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Development of a Structural Model for Breast Cancer Information Dissemination Among Sri Lankan Undergraduates

Palamandadige Kalpana Subhashani Manatunga^a, Daya Chandrani Kuruppu^b^aMain Library, University of Colombo, Colombo, Sri Lanka^bLibrary, Faculty of Medicine, University of Colombo, Colombo, Sri Lanka

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ABSTRACT

Background: Breast cancer is a leading public health concern in Sri Lanka, and access to reliable information is essential for early detection. Nonmedical female undergraduates, especially those in the social sciences, often engage in community education. Although this is not an official policy, their potential to raise awareness makes it important to understand how they handle information. This study aimed to develop a statistically validated structural model for the effective dissemination of breast cancer-related information, focusing on 6 constructs: Information Need, Satisfaction, Impact, Information Source, Information Dissemination, and Medium of Information.

Methods: A cross-sectional quantitative design was adopted, collecting data from 5 selected state universities using stratified self-weighting random sampling guided by the Krejcie and Morgan table. Data were collected using a structured, validated questionnaire (Cronbach $\alpha = 0.876$) administered via Google Forms. Analysis was conducted using SPSS version 23 and SmartPLS 3.2.6. Partial least squares structural equation modeling (PLS-SEM) was used to assess the measurement and structural models, focusing on validity, reliability, and model fit.

Results: The model initially included 38 indicators, later refined to 33. Bootstrapped analysis (5000 resamples) confirmed 9 of 11 hypotheses; the moderating effects of the Medium of Information were not significant.

Conclusion: The findings revealed that Satisfaction significantly contributed to the perceived Impact, while Information Need and Dissemination showed no direct effect. The validated model provides a foundation for designing culturally relevant, evidence-based awareness programs grounded in reliable information sources tailored to Sri Lankan undergraduates.

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INTRODUCTION

Breast cancer remains a leading public health concern in Sri Lanka, with a consistent increase in incidence and mortality over the past decades; by 2020, reported cases exceeded 5 000, reflecting a notable escalation in the national disease burden.¹ According to the World Health Organization, breast cancer accounted for 1.07% of all deaths in Sri Lanka,

which placed the country 124th in global breast cancer mortality rankings.² While the disease predominantly affects older women, younger age groups are not exempt from risk. According to the National Cancer Control Programme, breast cancer represents a significant proportion of female cancers in Sri Lanka, particularly among women aged 35 years and older. In 2019, there were 4 447 reported cases, which increased to 5 189 in 2020. Among women aged 35 to 49 years, breast cancer accounts for 35.7% of all female cancers, while it represents 30.7% among those aged 50 to 64 years and 23.0%

*Address for correspondence:

Palamandadige Kalpana Subhashani Manatunga, PhD,
Main Library, University of Colombo, Colombo, Sri Lanka
Email: kalpism@lib.cmb.ac.lk



among women aged 65 years and older. Although less prevalent among younger women, breast cancer remains the third most common cancer among those aged 15 to 34 years.¹

A global review by Ali³ in 2021, which synthesized findings from more than 400 studies, demonstrated that women diagnosed before the age of 35 years face a significantly higher risk of metastasis, ranging from 12.7% to 38%, compared with 3.7% to 28.6% among older patients. This disparity was attributed to the aggressive biological characteristics of breast cancer in younger individuals and delays in diagnosis.³ These insights emphasize the complexity of metastatic progression and the need for age-specific screening, timely diagnosis, and personalized intervention strategies. Given these trends, developing context-specific and age-appropriate awareness and prevention programs is critical to reducing the breast cancer burden across diverse female populations in Sri Lanka.

In the Sri Lankan context, nonmedical undergraduates represent a valuable demographic for supporting breast cancer awareness efforts. Their broad social networks and educational engagement put them in a position to disseminate simplified and accessible information on prevention, early detection, and treatment. Given their potential to reach diverse communities, these students can make meaningful contributions to enhancing public health literacy. Through communication and by helping to eradicate breast cancer stigmas, they can encourage early detection through regular screening and early medical intervention, leading to improved outcomes and reduced mortality.

Furthermore, involving nonmedical undergraduates in these activities fosters leadership, empathy, and social responsibility in future professionals across diverse fields. It facilitates interdisciplinary collaboration and reinforces collective responsibility to control breast cancer in Sri Lanka. The lack of research on breast cancer information behavior and its effect on nonmedical female undergraduates in Sri Lanka is due to numerous factors, including inadequate funding for health care research, resource constraints in research facilities and experienced researchers, and competing health care priorities that focus more on short-term needs. Stigma, cultural taboos related to breast cancer, and limited awareness about the necessity for such research also hinder these activities. The availability and quality of data, research capacity constraints, language issues, and sociopolitical instability also contribute to the lack of studies in Sri Lanka.

Understanding the information behavior of Sri Lankan nonmedical female undergraduates is

essential for designing effective educational programs and interventions related to breast cancer. Information behavior encompasses how individuals interact with information, specifically how they seek, access, manage, share, and use breast cancer-related information across various contexts. This study aims to examine the information-seeking behavior of nonmedical female undergraduates regarding breast cancer from 5 state universities in Sri Lanka and assess its impact. The ultimate objective is to develop a statistically validated model for effective information dissemination.

METHODS

The study employed a cross-sectional survey design, which is appropriate to develop a statistically validated structural model for the effective dissemination of breast cancer-related information among Sri Lankan nonmedical female undergraduates. The research was conducted in accordance with the standards set by the Research Committee of the Library, University of Colombo.

Population

This research targeted nonmedical female undergraduates enrolled in 2023 from 5 selected state universities in Sri Lanka, ensuring a nationally representative sample by focusing on students from non-health science faculties to exclude those with specialized knowledge in health-related fields. The inclusion requirements were language skills (ie, the ability to understand and respond to questionnaires in Sinhala, Tamil, or English) to ensure they could actively engage with the materials and provide informed responses. The second requirement was a selection based on participants' mental health status; only those participants who had no mental illness that would make it difficult for them to understand the information provided or respond accurately to the questionnaire were included. This was assessed through self-report, using a screening question at the beginning of the questionnaire. Participants were asked to confirm that they had not been diagnosed with any mental illness that could affect their comprehension or response accuracy. Only those who self-identified as having no such condition were included in the study. These criteria helped in selecting an adequate participant group to study the dissemination of information about breast cancer among a specific demographic population within Sri Lanka's state universities.

Sampling and the sample

To achieve representative sampling, self-weighting random sampling was employed, resulting in a sample size of 455 participants. Each



university formed a stratum based on its proportion of the total female nonmedical undergraduate population. The sample from each university was allocated proportionally to its population size to maintain representativeness (Table 1). The Krejcie and Morgan table determined this sample size, which is widely applied in social and educational research to determine the appropriate sample size for a given population size.⁴

Table 1. Selected Sample of Nonmedical Undergraduates (2023)

University/Strata	Population	Percent	Sample
State University 1	7 830	26	119
State University 2	6 739	22	100
State University 3	4 284	14	64
State University 4	5 905	19	86
State University 5	5 818	19	86
Total	30 576	100	455

A 20% nonresponse rate was anticipated based on standard practice in survey research. The sample size was adjusted accordingly to ensure adequate representation for statistical analysis, even if a portion of selected participants did not respond.

Five state universities in Sri Lanka were chosen, representing diverse geographic locations and academic fields. These universities were selected based on their availability, geographical distribution, and the variety of study programs offered and represent approximately 30% of the total universities in Sri Lanka. Random samples of female nonmedical undergraduates were drawn from across each of the nonmedical disciplines at each university using student databases with prior ethical clearance and formal permission obtained from the respective vice-chancellors. Stratified sampling was applied to represent the students from each discipline proportionally. This allows results to be generalized to the academic diversity of the undergraduates in Sri Lankan state universities.

Data collection instrument

The questionnaire was designed based on a conceptual framework and comprised 3 parts: demographic attributes (Part I), knowledge, attitudes, and practices regarding breast cancer (Part II), and information needs, sources, sharing, satisfaction, dissemination, and respondents' comments (Part III). Six professionals and students from medicine, behavior studies, and information studies conducted face validation, and their feedback shaped the final version. A pilot study with 100 randomly selected nonmedical undergraduates followed, and reliability was assessed using Cronbach α , which was 0.876 overall, exceeding the recommended threshold of 0.70 (Table 2).

Table 2. Reliability by Themes and the Number of Items

Themes	Cronbach α	No. of items
Knowledge	0.853	25
Attitude	0.808	10
Practice	0.833	10
Information Need	0.956	7
Satisfaction	0.973	7
Provider	0.588	8
Source of information	0.865	22
Medium	0.484	12
Information reception	0.535	8
Dissemination	0.978	23
Total	0.876	132

Although the themes “Provider,” “Medium of Source,” and “Information Reception” had α values below 0.7, they were retained due to their significance in the literature.⁵ It is acknowledged that retaining constructs with an α value below the threshold may affect the overall reliability argument; however, these constructs were considered essential to the conceptual model and were further validated through subsequent structural model testing.

In addition to reliability testing, the questionnaire underwent a comprehensive validity assessment. Six experts and students from the fields of medicine, behavioral sciences, and information studies evaluated the clarity, relevance, and appropriateness of each item, establishing face validity through reviews. Their insights led to minor modifications, enhancing the instrument's overall comprehensibility. Content validity was ensured by mapping the questionnaire items directly to the constructs identified in the conceptual framework and the existing literature on breast cancer information behavior. The experts confirmed that the items adequately covered the intended domains (Annexure 1).

Data collection

The study employed Google Forms to administer questionnaires, with distribution facilitated through email links to nonmedical undergraduates. Prior authorization was obtained from the vice-chancellors and deans of the 5 universities. Respondents were given ample time to comprehend the questionnaire and seek clarifications. The data collection period, from March to April 2023, was strategically chosen to avoid conflicts with critical events, such as semester examinations. The inclusion of an open-ended question allowed participants to express their opinions on breast cancer information.

All participants were provided with detailed information about the study's purpose, procedures, risks, and benefits prior to their participation. Informed consent was obtained from all individual participants included in the study. Participation was entirely voluntary, and participants were assured of



the confidentiality and anonymity of their responses. They were informed of their right to withdraw from the study at any time without any consequence. No identifiable personal data were collected or used in any form.

Research hypothesis

The study developed a conceptual model (Figure 1) with 11 hypotheses, including 6 latent variables: Information Need, Satisfaction, Impact, Information Source, Information Dissemination, and Medium of Information.

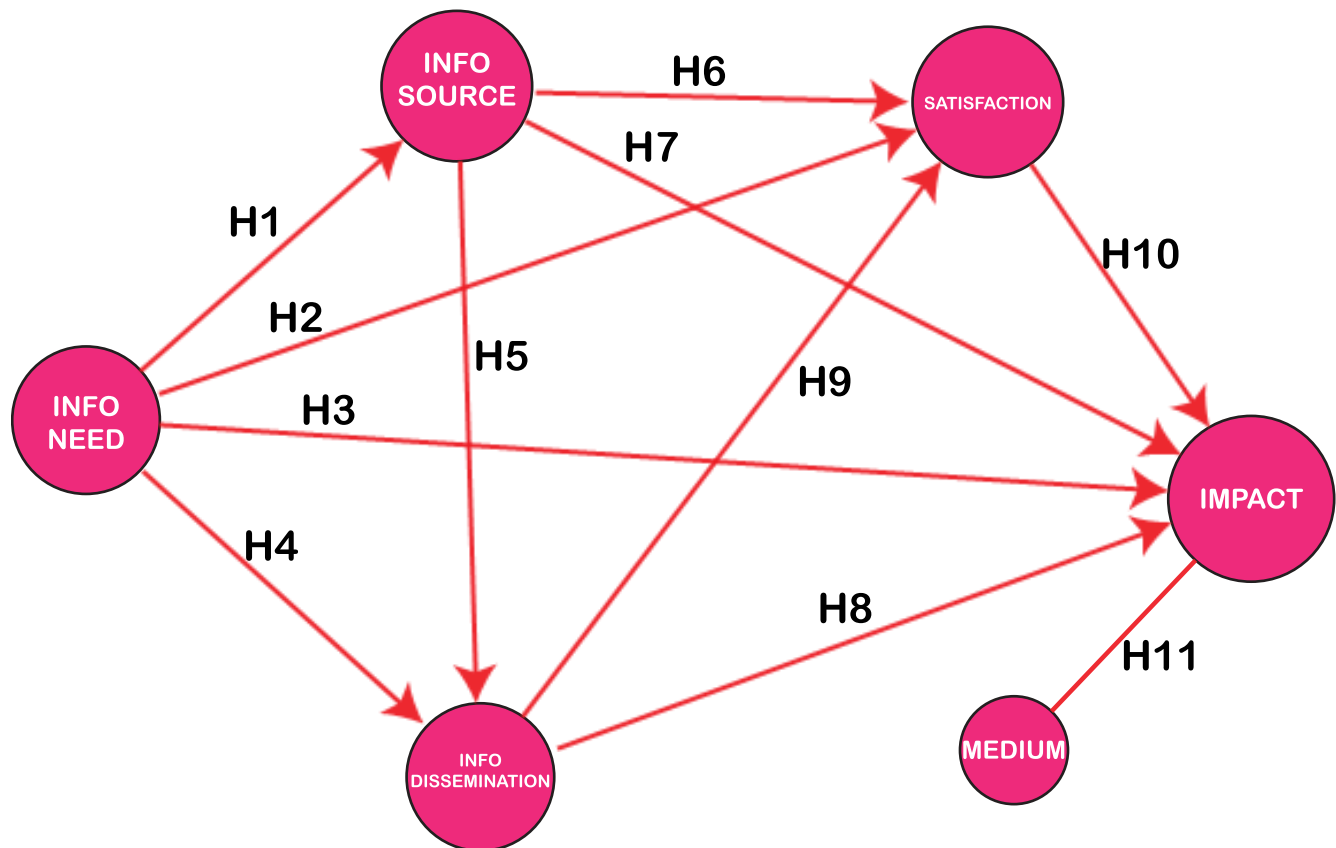


Figure 1. Conceptual Model of the Study

The dependent variable, Impact, reflected the cognitive, attitudinal, and behavioral effects of information exposure. Although demographic factors such as age, year of study, university, and region were collected to ensure sample representation, they were not treated as analytical control variables in the structural model. Based on this framework, 11 hypotheses were developed to test the relationships among the variables. The developed hypotheses are as follows:

H1: There is a cause-effect relationship between INFORMATION NEED and INFORMATION SOURCE.

H2: There is a cause-effect relationship between INFORMATION NEED and SATISFACTION.

H3: There is a cause-effect relationship between INFORMATION NEED and IMPACT.

H4: There is a cause-effect relationship between INFORMATION NEED and INFORMATION DISSEMINATION.

H5: There is a cause-effect relationship between INFORMATION SOURCE and INFORMATION

DISSEMINATION.

H6: There is a cause-effect relationship between INFORMATION SOURCE and SATISFACTION.

H7: There is a cause-effect relationship between INFORMATION SOURCE and IMPACT.

H8: There is a cause-effect relationship between INFORMATION DISSEMINATION and IMPACT.

H9: There is a cause-effect relationship between INFORMATION DISSEMINATION and SATISFACTION.

H10: There is a cause-effect relationship between SATISFACTION and IMPACT.

H11: There is a cause-effect relationship between MEDIUM and IMPACT.

The conceptual model guiding this study includes 11 hypothesized relationships among 6 latent variables. H1 hypothesizes a direct relationship between Information Need and Information Source, suggesting that individuals with a greater perceived need for information are more likely to engage with various sources. H2 posits a direct link between Information Need and Satisfaction, indicating that a



higher need may lead to increased Satisfaction with the information obtained. H3 examines the direct Impact of Information Need on Impact, suggesting that the perceived need alone can lead to cognitive or behavioral change. H4 assumes that Information Need directly influences Information Dissemination, whereby those needing information are more inclined to share it. H5 posits that Information Source directly affects Information Dissemination, while H6 and H7, respectively, suggest direct effects of Information Sources on Satisfaction and Impact. H8 explores the direct pathway from Information Dissemination to Impact, and H9 posits a direct influence of Information Dissemination on Satisfaction. H10, linking Satisfaction to Impact, is considered both a direct and mediated pathway, as Satisfaction also mediates the relationships between Information Need and Impact and between Information Source and Impact. Finally, H11 examines a moderated relationship, where the Medium of Information is hypothesized to moderate the strength of Impact. These hypothesized pathways form the basis for the structural equation modeling analysis conducted in this study.

Assessment of sampling adequacy

In this study, principal component analysis (PCA) was employed as a preliminary step prior to conducting partial least squares structural equation modeling (PLS-SEM) to strengthen the measurement model development. PCA was used to explore the underlying structure of observed variables related to the dissemination and reception of breast cancer-related information among nonmedical undergraduates. This approach enabled the identification of latent constructs by clustering correlated items, thereby ensuring conceptual coherence and parsimony in the subsequent model. To assess the suitability of the data for factor analysis, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett test of sphericity were applied, both of which confirmed that the data set was appropriate for dimension reduction. Factor extraction was based on standard thresholds, eigenvalues greater than 1, Varimax rotation, and factor loadings above 0.70 to ensure robust and interpretable components. By applying PCA in this manner, the study was able to refine and validate the indicators used in the PLS-SEM measurement model, thereby enhancing construct validity and improving overall model quality.

Analysis of data

Data collected through Google Forms was converted into SPSS file format for initial processing. Prior to conducting statistical analyses, exploratory

data analyses and checks for missing data were performed using SPSS version 23 to ensure data integrity. Missing values were handled using mean substitution, a standard technique where each missing value is replaced with the mean of the valid responses for that variable, since the proportion of missing data was below 2%.⁶

Based on the conceptual framework, a PLS-SEM model was developed and tested with SmartPLS software. An initial model was constructed with all constructs, and necessary optimizations were made according to the software manual. Initially, the model was used for exploratory and confirmatory purposes rather than a predictive-oriented approach. Furthermore, the moderating effect of the medium of sources of information on satisfaction, information source, information needs, and information dissemination was also included in the initial model, and the moderating effects were assessed through bootstrapped *t* statistics with 5000 iterations. Before the modeling effort, descriptive statistics, specifically the variance (standard deviations), correlation, and collinearity, were examined. According to the results, items that lacked standard deviations, had higher correlations (1.00), and had collinearity higher than 5 were removed from the data set.

Additionally, items with missing values were also removed. Subsequently, confirmatory composite factor analysis was carried out on the data set using the Factor option of SmartPLS by developing an initial PLS-SEM model that included 132 items. Based on the magnitude of the outer loadings, the items with lower loadings of less than 0.70 were removed from the data set. The resulting final model included 38 items, which were then subjected to model assessment.

Assessment of measurement model

Following the 2-stage analytical procedures of Anderson and Gerbing,⁷ the study first tested the validity and reliability of the measurement model before examining the structural model for hypothesized relationships.^{8–10} Convergent validity was assessed through outer loadings, average variance extracted (AVE), and composite reliability, with thresholds of 0.70, 0.50, and 0.60, respectively, though exploratory studies accept loadings of 0.40 or greater.^{11,12} Discriminant validity was evaluated using cross-loadings and the heterotrait-monotrait ratio (HTMT), with HTMT values below 0.90 indicating valid discriminant validity.¹³ Once the validity and reliability of the measurement model were confirmed, the inner structural model was assessed. This assessment evaluated the model's predictive relevance and the relationships between the constructs using the coefficient of determination (R^2),



path coefficient (β value), t statistic value, effect size (f^2), and the predictive relevance of the model (Q^2). Model fit was determined using the standardized root mean square residual (SRMR), normed fit index (NFI), and exact model fit metrics,¹³ with SRMR < 0.08 and NFI > 0.9 indicating a significant fit and nonsignificant values for d_ULS and d_G further supporting acceptable model fit.¹⁴

RESULTS

According to the descriptive analysis of respondents' demographic variables, the majority of respondents were aged between 21 and 23 years (60.2%), identified as Sinhalese (77.8%), and were Buddhist (74.9%). Most of them were never married (95.6%) and predominantly resided in the Western Province (25.7%). This demographic profile reflects a predominantly young, single, Sinhalese Buddhist student population concentrated in the Western region of Sri Lanka.

Designing a statistical model for effective breast cancer information dissemination among nonmedical undergraduates in Sri Lanka involves considering various critical factors. These include demographic variables, satisfaction, impact, information needs, information providers, sources, sharing, and factors affecting dissemination. Using PLS-SEM, the study

examined 11 hypotheses concerning breast cancer information dynamics to identify direct, indirect, and moderating effects. These findings highlight the intricate interplay between information needs, sources, dissemination, satisfaction, and impact, providing valuable insights for developing targeted interventions and strategies to enhance breast cancer awareness and prevention efforts.

The initial PLS-SEM model included 38 items. In line with best practices in structural equation modeling, items with low outer loadings were removed to retain only those that significantly contributed to their respective latent constructs.⁸ After this refinement, the final model comprised 33 items and underwent thorough evaluation.

The bootstrapped statistics of the initial model, presented in Table 3, indicate that all medium-related moderating effects were statistically insignificant ($P > 0.05$). These include the following:

Moderating Effect 1: Medium - Satisfaction → IMPACT

Moderating Effect 2: Medium - Information Source → IMPACT

Moderating Effect 3: Medium - Information Need → IMPACT

Moderating Effect 4: Medium - Information Dissemination → IMPACT

Table 3. Bootstrapped t Statistics for the Initial Model with Moderating Effects

Path	Original sample	Sample mean	Standard deviation	t statistics	P values
INFO DISSEMINATION → IMPACT	-0.10	-0.10	0.07	1.43	0.15
INFO SOURCE → IMPACT	0.08	0.08	0.06	1.46	0.14
INFO SOURCE → INFO DISSEMINATION	-0.11	-0.11	0.06	1.92	0.05
INFO SOURCE → SATISFACTION	-0.33	-0.33	0.05	7.15	0.00
INFONEED → IMPACT	-0.05	-0.05	0.08	0.59	0.56
INFONEED → INFO DISSEMINATION	0.11	0.10	0.08	1.36	0.17
INFONEED → INFO SOURCE	-0.13	-0.13	0.05	2.58	0.01
INFONEED → SATISFACTION	0.25	0.25	0.06	3.99	0.00
MEDIUM → IMPACT	-0.14	-0.14	0.07	1.98	0.05
Moderating Effect 1: Medium-Satisfaction → IMPACT	0.08	0.07	0.08	0.98	0.33
Moderating Effect 2: Medium - Information Source → IMPACT	0.07	0.06	0.06	1.16	0.25
Moderating Effect 3: Medium - Information Need → IMPACT	0.02	0.02	0.09	0.18	0.86
Moderating Effect 4: Medium-Information Dissemination → IMPACT	0.01	0.01	0.07	0.15	0.88
SATISFACTION → IMPACT	-0.12	-0.12	0.07	1.70	0.09
INFO DISSEMINATION → SATISFACTION	0.33	0.33	0.06	5.31	<0.001

Although the variable medium is conceptually relevant, it did not significantly moderate the relationships between the independent variables and the outcome variable (IMPACT). One possible explanation is that the media channels through which

participants accessed breast cancer-related information were relatively consistent across the sample, limiting the variability required for significant moderating effects. Another possibility is that the perceived quality or credibility of the media



did not vary substantially, thereby reducing their impact as a moderating factor. Similar findings have been reported in prior media-effects literature, where the influence of medium was found to be less significant than factors such as message content, source trustworthiness, or user engagement.^{15,16} These insights suggest that in information-rich environments, medium alone may not be a strong determinant of perceived informational impact.

Assessment of measurement model

The measurement model demonstrated satisfactory validity through the assessment of both convergent and discriminant validity. Convergent validity was confirmed as all items had outer loadings

above 0.70, composite reliability values exceeding 0.70, and AVE values greater than the 0.50 threshold, aligning with established guidelines.

Discriminant validity was assessed using the HTMT, Fornell-Larcker criterion, and cross-loadings. The HTMT values were within acceptable limits (<0.90) (Table 4), and the Fornell-Larcker criterion showed that the square roots of AVE (diagonal elements) were higher than the inter-construct correlations (off-diagonal elements).

Furthermore, cross-loadings confirmed that each indicator loaded more strongly on its intended item than on others. Collectively, these results confirm that the proposed measurement model demonstrates robust discriminant validity.

Table 4. Discriminant Validity: Heterotrait-Monotrait (HTMT) of the Proposed Model

	IMPACT	INFO DISSEMINATION	INFO SOURCE	INFONEED	MEDIUM
IMPACT					
INFO	0.18				
DISSEMINATION					
INFO SOURCE	0.13	0.29			
INFONEED	0.12	0.23	0.15		
MEDIUM	0.12	0.16	0.45	0.17	
SATISFACTION	0.20	0.42	0.46	0.32	0.11

Evaluation of the inner structural model

The next step was to measure the outcomes of the inner structural model. This included observing the model's predictive relevance and the relationships between the items. The coefficient of determination (R^2), path coefficient (β value), t statistic value, effect size (f^2), predictive relevance of the model (Q^2), and goodness-of-fit (GOF) index are the key criteria for evaluating the inner structural model. Two independent variables explained 19% of the variation in SATISFACTION; 19 independent variables

accounted for 18% of the variance in INFORMATION DISSEMINATION; and 2 independent variables accounted for 5% and 4 independent variables for 2% of the variations of Impact and Information Source, respectively. From Table 5, it is clear that the Q^2 values obtained for the proposed model were greater than 0 and higher than the threshold limit, suggesting that the path model's predictive relevance was adequate for the endogenous construct.

Table 5. Results of R^2 and Q^2

Construct	R^2	R^2 adjusted	SSO	SSE	Q^2
IMPACT	0.05	0.04	598.00	583.72	0.02
INFO DISSEMINATION	0.18	0.17	5 681.00	5 123.45	0.10
INFO SOURCE	0.02	0.01	1 196.00	1 187.50	0.01
INFONEED	—	—	1 196.00	1 196.00	0.00
MEDIUM	—	—	598.00	598.00	0.00
SATISFACTION	0.19	0.19	598.00	505.21	0.16

The calculated f^2 values are shown in Table 6, and according to the effect size, the effects for INFORMATION SOURCE $\rightarrow$ SATISFACTION and SATISFACTION $\rightarrow$ INFORMATION DISSEMINATION were significant ($P < 0.05$). Generally, values higher than 0.02, 0.15, and 0.35

indicate weak, moderate, and substantial effect sizes (f^2), respectively. Thus, according to the Cohen recommendation, the f^2 of all 5 exogenous latent constructs on model quality indicated a moderate to negligible effect on the value of R^2 .

**Table 6.** Significance of Effect Size (f^2) After Bootstrapping

	Original sample	Sample mean	Standard deviation	<i>t</i> statistics	<i>P</i> values
INFO DISSEMINATION → IMPACT	0.01	0.01	0.01	0.68	0.50
INFO SOURCE → IMPACT	0.00	0.01	0.01	0.54	0.59
INFO SOURCE → INFO DISSEMINATION	0.01	0.02	0.01	0.89	0.37
INFO SOURCE → SATISFACTION	0.14	0.14	0.04	3.04	0.00
INFONEED → IMPACT	0.001	0.01	0.01	0.13	0.90
INFONEED → INFO DISSEMINATION	0.01	0.02	0.02	0.58	0.56
INFONEED → INFO SOURCE	0.02	0.02	0.01	1.18	0.24
INFONEED → SATISFACTION	0.07	0.08	0.04	1.78	0.08
MEDIUM → IMPACT	0.02	0.02	0.02	1.05	0.30
SATISFACTION → IMPACT	0.01	0.01	0.01	0.67	0.50
INFO DISSEMINATION → SATISFACTION	0.10	0.11	0.04	2.38	0.02

Effect size values are 0.02, small; 0.15, medium; and 0.35, large.

Testing model fit

Since the proposed model was a saturated model without free paths, the saturated model (measurement) fit values and the estimated model (structural model) fit values were the same.

The SRMR value was 0.060 (<0.06), the NFI was 0.75 (>0.90), and the $d_ULS < \text{bootstrapped HI } 95\%$ of d_ULS and $d_G < \text{bootstrapped HI } 95\%$ of d_G , indicating the data fit the model well (Table 7).

Table 7. Model Fit Summary

	Saturated model	Estimated model		
SRMR	0.06	0.06		
d_ULS	1.84	2.31		
d_G	1.16	1.18		
χ^2	1 935.71	1 972.59		
NFI	0.75	0.75		
d_ULS	Original sample	Sample mean	95%	99%
Saturated model	0.06	0.04	0.04	0.06
Estimated model	0.06	0.04	0.05	0.05
d_G	Original sample	Sample mean	95%	99%
Saturated model	1.16	0.58	0.7	0.81
Estimated model	1.18	0.58	0.69	0.76

Hypothesis testing

Nine hypotheses (H1, H2, H4, H5, H6, H7, H9, H10, and H11) were empirically supported, revealing strong and statistically significant relationships (Table 8). These results highlight the critical roles of

information satisfaction, credibility of information sources, and proactive information-seeking behaviors in shaping the perceived Impact of breast cancer-related information among nonmedical undergraduates.

Table 8. Path Coefficients and *t* Statistics

	Original sample	Sample mean	Standard deviation	<i>t</i> statistics	<i>P</i> values
INFO DISSEMINATION → IMPACT	-0.10	-0.11	0.07	1.56	0.12
INFO SOURCE → IMPACT	0.13	0.13	0.05	2.40	0.02
INFO SOURCE → INFO DISSEMINATION	-0.22	-0.22	0.05	4.01	0.00
INFO SOURCE → SATISFACTION	-0.33	-0.34	0.05	7.01	0.00
INFONEED → IMPACT	-0.10	-0.10	0.08	1.28	0.20
INFONEED → INFO DISSEMINATION	0.22	0.22	0.07	2.99	<0.001
INFONEED → INFO SOURCE	-0.13	-0.13	0.05	2.55	0.01
INFONEED → SATISFACTION	0.29	0.29	0.07	4.39	0.00
MEDIUM → IMPACT	-0.14	-0.14	0.07	2.03	0.04
SATISFACTION → IMPACT	-0.13	-0.13	0.06	2.08	0.04
SATISFACTION → INFO DISSEMINATION	0.33	0.33	0.06	5.37	0.00

Predictive accuracy of the PLS-SEM model

Following the development of the model, its



accuracy was tested using a new data set of 100 nonmedical female undergraduates who were not included in the initial model development. The predicted values from the model, representing the impact of breast cancer–related information, were subjected to a 1-way analysis of variance (ANOVA) to assess predictive accuracy. Eta-squared (η^2) was calculated to evaluate the effect size. A 1-way ANOVA was used to test for statistically significant differences between the predicted and actual

outcomes. Additionally, η^2 measured the strength of the relationship between the predictions and the observed results.

The results indicated that the model's predictions were statistically significant and had a substantial effect size (Table 9), confirming the model's robustness and reliability in predicting the impact of breast cancer information among nonmedical female undergraduates.

Table 9. Predictive Accuracy and Effect Size of the Model

IMPACT				IMPACT	
	Sum of squares	df	Mean square		Sum of squares
Between groups	0.271	1	0.271	Between groups	0.271
Within groups	131.673	1998	0.066	Within groups	131.673
Total	131.944	1999		Total	131.944
	Point estimate	95% CI			
		Lower	Upper		
η^2	0.002	0	0.008	η^2	0.002

CI, confidence interval; df, degrees of freedom.

The ANOVA results demonstrate that the model's predictions are statistically significant ($P = 0.04$), implying a meaningful difference between the groups based on the predicted impact of breast cancer information.

However, the η^2 value of 0.002 indicated that only a small portion of the variance in Impact can be

attributed to the model. This small effect size indicated that, although the model was statistically significant, its practical significance in explaining the variance was minimal. This implies that the model has predictive power. The final developed model is depicted in Figure 2.

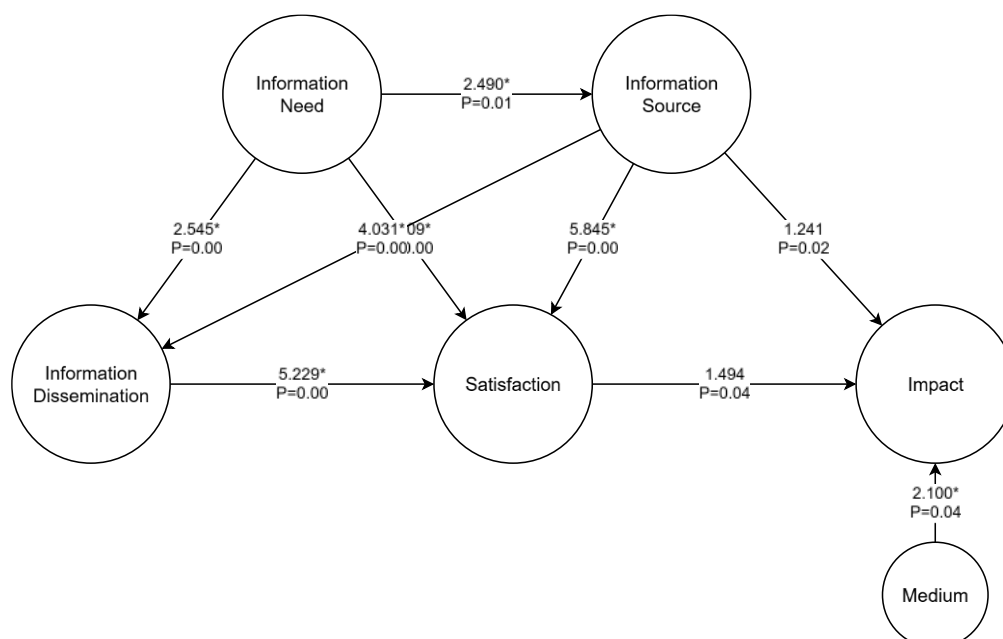


Figure 2. Model Developed for Effective Breast Cancer–Related Information Dissemination Among Nonmedical Female Undergraduates

*Critical $t > 1.96$; an asterisk indicates $P = 0.05$.

DISCUSSION



The validated model offers meaningful insights into the determinants of information effectiveness in health communication. The findings emphasize the need to move beyond simple dissemination toward user-centered strategies that foster satisfaction and relevance. Future research should explore potential mediators and contextual factors that shape the relationships between information behavior constructs and their outcomes. Regarding the proposed hypotheses, the results show the following:

H1: Information needs and sources

Information needs among nonmedical undergraduates shape the selection of breast cancer information sources. Online platforms are often used for general awareness, while peers and family are approached for emotional support. Communication style, clarity, and context significantly influence information comprehension and promote peer sharing, highlighting the need for flexible, audience-specific strategies in health communication.

H2: Information needs and satisfaction

Satisfaction is higher when information matches the depth and specificity of a user's need and is perceived as reliable and relevant. Mismatched or low-quality information leads to dissatisfaction. These findings support the need for tailored dissemination strategies that evolve in response to changing user expectations.

H4: Information needs as a driver of dissemination

Strong information needs encourage active sharing of breast cancer information. Dissemination enhances awareness, supports early detection, and reduces the stigma associated with the condition. These behaviors also foster peer-led initiatives, educational and health care partnerships, and research interests, positioning undergraduates as key agents in community health communication.

H5: Source credibility and dissemination

The perceived credibility of information sources influences dissemination. Health care professionals offer authoritative guidance, while informal sources provide relatable narratives that offer insight into personal experiences. Integrating both ensures accuracy and enhances resonance within diverse student communities.

H6: Information sources and satisfaction

Credible sources, both formal and informal, have a positive influence on user satisfaction. Key factors include clarity, personal relevance, and actionable content. These findings underscore the importance of

designing source-specific strategies that build trust and empower informed decision-making.

H7: Sources and their impact

Formal (eg, healthcare staff) and informal (eg, peers, survivors) sources shape students' attitudes and actions. Their interplay fosters a holistic communication ecosystem that blends clinical knowledge with social and emotional relevance, supporting multichannel dissemination strategies.

H9: Dissemination enhances satisfaction

Sharing relevant, understandable information enhances satisfaction. Students feel empowered and socially responsible when their contributions have a positive impact on their peers. This feedback loop strengthens information engagement and supports broader awareness efforts.

H10: Satisfaction influences knowledge, attitude, and practice

Satisfaction with breast cancer information significantly enhances students' knowledge, attitudes, and preventive practices. It fosters the adoption of self-examinations, participation in training, and proactive health behavior, particularly among those with limited prior knowledge.

Rejected hypotheses

The study rejected hypotheses 3 and 8, indicating no significant cause-and-effect relationship between information need and impact, as well as between information dissemination and measurable changes in students' knowledge acquisition, health-related attitudes, behavioral intentions, and preventive practices regarding breast cancer awareness, self-examination, and early detection behaviors. The rejection of these hypotheses suggests that merely having an information need or engaging in dissemination does not automatically translate into meaningful behavioral or cognitive change.

Various factors, including the accuracy and comprehensiveness of sources like newspapers, the internet, and social media, influence the dissemination of breast cancer information. Despite access to information, gaps in knowledge, attitudes, and practices remain, emphasizing the need for accurate education, especially on early detection methods. Overcoming these challenges requires tailored educational strategies, culturally sensitive communication, and improved access to credible resources. The model underscores the importance of easy access, accuracy, comprehensiveness, cultural sensitivity, relevance, and up-to-date information. Engaging formats and clear language ensure that information is accessible and impactful, contributing



to increased awareness, reduced stigma, and proactive health measures among nonmedical female undergraduates.

Language and knowledge enhancement

Language plays a crucial role in enhancing knowledge of breast cancer information. Culturally sensitive, clear, and emotionally engaging language makes information relatable, understandable, and shareable. Effective communication enhances knowledge, fosters community support, and encourages continuous dissemination. Simplifying medical terminology, ensuring cultural sensitivity, and providing accessible information in common languages are vital. Clear and understandable language facilitates informed decision-making.¹⁷ Providing multilingual resources ensures broad accessibility, emphasizing inclusivity and relevance to diverse linguistic backgrounds.

Adherence to universally applied health communication standards, such as those provided by the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the World Health Organization (WHO), may also ensure quality, uniformity, and cultural acceptability of breast cancer information delivery. These global standards provide comprehensive guidance on the production, pretesting, and release of health messages to render them accessible, usable, and effective for different populations.

WHO also emphasizes principles of people-centered communication, health literacy, and risk communication, which require messages to be accurate, transparent, timely, and tailored to the needs of different audience segments. For instance, the WHO's *Health Promotion Glossary* and *Strategic Framework for Effective Communications* propose participatory approaches that involve communities in message development so that messaging is reflective of the target audience's values, concerns, and jargon.^{18,19} This is particularly relevant in the context of breast cancer, where cultural beliefs, stigma, and disinformation can create obstacles to early diagnosis and treatment.

Similarly, UNESCO promotes inclusive communication approaches as part of its broader call for diversity in cultures and the right to information. Its models advocate linguistic pluralism and culturally responsive communication, especially in public health campaigns. UNESCO's work on media and information literacy supports activities that equip individuals and communities with the necessary competence to critically evaluate and act upon health-related messages.^{20,21} Translated into breast cancer awareness, this type of guideline advocates for the production of educational material in multiple

languages, the use of trusted local messengers, and the integration of old and new media to reach marginalized and disadvantaged sections of society. By calibrating breast cancer awareness campaigns to such international standards, health communicators make their interventions both evidence-informed and ethically oriented, socially inclusive, and likely to be sustainable. In the process of calibration, the communicators can transcend typical communication challenges such as medical elitism, cultural insensitivity, and linguistic exclusion that often get in the way of successful health education in low-resource or multicultural environments.

The findings of this study align with a growing body of international literature examining breast cancer information-seeking behavior among young adults and undergraduate populations. Studies from Malaysia, Nigeria, India, South Africa, and Bangladesh have reported comparable patterns in how youth engage with breast cancer information and how various factors mediate the transition from information access to behavioral impact. For instance, a study in Malaysia found that delays in diagnosis were significantly associated with fear, cultural barriers, and misconceptions, underscoring the importance of culturally sensitive communication strategies.²² Similarly, a Nigerian study found that high levels of awareness did not automatically translate into preventive action unless the information was deemed trustworthy and personally relevant.²³ These results support the current study's finding that source credibility and user satisfaction play pivotal roles in shaping behavioral outcomes. It was found that Indian university students concluded that while information-seeking behavior was active among the population, actual changes in knowledge, attitudes, or practices depended heavily on the accuracy, relatability, and contextual alignment of the information received.²⁴ This finding is consistent with the present results, which found that the direct effects of information need and dissemination on impact (H3 and H8) were statistically rejected. This suggests that sharing alone is insufficient for behavioral change without supporting mechanisms, such as satisfaction, trust, and perceived relevance.

Furthermore, in South Africa and Bangladesh, it was observed that merely having breast cancer-related information available did not necessarily result in improved health behavior. Instead, they emphasized the need for culturally and contextually appropriate communication strategies, tailored to the target audience's sociocultural realities.²⁵ These insights align closely with the present study's validated model, which highlights the importance of content quality, delivery format, and contextual relevance in enhancing both cognitive and behavioral



impact. Taken together, these comparative studies highlight the universal importance of satisfaction, clarity, cultural sensitivity, and source trustworthiness as mediating or moderating variables in health communication. The current study contributes to this body of knowledge by offering a context-specific, statistically validated model that informs strategic interventions for effective breast cancer information dissemination among university students in Sri Lanka.

Overall, the validated model offers meaningful insights into the determinants of information effectiveness within the context of health communication. The findings highlight the need for information strategies that go beyond mere dissemination, focusing instead on fostering satisfaction and relevance from the user's perspective. Future research may benefit from examining potential mediators or external contingencies that further elucidate the complex interplay between information-related constructs and their perceived influence.

Implications for policy and practice

A policy that applies a breast cancer-related information dissemination model to nonmedical female undergraduates benefits the individuals directly involved and contributes significantly to societal well-being, health care efficiency, and the overall fight against breast cancer. By initiating a multifaceted strategy and ensuring active collaboration among stakeholders, an effective breast cancer-related information dissemination model can be successfully integrated into nonmedical undergraduate education, leading to increased awareness, early detection, and a more supportive environment for those affected by breast cancer. Key components of this strategy include needs assessment and target audience analysis, customized educational programs, incorporating cultural sensitivity, using digital platforms, peer education and support, incorporating breast health in curricula, providing accessible resources, holding regular awareness events, collaborating with health care institutions, forming partnerships, and ensuring long-term engagement and follow-up.

The initiative could begin with training nonmedical female undergraduates through interactive presentations, discussions, and specialized training sessions, empowering them to serve as community educators. Collaboration with Ministry of Health clinics will facilitate health education efforts, while activities in various clinics, such as well-woman clinics and mobile clinics, will strengthen early detection and management. Awareness events, including walks and exhibits, are slated to engage the community, and establishing mobile health education

units affiliated with state universities will ensure widespread outreach.

CONCLUSION

The model developed for effective breast cancer information dissemination among nonmedical female undergraduates in Sri Lanka reveals significant insights and highlights critical cause-effect relationships between information needs, sources, Satisfaction, and the Impact of dissemination on knowledge and behavior. Information needs drive the selection of sources, with tailored dissemination strategies proving essential. Satisfaction is closely linked to the alignment of sources with specific needs, where credible sources, such as health care professionals and informal channels, significantly influence this satisfaction. Effective dissemination enhances awareness and positively affects attitudes and practices, fostering a culture of informed individuals. The study confirmed significant relationships between information need, source, satisfaction, and dissemination but found no significant impact on the overall Impact of information need or dissemination. In line with the Wilson Information Behavior model and the Health Belief Model, the framework emphasizes the initial need for information, diverse sources, and satisfaction, providing a comprehensive approach to breast cancer awareness. This integrated model is significant as it not only addresses the informational needs of nonmedical female undergraduates but also contributes to the broader societal impact by promoting proactive health care behaviors and reducing the stigma associated with breast cancer. Engaging nonmedical undergraduates in breast cancer education initiatives can foster a culture of health literacy and empower them as agents of change within their communities. Their interpersonal skills, peer influence, and access to institutional platforms make them effective channels for promoting awareness, identifying risk factors, and implementing screening practices. Ultimately, the model supports the development of targeted interventions and strategies to enhance breast cancer awareness and prevention efforts in Sri Lanka.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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ETHICAL CONSIDERATIONS

All participants were provided with detailed information about the study's purpose, procedures, risks, and benefits prior to their participation. Informed consent was obtained from all individual participants included in the study. Participation was entirely voluntary, and participants were assured of the confidentiality and anonymity of their responses. They were informed of their right to withdraw from the study at any time without any consequence. No identifiable personal data were collected or used in any form. The study protocol was reviewed and approved by the Ethics Review Committee, Faculty of Graduate Studies, University of Colombo, Sri Lanka (Ref. No.: FGS/ERC/2017/015).

DATA AVAILABILITY

The datasets used and analyzed during the current study are available to the corresponding author and can be provided upon reasonable request.

AI DISCLOSURE

Artificial intelligence (AI) tools were used solely to assist in language editing and grammar improvement during manuscript preparation. No AI system was involved in data generation, analysis, interpretation of results, or drawing of scientific conclusions. The authors reviewed and approved all AI-assisted text to ensure accuracy and integrity of the content.

AUTHOR CONTRIBUTIONS

In the authorship of this manuscript, PKS Manatunga has taken on the Corresponding Author role. As the primary researcher, PKS Manatunga was responsible for the study's conceptualization and design, the data collection and analysis, and the manuscript's writing and revision. Her work involved an extensive literature review, developing the research methodology, and synthesizing findings into a coherent and impactful narrative.

Dr. DC Kuruppu acted as the mentor, bringing additional scrutiny and expertise to the research. Dr Kuruppu's role involved a thorough review of the thesis, providing constructive critiques, and ensuring the academic rigour and integrity of the work. Their meticulous feedback helped to address potential weaknesses and enhance the overall robustness of the study.

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