

Breast Cancer Screening Behaviors and the Role of Specific Health Literacy: How Much and How?

Zohreh Rahaei¹, Reyhane Sefidkar², Hajar Hoshyar³, Tahere Soltani^{4*}

1- Associate Professor of Health Education & Promotion, School of Public Health. Shahid Sadoughi University of Medical Sciences, Yazd, Iran.

2-Assistant Professor of Center for Healthcare Data Modeling, Department of Biostatistics and Epidemiology, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.

3- Master's student in Health Education and Promotion. Shahid Sadoughi University of Medical Sciences, Yazd, Iran.

4- Assistant Professor of Health Education & Promotion, School of Public Health, Social Determinants of Health Research Center, Non-Communicable Diseases Research Institute, Shahid Sadoughi University of Medical Sciences, Yazd, Iran. **(Corresponding Author)** .Soltanitahere@gmail.com

Background and Objectives: Breast cancer is highly prevalent among Iranian women, yet screening participation remains suboptimal. Drawing upon integrated health literacy frameworks, this study investigated breast cancer-specific health literacy and its association with screening behaviors among women aged 30–59 years in Pasargad city, Iran.

Materials and Methods: This descriptive-analytical cross-sectional study surveyed 194 women selected via randomized stratified sampling. Data were gathered using validated demographic, mHealth Literacy (8- item), and breast cancer-specific health literacy (26-item) scales, alongside a screening behavior checklist (4-item) (BSE, CBE, and mammography). Multiple linear regression model was applied to assess relation between cancer-specific health literacy and screening behaviors.

Results: Participants' mean breast cancer-specific health literacy and mHealth literacy scores were 85 ± 7.88 and 19.09 ± 4.60 . Breast cancer-specific health literacy scores positively correlated with education, employment, and prior health training ($p < 0.05$). Conversely, age and number of children were inversely correlated with information evaluation and decision-making dimensions ($p < 0.05$). breast cancer-specific health literacy remained a significant factor for screening behaviors after controlling for confounders ($p = 0.05$). mHealth literacy showed no significant association.

Conclusion: Digital literacy alone is insufficient to drive preventive actions, highlighting the importance of mHealth literacy as a critical component of health literacy. Disease-specific health literacy acts as a critical cognitive antecedent that shapes screening behaviors by altering cognitive appraisal, modifying health knowledge, attitudes, and practice, and reducing barriers, thereby strengthening the behavioral intention required for actual screening compliance, including breast self-examination (BSE), clinical breast examination (CBE), and mammography. Health promotion programs must shift from basic information delivery toward cognitive and attitudinal restructuring to successfully bridge the gap between literacy and action and improve patient acceptance of health care.

Keywords: Breast Neoplasms; Health Literacy; mHealth Literacy; Breast Self-Examination; Mammography; Patient Acceptance of Health Care; Screening Behaviors

Received: 10 March 2026

Accepted: 21 July 2026

Doi: 10.22038/jhl.2026.94128.1931

Open Access Policy: This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited. To view a copy of this licence, visit <https://creativecommons.org/licenses/by/4.0/>

Introduction

Modern human societies, characterized by the complexities arising from rapid technological advancements and modernization, are facing a critical surge in the burden of non-communicable diseases (NCDs). Societal shifts—including accelerated urbanization, westernized dietary shifts, sedentary lifestyles, and heightened exposure to environmental pollutants—have collectively exacerbated the global incidence of various malignancies (1, 2). Among these, breast cancer stands as the most prevalent malignancy and a premier threat to women's health globally, including in Iran. Consequently, prioritizing preventive behaviors and establishing mechanisms for early detection are of paramount public health importance (3) .

In Iran, breast cancer ranks first among female malignancies, accounting for approximately 25% to 30% of all cancer cases diagnosed in women. According to recent reports from the Iranian National Cancer Registry and the Global Cancer Observatory (GLOBOCAN), the age-standardized incidence rate (ASR) of breast cancer in Iran has been steadily climbing, with more than 16,000 new cases diagnosed annually (3-6). Tragically, epidemiological data indicate that the mean age of onset among Iranian women is at least one decade younger than that observed in developed countries, with over 40% of patients concentrated in their peak productive years between the ages of 40 and 60 (7). In response to this shifting epidemiological landscape, the Ministry of Health and Medical Education has integrated structured guidelines for breast cancer screening and early detection within the primary healthcare network(8). However, despite the systemic availability of these screening programs, utilization and attendance rates for regular clinical examinations remain suboptimal due to pervasive barriers such as insufficient awareness, fatalistic or negative attitudes, and localized accessibility constraints (5, 7, 9).

A pivotal, yet often overlooked, determinant of this low screening participation is the level of women's disease-specific health literacy. To understand its role, disease-specific health literacy must be conceptualized not merely as isolated knowledge, but as a critical cognitive antecedent that shapes a woman's behavioral intention and subsequent actual screening. Within the framework of health behavior theories, processing specific information regarding breast cancer risk factors (e.g., genetic history, breast density, and lifestyle predictors) serves as the

foundational cognitive input (10, 11). When a woman possesses sufficient disease-specific health literacy, it directly alters her cognitive appraisal of the disease; it modifies her attitudes toward screening, reduces perceived psychological and structural barriers, and enhances her self-efficacy. These cognitive and attitudinal shifts are vital, as they collectively formulate and strengthen her behavioral intention—the immediate, most critical proximal determinant of action. Ultimately, A strong behavioral intention bridges the

gap between cognition and behavior, translating a woman's internal readiness into actual screening behaviors, specifically the regular practice of breast self-examinations (BSE) and adherence to clinical breast examinations (CBE)(12, 13).

Modern healthcare infrastructures increasingly shift the onus of disease prevention onto the consumer, demanding a high degree of "self-management." Patients are now expected to assume autonomous roles in searching for information, navigating complex healthcare regulations, and making logical medical decisions for themselves and their families(14) While global and national literatures have consistently demonstrated that deficits in health literacy strongly correlate with poor adherence to cancer screening guidelines (15-18), comprehensive, localized data regarding breast cancer-specific health literacy among middle-aged women (aged 30–59) in Pasargad City are currently lacking. Given that regional sociocultural dynamics heavily dictate health-seeking behaviors and the acceptance of preventive programs, localized evidence is vital.

The present study was conducted to determine the level of breast cancer-specific health literacy among women aged 30–59 in Pasargad City and to systematically investigate its association with the practice of screening behaviors (CBE and BSE and mammography). It is anticipated that these regional insights will provide a strong, evidence-based foundation for public health planners to design targeted, culturally tailored educational interventions to optimize screening adherence in this population.

Materials and Methods

Study Design and Participants

This study employed a descriptive, cross-sectional design. The target population consisted of women aged 30 to 59 years registered at the comprehensive health service centers in Pasargad city, Iran. The required sample size ($n=194$) was calculated considering $r=0.20$, $\alpha=0.05$, and $\beta=0.20$ utilizing (19).

$$n = \left(\frac{z_{1-\frac{\alpha}{2}} + z_{1-\beta}}{0.5 \ln\left(\frac{1+r}{1-r}\right)} \right)^2 + 3$$

To account for a potential non-response rate (about 15%) and to ensure adequate representation, a total of 225 eligible women were invited to participate using a stratified random sampling method. The comprehensive health service centers served as the strata, and participants were randomly selected proportional to the population size of each center using their electronic health records as the sampling frame. Ultimately, 194 women completed the questionnaires, yielding response rate of 86.2%. The primary reasons for non-participation were a lack of interest (n=18) and time constraints (n=13).

The inclusion criteria were voluntary willingness to participate, holding Iranian nationality, having an active health record at the comprehensive health service centers of Pasargad city, being female aged 30 to 59 years, and owning a mobile phone. Furthermore, participants had to have no personal history of breast diseases or clinical signs (including abnormal nipple discharge, mastitis, fibrocystic changes, Mastalgia, or fibroadenoma), no family history of common female malignancies in first-degree relatives, and no current cancer diagnosis. Conversely, women with a known history or current diagnosis of severe physical or psychiatric disorders (such as clinical anxiety, depression, or severe stress) that could interfere with self-reporting were excluded from the study.

The research procedure was implemented after obtaining a letter of introduction from the School of Public Health at Shahid Sadoughi University of Medical Sciences and Health Services, Yazd, and securing approval from the university's ethics committee. The data collection process was initiated with the assistance of the personnel at the comprehensive health service centers. The center personnel explained the study's objectives and assured the participants of the strict confidentiality of their information. After obtaining informed consent, eligible individuals enrolled in the study and completed the anonymous instruments,. This study was approved by the Ethics Committee of Shahid Sadoughi University of Medical Sciences, Yazd, under the code IR.SSU.SPH.REC.1402.200 .

Measures

Data were collected utilizing a structured four-part instrument comprising demographic characteristics, breast cancer-specific health literacy, mhealth literacy, and preventive screening behaviors.

1. Demographic Information Questionnaire

This self-designed background form captured essential socio-demographic covariates, including participant age, marital status, education level, employment status, monthly household income, insurance coverage, and family history of breast cancer or other common malignancies.

2. Breast Cancer-Specific Health Literacy Questionnaire

To assess disease-specific health literacy, the instrument developed and psychometrically validated by Rajabi et al.(16) Was employed. This 26-item scale measures five distinct operational dimensions: Reading Skills (3 items), Access (5 items), Comprehension (5 items), Evaluation (5 items), and Decision-Making and Behavior (8 items). Responses are scored on a 5-point Likert scale ranging from 1 (Very Difficult) to 5 (Very Easy), yielding a total raw score between 26 and 130. Higher scores reflect superior levels of breast cancer-specific health literacy .The original validation study reported excellent content validity indices (Content Validity Index [CVI] = 0.92; Content Validity Ratio [CVR] = 0.78). In the present study, internal consistency was confirmed with an overall Cronbach's alpha of 0.73, with subscale alphas ranging from 0.68 to 0.79.

3. Mobile Health Literacy Scale (mHEALS)

Participants' capacity to seek and utilize health information via mobile platforms was measured using the 8-item Mobile Health Literacy Scale (mHEALS), originally developed by Lin et al.(17) based on the eHealth Literacy Scale (eHEALS) by Norman and Skinner (20). The scale encompasses two primary dimensions: Searching for Health Information (4 items) and Evaluating Health Information (4 items). Items are rated on a 5-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree), with cumulative scores ranging from 8 to 40. Higher scores signify proficient mobile health literacy. The psychometric properties of the Persian version were previously verified by Yarmohammadi et al. (15). In this study, the instrument displayed exceptional internal consistency, with an overall Cronbach's alpha of 0.94, and dimension-specific alphas of 0.86 for information searching and 0.81 for information evaluation.

4. Screening Behaviors Questionnaire

Breast cancer screening behaviors were evaluated using a 4-item, behavior-focused questionnaire developed by the research team in strict accordance with the national guidelines for early detection of breast cancer (21). The items objectively assessed the following components: Having ever performed a breast self-examination (BSE) (Yes/No); Having ever undergone a clinical breast examination (CBE) by a healthcare professional (Yes/No); Having ever undergone mammography screening (Yes/No; evaluated specifically for participants meeting the age-eligible criteria outlined in national guidelines); and the specific frequency of

BSE practice over the past 12 months (categorized as never, once, 2–3 times, or monthly)(22). Qualitative face validity was endorsed by a panel of five independent health education and promotion experts. Given that this scale registers factual, retrospective behaviors rather than subjective attitudes, temporal stability was evaluated via test-retest reliability on a subsample of 20 women with a two-week interval, demonstrating high stability ($r = 0.88$). Data were collected anonymously and, with confidentiality ensured, used for statistical analysis.

Data Analysis Method

Following extraction and initial cleaning the information was entered into SPSS version 26 for statistical analysis. Descriptive statistics, including measures of central tendency, dispersion, and frequency distributions, were used to summarize the characteristics of the study groups. For inferential statistics, the normality of quantitative data was initially assessed via the Kolmogorov–Smirnov test. Categorical variables were compared between groups using the Chi-square test. For continuous variables, independent t-tests or analysis of variance (ANOVA) were used for normally distributed data, while the Mann–Whitney U or Kruskal–Wallis tests were applied for non-normally distributed variables. Additionally, a multiple linear regression model was utilized to examine the relationships between independent variables on the dependent variable. Statistical significance was set at $P \leq 0.05$ for all tests.

Results

Demographic Characteristics

In this cross-sectional study, a total of 194 women aged 30 to 59 years residing in Pasargad City were evaluated. The mean age of participants was 39.06 ± 6.28 years, and their mean age at marriage was 22.65 ± 5.6 years. The majority of participants held a high school diploma (59.3%), were married (87.6%), and were housewives (70.1%). Nearly half of the women (54.6%) had never attended health-related educational classes.

Health Literacy and Its Dimensions

The mean breast cancer–specific health literacy score among participants was 85 ± 7.88 out of 133, indicating a moderate level of health literacy. Across the health literacy dimensions, the decision-making domain had the highest mean score (30.11 ± 6.21), whereas the reading dimension had the lowest (7.48 ± 2.79) (**Table 1**).

The mean score of m health literacy was 19.09 ± 4.60 out of 40, with the highest score in the information evaluation domain (9.62 ± 2.52) and the lowest in information seeking (9.47 ± 2.48).

Breast Cancer Screening Behaviors

The mean score for breast cancer screening behaviors was 3.02 ± 1.81 out of 7. The results indicated that 33% of participants reported performing monthly breast self-examinations, while 50.5% had undergone a clinical breast examination by a physician or midwife within the previous year.

Correlations of Health Literacy Dimensions with Demographic Variables

As presented in **Table 2**, several significant correlations were observed between health literacy dimensions and demographic variables. The reading dimension ($r=0.191$, $P<0.01$) and comprehension dimension ($r=0.199$, $P<0.01$) showed significant positive correlations with age. Conversely, access ($r=-0.183$, $P<0.01$), evaluation ($r=-0.191$, $P<0.01$), and decision-making ($r=-0.150$, $P<0.05$) demonstrated significant inverse correlations with age. Reading showed a significant positive correlation ($r=0.265$, $P<0.01$), while access ($r=-0.147$, $P<0.05$) and evaluation ($r=-0.149$, $P<0.05$) showed significant inverse correlations with the number of children.

Reading ($r=0.226$, $P<0.01$) and comprehension ($r=0.168$, $P<0.05$) correlated positively with spouse's age, whereas access ($r=-0.191$, $P<0.01$), evaluation ($r=-0.193$, $P<0.01$), and decision-making ($r=-0.167$, $P<0.05$) showed inverse correlations.

Reading ($r=0.275$, $P<0.01$) and information seeking ($r=0.151$, $P<0.05$) correlated positively with the number of deliveries, while access showed an inverse correlation ($r=-0.165$, $P<0.05$). No significant correlations were found between any health literacy dimension and age at marriage.

Regression Analysis of Determinants of Breast Cancer Screening Behaviors

Linear regression analysis was performed to examine the association and relative contribution of health literacy to breast cancer screening behaviors. The results are summarized in Table 3.

Model 1 (Unadjusted): Breast cancer-specific health literacy was significantly and positively related with screening behavior scores ($B=0.05$, $SE=0.01$, $P<0.001$).

Model 1 (Adjusted for confounders): After adjustment for employment, education, income, tobacco use, history of illness, menopausal status, contraceptive method, and BMI, breast cancer-specific health literacy remained a significant independent determinant of screening behavior scores ($B=0.03$, $SE=0.01$, $P=0.02$).

Model 2 (Unadjusted): mHealth literacy alone showed a significant negative related with screening behavior scores. ($B=-0.06$, $SE=0.02$, $P=0.02$).

Model 2 (Adjusted): After adjustment, mHealth literacy was no longer significantly related with screening behavior scores ($B=-0.04$, $SE=0.02$, $P=0.13$).

In Model 3, which included both cancer-specific health literacy and mHealth literacy, specific health literacy was a significant determinant of screening behavior scores ($B=0.05$, $SE=0.01$, $P=0.003$), whereas mHealth literacy was not a significant determinant ($B=-0.03$, $SE=0.02$, $P=0.19$).

In the adjusted model (Model 3), cancer-specific health literacy remained a significant determinant of screening behavior scores after controlling for covariates ($B=0.03$, $SE=0.01$, $P=0.05$), while mHealth literacy was not a significant determinant ($B=-0.02$, $SE=0.02$, $P=0.31$).

Table 1. Descriptive Statistics of Breast Cancer Health Literacy Scores

Variable	Achievable Range	Min – Max	Mean	Standard Deviation
Access	5 – 25	9 – 25	19.10	3.68
Reading	3 – 15	3 – 15	7.48	2.79
Comprehension	5 – 25	5 – 25	10.82	3.59
Evaluation	5 – 25	8 – 25	17.46	3.76
Decision Making	8 – 40	9 – 40	30.11	6.21
cancer specific health literacy	26 – 133	65 – 105	85.00	7.88
Health Information Searching	4 – 20	5 – 20	9.47	2.48
Health Information Evaluation	4 – 20	5 – 20	9.62	2.52
m Health Literacy (Total)	8 – 40	11 – 35	19.09	4.60
Breast Cancer Screening Behaviors	0 – 7	0 – 7	3.02	1.81

Table 2. Correlation Matrix between Health Literacy Dimensions and Demographic Variables

Variable	Age	Number of Children	Spouse's Age	Number of Deliveries	Age at Marriage
Access	-0.183**	-0.147*	-0.191**	-0.165*	0.114
Reading	0.191**	0.265**	0.226**	0.275**	-0.110
Comprehension	0.199**	0.088	0.168*	0.081	-0.005
Evaluation	-0.191**	-0.149*	-0.193**	-0.135	0.022
Decision Making	-0.150*	-0.137	-0.167*	-0.131	-0.010
Information Searching	0.116	0.151*	0.085	0.151*	-0.119
Information Evaluation	0.037	0.004	0.003	0.004	-0.080

* $P < 0.05$, ** $P < 0.01$

Table 3. Linear Regression model of Determinants of Breast Cancer Screening Behaviors

Variable	B	SE	P	Model
cancer specific health literacy	0.05	0.01	<0.001	Model 1 (Unadjusted)
cancer specific health literacy	0.03	0.01	0.02	Model 1* (Adjusted)
M Health Literacy	-0.06	0.02	0.02	Model 2 (Unadjusted)
M Health Literacy	-0.04	0.02	0.13	Model 2* (Adjusted)
cancer specific health literacy	0.05	0.01	0.003	Model 3 (Unadjusted)
M Health Literacy	-0.03	0.02	0.19	Model 3 (Unadjusted)
cancer specific health literacy	0.03	0.01	0.05	Model 3* (Adjusted)
M Health Literacy	-0.02	0.02	0.31	Model 3* (Adjusted)

Note: Models marked with * (asterisk) are adjusted for employment, educational history, income, tobacco use, history of illness, menopausal status, education level, contraceptive method, and body mass index (BMI).
B = unstandardized regression coefficient; SE = standard error

Discussion

The primary objective of this study was to determine the level of breast cancer-specific health literacy and its relationship with screening behaviors among women aged 30–59 in Pasargad City, while exploring the modifying role of demographic characteristics. Our findings revealed a pronounced "knowledge-practice gap"; while the study population exhibited a moderate level of specific health literacy, their actual breast cancer screening behaviors were remarkably low. This discrepancy aligns with previous domestic investigations in Iran, such as studies in Zahedan (23) and Sari (24), as well as international literature from developing nations (25, 26). This persistent gap underscores that possessing health knowledge or basic literacy skills does not automatically translate into preventive health actions, highlighting the necessity of addressing deep-seated behavioral, socio-cultural, and structural barriers.

Relationship between Demographic Characteristics and specific Health Literacy

Our study confirmed that higher educational attainment, employment status, and a history of attending health education classes are significantly associated with superior health literacy scores. These findings are consistent with strong international (27) and national (11, 28) evidence emphasizing socio-demographic factors as primary structural determinants of health literacy. Higher education enhances cognitive capacity, enabling individuals to comprehend complex medical jargon and navigate health systems effectively (29, 30). Similarly, employment often expands social networks, fosters autonomy, and increases exposure to wellness information in the workplace. We also observed a significant correlation between marital status and health literacy, corroborating the work of Khaleghi et al (31), which suggests that marital partnerships may facilitate shared health responsibility and mutual information support.

An intriguing and nuanced finding was the divergent effect of age and parity (number of children) across different dimensions of health literacy. We found a positive correlation between age and parity with the "Reading" dimension score. This suggests that older women and multiparous mothers may develop enhanced functional skills over time due to repeated, compulsory interactions with maternal and child healthcare systems (e.g., routine vaccinations, pediatric visits). This pattern is supported by literature linking cumulative life experience to improved functional health literacy (32, 33).

Conversely, an inverse and significant relationship emerged between age and parity and the advanced cognitive dimensions of health literacy, namely Access, Evaluation, and Decision-Making. This phenomenon can be strongly explained by the Family Responsibility Burden

Theory (34, 35) . As women age or bear more children, their domestic, caregiving, and financial responsibilities multiply. This heavy burden disproportionately drains their limited cognitive bandwidth and time resources. Consequently, despite being able to "read" health materials, they experience a diminished capacity to critically analyze conflicting medical information (Evaluation) or execute autonomous health choices (Decision-Making) amid competing family priorities (34).

Relationship between specific health literacy and Screening Behaviors

The current study indicates that women in Pasargad City participate at very low rates in Breast Self-Examination (BSE), Clinical Breast Examination (CBE), and mammography. Notably, mammography rates among women over 40 were critically low. This functional deficit persisted despite moderate health literacy scores, reinforcing the premise that cognitive literacy alone cannot bypass systemic obstacles. This is consistent with studies by Armin et al. (36) and regional data showing that restricted health literacy directly diminishes breast cancer awareness and limits routine BSE practice (37).

Importantly, **multiple** linear regression analysis revealed a strong and stable independent association between specific breast cancer health literacy and screening behaviors. Notably, this link remained statistically significant after adjusting for key socio-demographic confounders. (age, education, and economic status). Conversely, the statistical significance of mHealth literacy disappeared upon controlling for these confounding factors (38).

As conceptualized in the introduction of this study, disease-specific health literacy must not be viewed merely as isolated knowledge, but as a critical cognitive antecedent that is linked with the processing of specific breast cancer risk factors. Our regression findings empirically support this conceptualization. While general health literacy lacks the tailored depth to induce psychological shifts (39), superior disease-specific health literacy may contribute to a more favorable cognitive appraisal of the disease. Specifically, it is associated with positive attitudes toward screening, lower perceived psychological and structural barriers, and enhanced self-efficacy (40, 41). These cognitive and attitudinal shifts are vital because, within our theoretical framework, they collectively characterize and strengthen her behavioral intention. This intention represents the immediate, most critical proximal determinant of action(42). Ultimately, a strong behavioral intention is what bridges the gap between cognition and behavior (41). The low screening rates observed in our study population suggest a potential breakdown in this process. Without adequate disease-specific cognitive input, the subsequent cascade of cognitive appraisal and self-efficacy may be halted. Consequently, this fails to generate the behavioral intention necessary to translate an individual's internal readiness into actual screening behaviors, such as BSE, CBE, and mammography (43).

Study Limitations and Strengths: Several methodological limitations warrant consideration when interpreting the findings of this study. First, the cross-sectional design precludes establishing definitive causal relationships among the variables. Second, data collection regarding screening behaviors relied on self-reports, which may introduce recall or social desirability biases. Third, because the sample was drawn exclusively from comprehensive health service centers in Pasargad city, the generalizability of the findings to regions with different sociocultural or socioeconomic contexts is limited. Finally, despite statistically adjusting for multiple demographic covariates, residual confounding from unmeasured factors, such as geographical accessibility to specialized healthcare facilities, cannot be entirely ruled out.

Despite these limitations, this study possesses several notable strengths. It addresses critical and highly relevant dimensions of public health, specifically advanced critical health literacy skills, including information appraisal and clinical decision-making. Additionally, the methodological rigor is enhanced by adjusting for multiple demographic covariates, thereby reducing the potential impact of confounding variables. Furthermore, the study maintains a high level of transparency regarding its challenges while providing well-defined directions for future research.

Based on the findings and limitations of this study, the following directions are recommended for future inquiries: Future studies should employ prospective longitudinal designs to empirically validate causal pathways and temporal dynamics, complemented by qualitative approaches to deeply explore how lived experiences (e.g., aging and multiparity) shape health literacy. Furthermore, conducting multi-center studies with wider geographic sampling and diverse socioeconomic cohorts will enhance the external validity of the findings.

Conclusion

Digital literacy alone is insufficient to drive preventive actions. Instead, disease-specific health literacy acts as a critical cognitive antecedent that directly shapes breast cancer screening behaviors. It refines cognitive appraisal, modifies attitudes, and mitigates perceived barriers, thereby strengthening the behavioral intention required to translate internal readiness into actual screening compliance (including BSE, CBE, and mammography). Consequently, health promotion initiatives must shift from basic information dissemination toward cognitive and attitudinal restructuring to successfully bridge the gap between literacy and action. Crucially, health authorities should design and implement tailored educational interventions grounded in behavior change principles, with a specific emphasis on strengthening evaluation and decision-making skills among vulnerable cohorts, particularly older and multiparous women.

Acknowledgments: This study is based on an MSc thesis in Health Education and Promotion, which was approved by the Research and Technology Deputy of Shahid Sadoughi University of Medical Sciences. The authors wish to extend their appreciation to the Deputy of Research and Technology at Yazd Shahid Sadoughi University of Medical Sciences for providing financial support for the project. Additionally, the author acknowledges the research subjects for their participation, whose provision of information and time made this study possible.

Availability of Data and Materials: The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflicts of interest: The authors declare that they have no competing interests.

Consent for publication: Not applicable.

Ethical Approval and consent to participate: This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Ethics Committee of Shahid Sadoughi University of Medical Sciences, Yazd, Iran. (IR.SSU.SPH.REC.1402.200). The study objectives were verbally explained, and the confidentiality of the collected information was assured.

Funding: This research was carried out without external financial support.

Authors' Contributions: T.S, Z.R, H.H, and R.S contributed to the study conception and design, data analysis, and drafting of the manuscript. H.H contributed to data collection. Z.R, and R.S contributed to statistical analysis. T.S supervised the project and All authors reviewed and approved the final version.

References

1. Pati S, Irfan W, Jameel A, Ahmed S, Shahid RK. Obesity and Cancer: A Current Overview of Epidemiology, Pathogenesis, Outcomes, and Management. *Cancers*. 2023;15(2):485. <https://doi.org/10.3390/cancers15020485> PMID:36672434 PMCID:PMC9857053
2. Li J, Xu J, Zheng Y, Gao Y, He S, Li H, et al. Esophageal cancer: Epidemiology, risk factors and screening. *Chin J Cancer Res*. 2021;33(5):535-47. <https://doi.org/10.21147/j.issn.1000-9604.2021.05.01> PMID:34815628 PMCID:PMC8580797
3. Schwartz SM. Epidemiology of Cancer. *Clin Chem*. 2024;70(1):140-9. <https://doi.org/10.1093/clinchem/hvad202> PMID:38175589
4. Janatolmakan M, Lashkari M, Lehto R, R N. Improving early detection of breast cancer in Iran: Identifying barriers and proposing policy solutions. *Nurs Pract Today*. 2026;13(2):121-6. <https://doi.org/10.18502/npt.v13i2.21463>
5. Mohammadi E, Aminorroaya A, Fattahi N, Azadnajafabad S, Rezaei N, Farzi Y, et al. Epidemiologic pattern of cancers in Iran; current knowledge and future perspective. *J Diabetes Metab Disord*. 2021;20(1):825-9. <https://doi.org/10.1007/s40200-020-00654-6> PMID:34222092 PMCID:PMC8212225
6. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. *CA Cancer J Clin*. 2021;71(3):209-49. <https://doi.org/10.3322/caac.21660> PMID:33538338

7. Çelik B, Akın B. The Relationship Between the Health Literacy Levels of Women of Reproductive Age and Their Level of Knowledge About Cancer Screenings. *J Eval Clin Pract.* 2025;31(5): e70162. <https://doi.org/10.1111/jep.70162> PMID:40618412 PMCID:PMC12229259
8. Ministry of Health and Medical Education. Iranian Annual National Cancer Registration Report. Tehran: Ministry of Health; 2024.
9. Aksoy F, Boyraz Yanık HG, Erbil N. Relationship Between Health Literacy and Knowledge About Gynaecological Cancer Prevention of Women. *Int J Nurs Pract.* 2025;31(1): e70000. <https://doi.org/10.1111/ijn.70000> PMID:39908577 PMCID:PMC11798590
10. Glanz K, Rimer BK, Viswanath K, editors. *Health behavior: Research, theory, and practice.* 5th ed. San Francisco: Jossey-Bass; 2015.
11. Saffari M, Sanaeinasab H, Zaboli R, Rahmati F, Ameryoun A, Lin CY. Sociodemographic Factors Associated with Health Literacy in General Population: A Systematic Review. *J Health Lit.* 2025;9(1):9-26.
12. Nutbeam D. The evolving concept of health literacy. *Soc Sci Med.* 2008;67(12):2072-8. <https://doi.org/10.1016/j.socscimed.2008.09.050> PMID:18952344
13. Bahri N, Mardani F, Sharifi N, Dashti S. Predicting factors for breast cancer screening in Middle Eastern women based on health belief model: a systematic review. *J Egypt Natl Canc Inst.* 2022;34(1):50. <https://doi.org/10.1186/s43046-022-00150-3> PMID:36464741 PMCID:PMC13314224
14. Bodenheimer T, Lorig K, Holman H, Grumbach K. Patient self-management of chronic disease in primary care. *JAMA.* 2002;288(19):2469-75. <https://doi.org/10.1001/jama.288.19.2469> PMID:12435261 PMCID:PMC6549848
15. Yarmohammadi P, Morowatisharifabad MA, Khayyat-zadeh SS, Madadzadeh F, Rahaei Z. Psychometric Properties of the Mobile Health Literacy Scale in the Workers of an Automotive Metal Sheet Factory in Shahrekord, Iran. *Health Lit Res Pract.* 2022;6(4): e257-e61. <https://doi.org/10.3928/24748307-20220921-01> PMID:36215109 PMCID:PMC9545815
16. Rajabi R, Abedi P, Araban M, Maraghi E. Effects of Education via WhatsApp vs Compact Disk on Health Literacy and Behavior of Middle-Aged Women about Screening Methods of Breast Cancer. *J Health Lit.* 2021;6(3):12-22. <https://doi.org/10.30699/ijbd.14.3.12>
17. Lin TT, Bautista JR. Understanding the relationships between mHealth apps' characteristics, trialability, and mHealth literacy. *J Health Commun.* 2017;22(4):346-54. <https://doi.org/10.1080/10810730.2017.1296508> PMID:28323546
18. Burke J, Hernon M, Vemuru SR, Adams M, Leonard L, Taft N, et al. Self-reported Health Literacy, Digital Literacy, and Barriers to accessing care at a Safety Net Breast Surgical Oncology Clinic. *medRxiv.* 2024. doi:10.1101/2024.01.01.24300700. <https://doi.org/10.1101/2024.09.20.24314073>

19. Aghaieian N, Farahaninia M, Janmohammadi S, Haghani H. Association between health literacy and preventive behaviors of breast cancer in women. *J Health Lit.* 2019;4(2):9-17.
20. Norman CD, Skinner HA. eHEALS: the eHealth literacy scale. *J Med Internet Res.* 2006;8(4): e507. <https://doi.org/10.2196/jmir.8.4.e27> PMID:17213046 PMCID:PMC1794004
21. Ministry of Health and Medical Education. National guidelines for breast cancer screening and early detection in primary health care. Tehran: UNICEF and Ministry of Health; 2023. Available from: <https://health.behdasht.gov.ir/vst>
22. Tavakol Z, Bani Hosseini SZ, Mansouri A. Evaluating knowledge, attitude, and performance of Tehran University of Medical Sciences students about breast cancer screening, in 2010. *Navid No.* 2012;16(58):45-53.
23. Heidari Z, Mahmoudzadeh-Sagheb HR, Sakhavar N. Breast cancer screening knowledge and practice among women in southeast of Iran. *Acta Med Iran.* 2008;46(4):321-8.
24. Ahmadzadeh Amiri A, Haghshenas M, Ahmadzadeh Amiri A, Daneshvar F. Knowledge and attitude among outpatient women visiting a healthcare center in northern Iran regarding breast self-examination: a cross-sectional study. *J Health Res.* 2021;36(5):964-71 <https://doi.org/10.1108/JHR-09-2020-0419>
25. Ayebeng C, Okyere J, Okantey C, Addo IY. Multifaceted barriers associated with clinical breast examination in sub-Saharan Africa: A multilevel analytical approach. *PLoS One.* 2025;20(1): e0316800. <https://doi.org/10.1371/journal.pone.0316800> PMID:39804868 PMCID:PMC11730425
26. Ebrahimoghli R, Aghaei MH, Azami-Aghdash S, Houssami N. Uptake of breast cancer screening practices in low- and middle-income countries: a systematic review and meta-analysis. *J Natl Cancer Inst.* 2025;117(1):29-39. <https://doi.org/10.1093/inci/djae187> PMID:39133184
27. Gonçalves-Fernández ML, Pino-Juste M. Health literacy in healthy adults: A systematic review of recent evidence. *Aten Primaria.* 2025;57(11):103300. <https://doi.org/10.1016/j.aprim.2025.103300> PMID:40680630 PMCID:PMC12296493
28. Shahrahmani H, Kariman N, Ahmadi A, Nasiri M, Keshavarz Z. Factors Related to Health Literacy Among the Iranian Population: A Scoping Review. *Med J Islam Repub Iran.* 2023; 37:138. <https://doi.org/10.47176/mjiri.37.138> PMID:38435830 PMCID:PMC10907049
29. Saw Ye T, Muhammad Alwi P, Yu Y, Fu-Gong L. Exploring the Interplay of Health Literacy and Non-Communicable Disease Health Outcomes in Southeast Asia: A Systematic Review. *Iran J Public Health.* 2025;54(10):1820-32.
30. Paasche-Orlow MK, Wolf MS. The causal pathways linking health literacy to health outcomes. *Am J Health Behav.* 2007;31 Suppl 1: S19-26. <https://doi.org/10.5993/AJHB.31.s1.4>

31. Khaleghi M, Amin Shokravi F, Peyman N. The Relationship Between Health Literacy and Health-Related Quality of Life in Students. *Iran J Health Educ Health Promot.* 2019;7(1):66-73. <https://doi.org/10.30699/ijhehp.7.1.66>
32. Moradzadeh R, Nazari J, Orouji A, Zamanian M, Shamsi M, Chezani-Sharahi N. Health Literacy among Mothers with Children under 6 Years Old, a Population-based Cross-Sectional Study in Iran, 2019-20. *Health Educ Health Promot.* 2025;10(2):395-401.
33. Santha AR. Maternal health literacy of ethnic Hungarian mothers in Romania. *Kontakt.* 2019;21(2):197-205. <https://doi.org/10.32725/kont.2019.011>
34. Houston AJ, Gunn CM, Paasche-Orlow MK, Basen-Engquist KM. Health Literacy Interventions in Cancer: a Systematic Review. *J Cancer Educ.* 2021;36(2):240-52. <https://doi.org/10.1007/s13187-020-01915-x> PMID:33155097 PMCID:PMC8005416
35. Zahedi H, Sahebiagh MH, Mirghafourvand M, Peters K, Hosseinzadeh M. Preparedness for caregiving among caregivers of breast cancer patients and its association with health literacy and caregiving competence. *Sci Rep.* 2025;15(1):14179. <https://doi.org/10.1038/s41598-025-97437-x> PMID:40269075 PMCID:PMC12019558
36. Armin J, Torres CH, Vivian J, Vergara C, Shaw SJ. Breast self-examination beliefs and practices, ethnicity, and health literacy: Implications for health education to reduce disparities. *Health Educ J.* 2014;73(3):274-84. <https://doi.org/10.1177/0017896912471048> PMID:25284844 PMCID:PMC4179105
37. Tailakh A, Portillo Y, Winokur EJ. Health Literacy and Preventive Health Behaviors Among Hispanics: Path Analysis Approach. *J Transcult Nurs.* 2025;36(6):661-70. <https://doi.org/10.1177/10436596251343786> PMID:40411194
38. Poon PKM, Tam KW, Lam T, Luk AKC, Chu WCW, Cheung P, et al. Poor health literacy associated with stronger perceived barriers to breast cancer screening and overestimated breast cancer risk. *Front Oncol.* 2023; 12:103425. <https://doi.org/10.3389/fonc.2022.1053698> PMID:36686831 PMCID:PMC9850080
39. Isonne C, Sinopoli A, Pistollato A, Sciurti A, Iera J, Migliara G, et al. Does cancer literacy predict cancer screening intention or uptake? A systematic review. *Patient Educ Couns.* 2025; 141:109346. <https://doi.org/10.1016/j.pec.2025.109346> PMID:40939488
40. Indah N, Nilawati Usman A, Sanusi Baso Y, Syarif S, Ahmad M, Agus Mumang A. Application of the Health Belief Model in Breast Self-Examination: A Meta-Analysis. In: *The International Conference on Public Health Proceeding.* 2024;9(1):48-56.
41. Indah N, Nilawati Usman A, Sanusi Baso Y, Syarif S, Ahmad M, Agus Mumang A. Early detection of self-breast examination using smartphone breast application. *Breast Dis.* 2024;43(1):135-44. <https://doi.org/10.3233/BD-249004> PMID:38820009 PMCID:PMC11191427

42. Engelman KK, Cupertino AP, Daley CM, Long T, Cully A, Mayo MS, et al. Engaging diverse underserved communities to bridge the mammography divide. BMC Public Health. 2011;11(1):47. <https://doi.org/10.1186/1471-2458-11-47> PMID:21255424 PMCID:PMC3036625
43. Sentell TL, Tsoh JY, Davis T, Davis J, Braun KL. Low health literacy and cancer screening among Chinese Americans in California: a cross-sectional analysis. BMJ Open. 2015;5(1): e006104. <https://doi.org/10.1136/bmjopen-2014-006104> PMID:25564140 PMCID:PMC4289731

ImPress