings, postintervention outcomes, and observed behavioral changes.

Demographic Profile of Participants

The sample consisted of 300 rural women between the ages of 25 to 60 years from selected villages of Punjab. The sociodemographic characteristics of the participants reveal important contextual factors influencing breast cancer literacy. The sociodemographic characteristics of participants are summarized in Table 1.

These findings highlight that most the participants were housewives with low educational attainment, had limited financial independence, and were largely unexposed to previous health education about breast cancer. These vulnerabilities further emphasize the critical need for targeted awareness interventions.

Preintervention Findings

The baseline assessment revealed low levels of breast cancer knowledge, poor health-seeking behavior, and widespread cultural misconceptions.

The baseline assessment of participants revealed a significant gap in breast cancer awareness and preventive practices among rural women. The mean knowledge score was 9.82 out of 25, indicating limited understanding of breast cancer symptoms, risk factors, and early detection methods. Alarmingly, only 8% of participants reported ever performing BSE, and just 22% had heard of any symptoms related to breast cancer, such as a lump, nipple discharge, or changes in breast shape. Misconceptions were widespread; common myths included the belief that cancer is contagious or a form of divine punishment, which contributed to fear and stigma. Furthermore, the practice of CBE was virtually nonexistent, largely due to lack of awareness, absence of trained female health-care providers, and fear of social judgment. These findings reflect not only a profound knowledge deficit but also the influence of deep-rooted sociocultural barriers and misinformation that hinder timely detection and preventive health behavior among women in these communities.

Postintervention Outcomes

Following the structured awareness session, participants demonstrated statistically significant improvements in knowledge and breast health behaviors.

These findings demonstrate that even a one-time structured intervention can lead to dramatic gains in awareness and preventive health practices. Participants not only scored higher on knowledge assessments but also reported increased willingness to engage in screening. A comparison between preintervention and postintervention outcomes is presented in Table 2. No statistically significant differences were observed in baseline knowledge or postintervention improvement across the eight awareness camps; therefore, data were pooled for analysis. Exploratory observations indicated that women with formal education demonstrated slightly higher baseline knowledge scores; however, postintervention improvements were evident across all age groups and educational levels.

Figure 1 illustrates the comparative improvements observed after the intervention.

This bar graph illustrates the significant improvements in key breast cancer literacy and health behavior indicators among rural women after the educational intervention:

Postintervention results demonstrated a substantial improvement in both knowledge and behavioral outcomes related to breast cancer awareness among participants. The mean knowledge score increased from 9.82 to 18.45 out of 25, indicating a marked enhancement in participants' understanding of breast cancer, its symptoms, and preventive practices. The proportion of women practicing monthly BSE rose significantly from 8% to 40%, suggesting effective behavioral adoption of early detection practices. Likewise, awareness of breast cancer symptoms increased from 22% to 71%, reflecting a greater ability to recognize early warning signs. Importantly, willingness to seek CBE increased from 15% to 55%, indicating a reduction in fear and social stigma associated with breast health checks. Additionally, knowledge of risk factors rose from 18% to 65%, highlighting improved understanding of the causative and contributory elements of the disease. Collectively, these findings underscore the strong educational and behavioral impact of the health education intervention implemented through the awareness camps.

Observational and Behavioral Changes

In addition to statistical data, qualitative observations were recorded by the facilitators during and after the sessions. These

Table 1
Sociodemographic characteristics of the participants (n = 300)

Variable	Category	Percentage (%)
Occupation	Housewives	60%
Education level	No formal education	55%
Economic dependence	Dependent on male family	82%
Marital status	Married	76%
Age group	25–40 years	58%
Religion	Sikh	65%
Access to PHC	Yes	42%
Previous exposure to cancer awareness	Yes	19%

PHC = Primary health center.

behavioral indicators further validate the success of the intervention.

Key Observational Outcomes

- During the postsession discussions, participant engagement rose significantly, with a four-fold increase in questions asked compared to the beginning.
- Many women expressed that they felt more confident, less ashamed, and empowered to take action regarding their breast health.
- Support groups spontaneously formed in at least three villages, where women began meeting monthly to share their learning and perform BSE together.

Additionally, anecdotal records from facilitators noted that many participants brought relatives or friends to subsequent sessions, indicating a positive word-of-mouth effect and community-driven advocacy. Facilitators also observed increased peer-to-peer information sharing and informal leadership among participants, with women encouraging others to adopt BSE practices and attend follow-up sessions. These trends suggest growing community ownership of breast health awareness. Observed behavioral changes before and after the intervention are presented in Table 3.

This graph depicts coded observational scores (0 = none, 3 = high) across five key behavioral indicators:

The qualitative assessment revealed notable improvements in participants' attitudes and interpersonal engagement after the breast cancer awareness intervention. Participation in group discussions increased from passive (score 1) to highly active (score 3), indicating greater confidence and willingness among women to engage in dialog on breast health topics. Similarly, comfort in discussing breast-related issues improved from low (score 1) to moderate (score 2), reflecting a reduction in embarrassment and stigma. A significant reduction in misinformation was observed, with misconceptions about cancer declining from high (score 3) to low (score 1), particularly beliefs that cancer is contagious or a punishment. Peer-group engagement improved markedly, rising from no interaction (score 0) to active formation of support groups (score 2), suggesting a shift toward collective learning and community solidarity. Additionally, there was a positive change in health-seeking behavior, as participants' intention to consult a doctor increased from low (score 1) to moderate (score 2). These qualitative outcomes underscore the effectiveness of the intervention in fostering a more informed, open, and proactive community environment regarding breast health. These shifts suggest not only increased awareness but also a cultural shift toward more open, health-seeking, and empowered behavior among the participants. Figure 2 illustrates changes in key behavioral indicators after the educational intervention.

During postsession discussions, participants expressed concerns regarding access to diagnostic services, including limited availability of nearby facilities offering mammography, absence of female health-care providers, financial constraints, and uncertainty about referral pathways. These concerns highlighted structural barriers to early detection despite improved awareness.

Summary of Results

The findings from the postintervention phase indicate a significant improvement in breast cancer knowledge and preventive behaviors among participants. The increase in awareness was not limited to individual understanding but also translated into tangible behavioral and attitudinal changes, including greater willingness to engage in early detection practices such as BSE and CBE. These shifts reflect a growing sense of empowerment and openness among the women, many of whom began discussing breast health more comfortably and confidently within their families and communities. Furthermore, the intervention generated a positive community-wide ripple effect, as evidenced by the emergence of self-formed support groups and peer-led BSE demonstrations in several villages. This spontaneous peer engagement suggests not only retention of the knowledge imparted but also a sustainable model of community-based awareness and support, essential for long-term breast health promotion in rural settings. These outcomes emphasize that health education, when delivered in a culturally appropriate and participatory manner, can generate meaningful and sustainable change even with limited resources.

Discussion

Interpretation of Results

The intervention significantly improved awareness and positively influenced attitudes toward breast health. Knowledge gain and the practice of BSE increased, demonstrating that even a single-session campaign, when well-designed and contextually tailored, can yield meaningful outcomes.

These results are consistent with similar interventions conducted in other regions of India, highlighting the effectiveness of

Table 2
Comparison between preintervention and postintervention results

Parameter	Preintervention	Postintervention	% Increase	Significance
Mean knowledge score (out of 25)	9.82	18.45	+88%	$p < .001$
Monthly BSE practice	8%	40%	+400%	$p < .001$
Awareness of symptoms	22%	71%	+222%	$p < .001$
Willingness to seek CBE	15%	55%	+266%	$p < .001$
Knowledge of risk factors	18%	65%	+261%	$p < .001$

BSE = Breast self-examination; CBE = clinical breast examination.

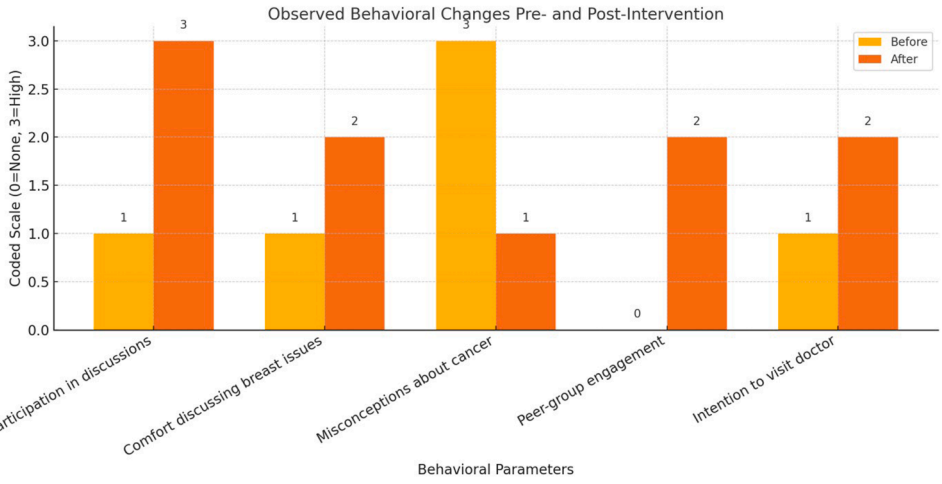

Figure 1. Comparisons between preintervention and postintervention outcomes.

community-based breast cancer awareness programs. For example, Nisha and Murali (2020) reported a 71.8% increase in BSE practice among rural women in Tamil Nadu after an educational intervention. Similarly, Kathrikolly et al. (2020) in Karnataka found that community-led outreach programs effectively enhanced awareness and promoted early detection behaviors. A distinguishing feature of the present study, however, was the integration of culturally embedded content and local storytelling techniques. In Punjab, where stigma and social silence around breast health are deeply ingrained, these culturally familiar narratives helped break barriers, normalize discussions, and increase participant engagement, making the intervention more relatable and acceptable.

Sociocultural Barriers

The study's findings align with previous research by Akram et al. (2017) and Yadav and Jaroli (2010), which identified persistent barriers to early breast cancer detection and care-seeking in low- and middle-income settings. Prominent among these is the perception of cancer as a death sentence, which discourages women from seeking medical consultations. Additionally, cultural norms that stigmatize discussions about breast health—even within families—perpetuate silence and misinformation. Financial dependence on male family members and limited autonomy in decision-making further restrict access to health-care services. Participants also reported transportation-related challenges, including long distances to health-care facilities, limited availability of public transport, and reliance on family members for travel, which further delayed access to diagnostic and preventive services. Collectively, these structural and sociocultural challenges highlight the urgent need for gender-sensitive, community-based interventions that empower women with both knowledge and agency to manage their breast health.

Table 3
Observational and behavioral shifts among participants

Observed behavior	Before intervention	After intervention
Participation in discussions	Passive or silent	Actively engaged
Comfort discussing breast issues	Low	Moderate to high
Misconceptions about cancer	Common	Reduced significantly
Peer-group engagement	None	Support groups initiated
Reporting intention to visit a doctor	Very low	Noticeable increase

Limitations

While the intervention demonstrated promising short-term outcomes, several limitations should be acknowledged. The community-based pre—post interventional design without a control group limits causal inference, making it difficult to attribute observed changes solely to the intervention. In addition, the single-session format did not allow assessment of long-term knowledge retention or sustained behavioral change.

Language and literacy barriers posed challenges during both intervention delivery and data collection. Despite the use of simple language and visual aids, reliance on structured questionnaires may have introduced literacy bias, potentially underrepresenting nonliterate or semi-literate women and skewing findings toward participants with higher educational levels.

The timing and delivery context of the sessions may also have influenced participation and engagement. Daytime scheduling could have limited attendance for women with household or caregiving responsibilities. Variations in camp size (25—30 participants) may have affected interaction, individual attention, and consistency of educational delivery.

Finally, community-based settings introduced environmental and contextual challenges, including noise, space limitations, and interruptions, which may have affected concentration and uniformity of training. The geographic restriction to selected rural and semi-urban areas of Punjab limits generalizability to regions with different cultural, linguistic, and health-care contexts.

Future studies incorporating controlled designs, multi-session follow-up, flexible scheduling, literacy-inclusive tools, and broader geographic coverage are recommended to strengthen evidence and applicability.

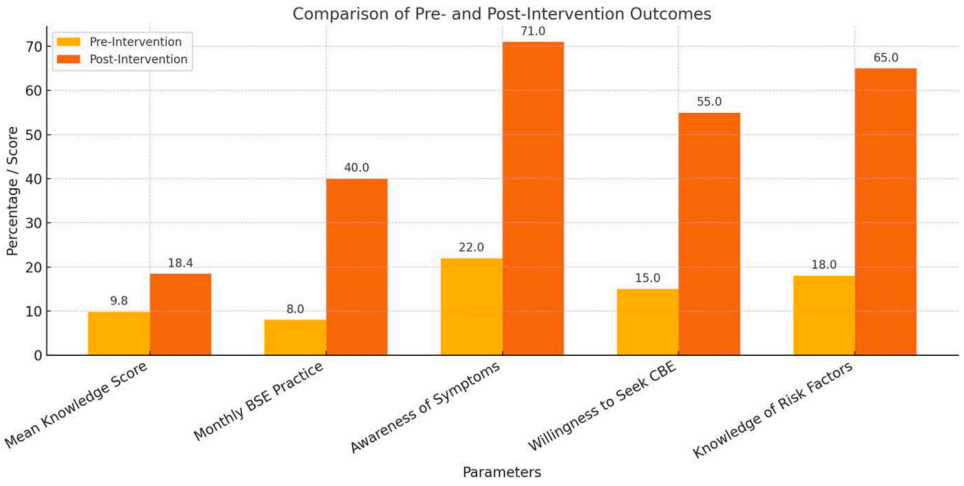

Figure 2. Observed behavioral changes preintervention and postintervention.

Conclusion

This study confirms that structured, culturally sensitive breast cancer awareness interventions can significantly improve literacy and health-seeking behaviors among rural women. While gains in knowledge and BSE practice were evident, persistent challenges—such as stigma, infrastructural deficits, and gender inequality—require multi-pronged, policy-integrated solutions. To achieve meaningful reductions in mortality, future initiatives must focus on training frontline health workers in breast health education, integrating breast cancer awareness into maternal health programs, deploying mobile screening vans, and developing regional Information, Education, and Communication materials in vernacular languages. Such an integrated, women-centered approach has the potential to bridge the urban-rural gap in cancer literacy and improve early detection and outcomes.

Patient consent/ethics statement

This community-based study involved voluntary participation of women aged 25 to 60 years from rural Punjab. Before the intervention, the study objectives and procedures were explained to all participants, and written informed consent was obtained. Participation was entirely voluntary, and participants could withdraw at any time without any consequences. Confidentiality was maintained throughout the study.

All procedures were noninvasive and designed to promote breast cancer awareness through education, in line with ethical principles for research involving human participants.

Conflict of interest statement

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CRediT authorship contribution statement

Mamta Panda: Writing – review & editing, Supervision, Methodology, Investigation, Conceptualization. **Shraddha Kumari:** Writing – original draft. **Kritika Sharma:** Conceptualization, Methodology, Project administration, Software. **Varshdeep Kour:** Visualization. **Lalit Kumar Gupta:** Validation, Supervision, Resources.

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