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REVIEW

Exploring Theoretical Models and Frameworks Used to Explain Factors Influencing Breast Cancer Screening Participation: A Scoping Review

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Objective: The purpose of this study was to explore theoretical models and frameworks used to guide research studies that explain factors influencing participation in breast cancer screening (BCS).

Methods: This study was conducted according to the framework developed by Arksey and O'Malley and reported in line with the PRISMA-ScR guidelines. A comprehensive search was performed across six databases: PubMed, Embase, CNKI, Scopus, EBSCO, and the Cochrane Library. Two researchers independently screened titles and abstracts. Data extraction and cross-checking were conducted on included studies, with a third researcher facilitating consensus in cases of disagreement. Extracted information included author, publication year, country, research methods, sample size, age, theoretical framework, and outcomes. A pre-designed form ensured consistency and accuracy in data extraction.

Results: A total of 70 studies were included. The studies were primarily cross-sectional (66/70, 94.29%), with the largest geographical locations being the United States (16/70, 22.86%), Iran (15/70, 21.43%), and China (9/70, 12.86%). The review identified 13 models, with Health Belief Model being the most commonly used (21/70, 30.0%), followed by Andersen's Behavioral Model (11/70, 15.71%) and Theory of Planned Behavior (8/70, 11.43%). The Health Belief Model emerged as the most empirically supported framework across all studies, particularly effective in identifying economic barriers and trust issues within healthcare systems among low-income and low-health literacy populations. This model has also been incorporated into more comprehensive frameworks, demonstrating strong predictive power and practical applicability with additional variables. All models offer distinct strengths, but their predictive power largely depends on research contexts and target populations. These variations may result in an incomplete or unreliable understanding of factors influencing BCS behavior.

Conclusion: The findings provide a comprehensive summary of the models and frameworks employed to investigate factors influencing BCS over the past decade. These insights have significant implications for designing targeted healthcare interventions and informing policy changes to enhance global BCS participation and reduce disparities. Future refinements of these models are expected to improve their applicability and effectiveness across diverse populations and settings.

Keywords: breast cancer screening, theories, models, frameworks, factors

Introduction

Breast cancer (BC) represents the most common cancer among women in 86% of countries.[1] In 2022, BC mortality was ranked fourth worldwide, as reported by the International Agency for Research on Cancer.[2] Annually, around 1.7 million new cases of BC are diagnosed. Projections suggest that by 2040, this figure may increase to 3.19 million new cases each year, accompanied by an estimated 1.04 million deaths.[3] Early detection and regular screening are essential for identifying cases prior to the advanced stage of disease.[4,5]

Existing research indicated that approximately 40% of cancer-related deaths are preventable through early screening.[6] Evidence consistently shows that breast cancer screening (BCS) significantly reduces the incidence of late-stage

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diagnosis and associated mortality rates of BC.[7–10] According to BCS, women can engage in many methods,[11] including breast self-examination (BSE),[12] mammography (MMG),[13] clinical breast examination (CBE),[14] MRI,[15] and ultrasound.[16] Available evidence indicates that the participation rate of women in BCS remains low worldwide.[17] This low participation has been linked to multiple factors, including cultural beliefs and social norms that influence health-seeking behaviors, limited health literacy, socioeconomic constraints, and inadequate access to screening services—particularly among women in developing countries and vulnerable populations.[18]

To comprehend the low participation rate in BCS, it is essential to establish a theoretical framework to guide research on factors influencing BCS involvement. Therefore, theoretical models are essential for explaining and predicting the complex factors that influence individuals' decisions to participate in BCS.[18] Theoretical models, along with their "metaphoric structures",[19] provide a framework for linking observed phenomena with conceptual insights.[20] These frameworks or models enable researchers to understand the relationships between variables, formulate hypotheses, interpret findings, and draw meaningful conclusions.[20] Nilsen's Taxonomy classifies different theories and models according to various dimensions of their function and application.[21] This taxonomy is commonly used in health behavior research to identify which theories are more effective in explaining mechanisms of behavior change, including Process models, Determinant frameworks, Classic theories, Implementation theories, and Evaluation frameworks.[22]

The BCS theoretical model offers a framework for understanding and predicting factors influencing participation in BCS,[23] examining personal, environmental, social, and health-related aspects. It serves as a tool for policymakers, healthcare providers, and educators to promote screening behaviors.[24] Various theoretical models have been employed to address the numerous factors affecting screening participation, but challenges such as inadequate knowledge dissemination, patient willingness, and insufficient decision support hinder their implementation.[25] Additionally, issues like poor local adaptation and practical application barriers further limit the success of these models.[26] Despite the theoretical models proposed, their practical application often faces difficulties in feasibility and effectiveness, often due to a disconnect between theory and real-world practice. Common challenges, such as inappropriate model selection and insufficient rigor, can undermine their effectiveness.[27] Although numerous theoretical models have been developed to explain BCS behavior, many fail to fully address contextual factors such as cultural norms, differences in health literacy, and socioeconomic barriers that influence participation, particularly among disadvantaged populations.

This study reviews theoretical models applied to BCS participation over the past decade. It emphasizes an integrated approach across diverse populations and healthcare systems and examines which theoretical frameworks most effective in explaining the factors influencing BCS participation rates. It also accesses their applicability, identifies, challenges in implementation, and their potential to bridge the gap between theory and practice in promoting BCS uptake.

Materials and Methods

This study is based on the scoping review framework proposed by Arksey and O'Malley,[28] with procedural guidance derived from the specific methodology outlined by Canadian scholars Danielle Levac.[29] Additionally, the study adheres to the PRISMA-ScR guidelines for reporting.[30] To ensure transparency in the research process, the study protocol for this scoping review has been registered with the Open Science Framework (https://osf.io/gujm7/).

Identifying the Research Question

This study aims to address the following research questions:

1) Which theoretical models and frameworks have been utilized in the past decade to examine the factors influencing BCS?
2) How effective in explaining the determinants of BCS participation?
3) What are the similarities and differences among these models and frameworks in the context of BCS research?

Identifying Relevant Studies

For the search strategy of this study, we constructed the search terms based on the components of the PICO(T)/PICo framework (Table 1), focusing on the key concepts relevant to the research question: "breast cancer screening,

participation, and 'factors'", as well as "theories/models/frameworks". We employed free-text terms, subject headings, MeSH Terms, Boolean operators ("AND" and "OR"), and truncation to ensure a comprehensive search (Tables 2–7). The final search strategy was tested on Ovid and subsequently adapted for other databases. We searched six major electronic databases: PubMed, Embase, CNKI, Scopus, EBSCO, and the Cochrane Library, for studies published between January 1, 2014, and December 31, 2024.

Study Selection

Articles imported into EndNote 21 underwent independent dual screening by two researchers. Initially, titles and abstracts were assessed, followed by full-text evaluation, according to predefined inclusion and exclusion criteria. The inclusion criteria were: 1) Studies published in English or Chinese investigating factors influencing breast cancer screening, employing established theoretical models; 2) Women participants; 3) Quantitative, qualitative, or mixed-method research designs. The following studies were excluded: (1) systematic reviews, meta-analyses, review articles, case reports, expert opinions, conference proceedings, and book chapters; and (2) intervention-based research.

Charting the Data

The research team utilized a collaboratively developed data chart and table to examine the application of theories or models within the studies. Weekly meetings were held to refine, supplement, and adjust the table in order to determine which variables should be extracted to address the primary research questions. The data extraction fields were adapted from the Joanna Briggs Institute (JBI) template in the JBI Evidence Synthesis Handbook.[31] The reviewers conducted a trial run and refinement of data extraction forms for 17.14% (12/70) of the included studies to ensure consistency and clarity in the extracted data. The types of theories, models, or frameworks described in the studies were classified according to the categorization system proposed by Nilsen (2015). The figures were completed using ggplot 2 in the R language.

Table 1 Database Search Terms Using the PICO(T)/PICO Framework

Patient, Population, or Problem	Phenomenon of Interest	Context	Results	Time (2014–2024)
Patients or populations involved in breast cancer screening, especially women who participate in screening.	Factors that influence breast cancer screening participation. These factors may include psychological factors, sociocultural factors, health beliefs, etc.	The social health environment, cultural background, and availability of medical resources for breast cancer screening.	The study focused on the effectiveness and applicability of different theoretical models in explaining breast cancer screening participation, and may analyze the application effects of different models in different settings or populations.	Time The research scope may cover the past 10 years or a specific time period (2014–2024).

Table 2 Search Strategies (PubMed Database)

Number	Search Items
#1	(Breast Cancer Screening [MeSH Terms] OR Breast Neoplasms [MeSH Terms] OR Mass Screening [MeSH Terms] OR Mammography [MeSH Terms] OR Early Detection of Cancer [MeSH Terms] OR Magnetic Resonance Imaging [MeSH Terms] OR Ultrasonography [MeSH Terms] OR Breast Self-Examination [MeSH Terms] OR Clinical Breast Examination [MeSH Terms] OR Health Services Accessibility [MeSH Terms])
#2	(Theory [MeSH Terms] OR Models, Theoretical [MeSH Terms])
#3	(#1 AND #2)
#4	(Risk Factors [MeSH Terms] OR Protective Factors [MeSH Terms] OR Etiology [MeSH Terms] OR Contributing Factors [MeSH Terms] OR Environmental Factors [MeSH Terms] OR Genetic Factors [MeSH Terms] OR Behavioral Factors [MeSH Terms] OR Socioeconomic Factors [MeSH Terms] OR Psychosocial Factors [MeSH Terms] OR Demographic Factors [MeSH Terms])
#5	(#3 AND #4) AND ("last 10 years" [PDat])

Table 3 Search Strategy (Cochrane Library)

Number	Search Items
#1	("Breast Cancer Screening" OR "Breast Neoplasms" OR "Mass Screening" OR "Mammography" OR "Early Detection of Cancer" OR "Magnetic Resonance Imaging" OR "Ultrasonography" OR "Breast Self-Examination" OR "Clinical Breast Examination" OR "Health Services Accessibility")
#2	("Theory" OR "Models, Theoretical")
#3	("Breast Cancer Screening" OR "Breast Neoplasms" OR "Mass Screening" OR "Mammography" OR "Early Detection of Cancer" OR "Magnetic Resonance Imaging" OR "Ultrasonography" OR "Breast Self-Examination" OR "Clinical Breast Examination" OR "Health Services Accessibility") AND ("Theory" OR "Models, Theoretical")
#4	("Factors" OR "Risk Factors" OR "Protective Factors" OR "Etiology" OR "Contributing Factors" OR "Environmental Factors" OR "Genetic Factors" OR "Behavioral Factors" OR "Socioeconomic Factors" OR "Psychosocial Factors" OR "Demographic Factors")
#5	("Breast Cancer Screening" OR "Breast Neoplasms" OR "Mass Screening" OR "Mammography" OR "Early Detection of Cancer" OR "Magnetic Resonance Imaging" OR "Ultrasonography" OR "Breast Self-Examination" OR "Clinical Breast Examination" OR "Health Services Accessibility") AND ("Theory" OR "Models, Theoretical") AND ("Factors" OR "Risk Factors" OR "Protective Factors" OR "Etiology" OR "Contributing Factors" OR "Environmental Factors" OR "Genetic Factors" OR "Behavioral Factors" OR "Socioeconomic Factors" OR "Psychosocial Factors" OR "Demographic Factors")

Table 4 Search Strategy (Embase)

Number	Search Items
#1	("breast cancer"/exp OR "breast cancer" OR "breast neoplasm"/exp OR "breast neoplasm" OR "mammography"/exp OR "mammography" OR "early detection of cancer"/exp OR "early detection of cancer" OR "ultrasonography"/exp OR "ultrasonography" OR "health services accessibility"/exp OR "health services accessibility" OR "breast self-examination"/exp OR "breast self-examination" OR "clinical breast examination"/exp OR "clinical breast examination")
#2	("theory"/exp OR "theory" OR "theoretical models"/exp OR "theoretical models")
#3	("factors" OR "risk factors"/exp OR "risk factors" OR "protective factors"/exp OR "protective factors" OR "etiology"/exp OR "etiology" OR "contributing factors" OR "environmental factors" OR "genetic factors" OR "behavioral factors" OR "socioeconomic factors"/exp OR "socioeconomic factors" OR "psychosocial factors"/exp OR "psychosocial factors" OR "demographic factors"/exp OR "demographic factors")
#4	year >= 2014

Table 5 Search Strategy (CNKI)

Number	Search Items
#1	(Breast cancer screening OR Breast tumor OR Mammography OR Early detection of breast cancer OR Magnetic resonance imaging OR Ultrasound examination OR Breast self-examination OR Clinical breast examination OR Accessibility of health services)
#2	(theory OR theoretical model)
#3	(Factors OR Risk factors OR Protective factors OR Etiology OR Influencing factors OR Environmental factors OR Genetic factors OR Behavioral factors OR Socioeconomic factors OR Psychosocial factors OR Demographic factors)

Table 6 Search Strategy (EBSCO)

Number	Search Items
#1	("Breast Cancer Screening" OR "Breast Neoplasms" OR "Mass Screening" OR "Mammography" OR "Early Detection of Cancer" OR "Magnetic Resonance Imaging" OR "Ultrasonography" OR "Breast Self-Examination" OR "Clinical Breast Examination" OR "Health Services Accessibility")
#2	("Theory" OR "Models, Theoretical")
#3	("Factors" OR "Risk Factors" OR "Protective Factors" OR "Etiology" OR "Contributing Factors" OR "Environmental Factors" OR "Genetic Factors" OR "Behavioral Factors" OR "Socioeconomic Factors" OR "Psychosocial Factors" OR "Demographic Factors") AND (Limit: Publication Date = Last 10 years)

Table 7 Search Strategy (Scopus)

Number	Search Items
#1	TITLE-ABS-KEY ("Breast Cancer Screening" OR "Breast Neoplasms" OR "Mass Screening" OR "Mammography" OR "Early Detection of Cancer" OR "Magnetic Resonance Imaging" OR "Ultrasonography" OR "Breast Self-Examination" OR "Clinical Breast Examination" OR "Health Services Accessibility")
#2	TITLE-ABS-KEY ("Theory" OR "Models, Theoretical")
#3	TITLE-ABS-KEY ("Factors" OR "Risk Factors" OR "Protective Factors" OR "Etiology" OR "Contributing Factors" OR "Environmental Factors" OR "Genetic Factors" OR "Behavioral Factors" OR "Socioeconomic Factors" OR "Psychosocial Factors" OR "Demographic Factors")AND PUBYEAR > 2014

Collating, Summarizing and Reporting the Results (Analysis)

We conducted descriptive statistics to identify the theoretical models influencing BCS, including the number of indexed publications from which data were extracted. Additionally, we reported the counts and/or frequencies and proportions of the characteristics of the theoretical models from which data were extracted. An iterative process was employed by the research team during the organization and synthesis of the results to ensure consensus was reached. The results were synthesized and reported through a narrative summary of the extracted data from all full-text publications, with graphical displays used to present the extracted information. A theme classification system was used to differentiate between the various theories, models, and frameworks related to factors influencing BCS. The similar components of each theoretical model were identified as one theme. Studies utilizing more than one theory, model, or framework were categorized as employing a "UN-category of model" approach.

Results

Study Characteristics

The database search yielded 9,633 citations. After removing duplicates, records flagged as ineligible by automated tools, and those excluded for other reasons, 1,934 citations remained for the abstract screening process. The inter-rater agreement for the title/abstract screening phase was 89%, with all discrepancies resolved through consensus. The remaining 889 studies underwent full-text review, following the same procedures as the title/abstract screening. The inter-rater agreement during the full-text screening phase was 87%. The reasons for exclusion at this stage were also recorded. A total of 70 articles passed the full-text screening and were included in this scoping review. The study selection process is illustrated in the PRISMA flowchart (Figure 1).

These studies employed diverse research methods, with cross-sectional studies being the most prevalent (66/70, 94.29%), followed by qualitative studies (3/70, 4.29%) and mixed-methods study (1/70, 1.43%). Geographically, the studies were conducted in various countries worldwide, with the highest number of studies originating from the United States (16/70, 22.86%), Iran (15/70, 21.43%), and China (9/70, 12.86%). The age of participants varied, with the majority falling between 40 and 70 years old, thereby targeting predominantly middle-aged and older populations. The sample sizes varied considerably across studies, with some involving thousands of participants such as the study by Narcisse,[32] with a sample size of 5,484, while others were small-scale case studies, such as Sarmah's studies with around 22 participants.[33]

Research on Applying BCS Theoretical Model

The scoping review identified 13 theoretical models, each used independently as a framework to examine factors influencing BCS participation. The three most frequently used models were the Health Belief Model (HBM) (21 studies, 30.0%), followed by Andersen's Behavioral Model (ABM) (11 studies, 15.71%), and the Theory of Planned Behavior (TPB) (8 studies, 11.43%). Additionally, some studies employed a combination of models, such as HBM and TPB, to provide a more comprehensive explanation of the factors influencing BCS participation. Details of these models are presented in Table 8.

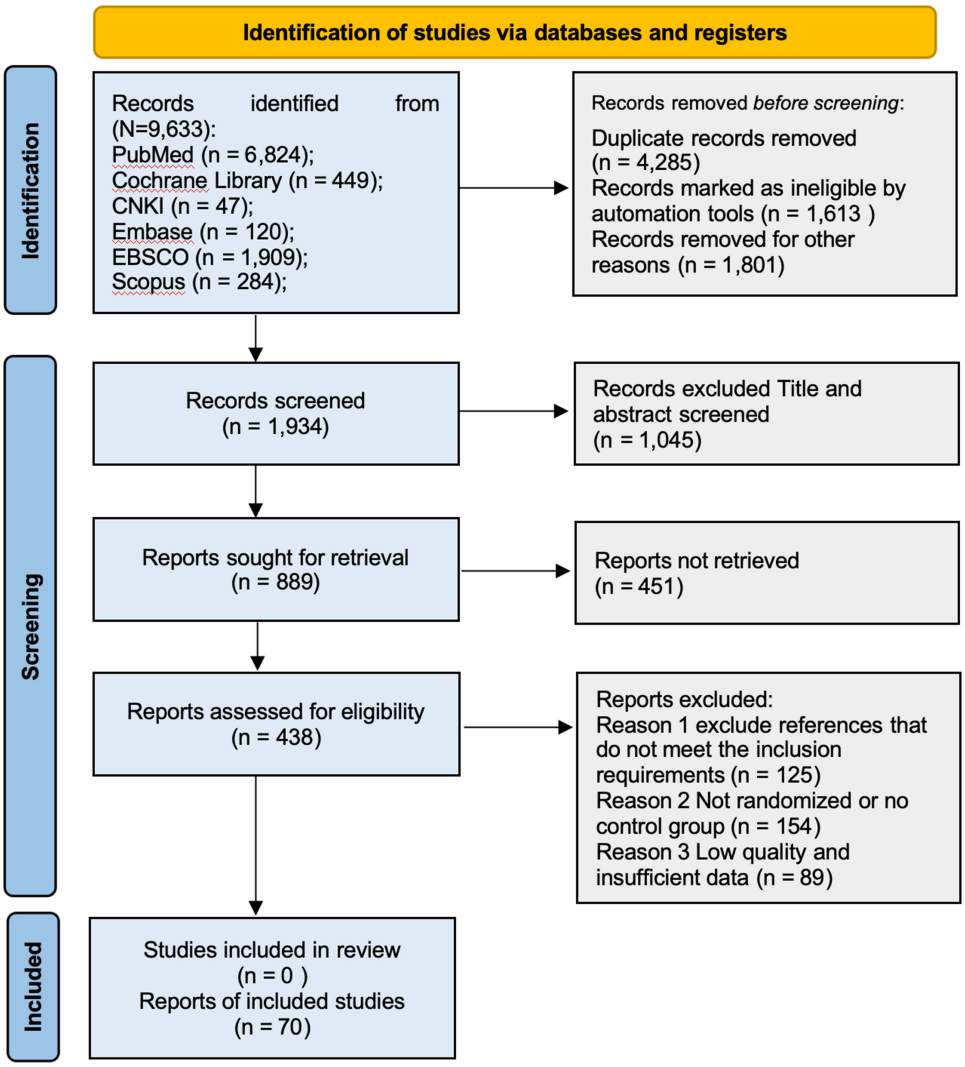

Figure 1 PRISMA flowchart. This diagram illustrates the process of identifying and screening studies through database searches. From the initial 9,633 records, studies were ultimately selected for analysis after deduplication, screening, and eligibility assessment.

These 13 models can be categorized into three themes based on the characteristics they address. The first theme, Behavioral and Cognitive factors, includes six models: the HBM, the TPB, the Social Cognitive Theory (SCT), the Protection Motivation Theory (PMT), the Information-Motivation-Behavioral Skills Model (IMB), and the Transtheoretical Model (TTM). The second theme, Health and Social Determinants, includes the Self-Determinant Theory (SDT), the PEN-3 Cultural Model (PEN-3), the Kleinman's Explanatory Model (KEM), and the Theory of Care Seeking Behavior (CSB). The final theme, Systems and Contextual Factors, includes the ABM, the Salutogenic Model of Health (SMH) and the Systems Model of Clinical Preventive Care (SMCPC), which focus on the impact of healthcare delivery systems (Table 9). Although these models are categorized separately, they intersect conceptually across themes to explain their impact on health behaviors and other components related to health outcomes.

Discussion

Variability in Predictive Ability of Models for BCS Behavior

Among all studies analyzing BCS factors using theoretical models. The HBM ranks first. It focuses on individual perceptions,[97,102] and performs well in identifying economic barriers and health system trust issues, especially among low-income populations in urban settings of developing countries, such as India.[35] However, it shows limitations in

Table 8 Basic Characteristics of Included Studies (N = 70)

Theory, Model, or Framework	Key Components	Author/Year	Country	Age	Sample Size	Screening Type	Data Type
HBM	Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers, Self-Efficacy, Cues to Action	Tupper et al/2024[34]	Armenia	35-65	170	Not Specified	Quantitative
HBM		Shiryazdi et al/2014[35]	Iran	34.7±13.7	441	BES+MMG	Quantitative
HBM		Rezaeimanesh et al/ 2021[36]	Iran	>40	985	MMG	Quantitative
HBM		Tarı Selçuk et al/2020[37]	Turkey	>40	416	BSE+CBE+MMG	Quantitative
HBM		Altunkurek et al/2022[38]	Somalia	22 ± 11.21	413	BSE	Quantitative
HBM		Kangmennaang et al/2019[39]	Namibia	\	\	BSE	Quantitative
HBM		Jiraniramai et al/2024[40]	Thailand	40-70	130	BSE+MMG+UTS	Quantitative
HBM		Nikpour et al/2019[41]	Iran	35-85	800	BSE+MMG+CBE	Quantitative
HBM		Park et al/2020[42]	Armenia	None	139550	MMG	Quantitative
HBM		Juárez-García et al/2019[43]	Mexico	>40	612	MMG	Quantitative
HBM		Khazir et al/2019[44]	Iran	>40	262	MMG	Quantitative
HBM		Mekuria et al/2020[45]	Ethiopia	39.8± 10.4	247	BSE	Quantitative
HBM		Noman et al/2021[46]	Malaysia	33.99±6.49	103	BSE+MMG	Quantitative
HBM		Racine et al/2021[47]	Canada	37.9 ±12.4	75	BSE+CBE+MMG	Quantitative
HBM		Wang et al/2014[48]	China-TW	45-69	766	MMG	Quantitative
HBM		Tsunematsu et al/2013[49]	Japan	40-69	993	Not Specified	Quantitative
HBM		Sha et al/2017[50]	China	40-70	805	Not Specified	Quantitative
HBM		Shubayr et al/2022[51]	Saudi Arabia	24	680	BSE	Quantitative
HBM		Roh et al/2018[52]	America	18-89	286	CBE+MMG	Quantitative
HBM		Esna-Ashari et al/2022[53]	Iran	46±4.1	458	MMG	Quantitative
HBM		Wuur et al/2022[54]	Ghana	18-49	243	BSE+CBE+MMG	Quantitative
TPB	Attitude, Subjective Norms, Perceived Behavioral Control	Ketema et al/2023[55]	Ethiopia	>18	420	CBE	Quantitative
TPB		Bhandari et al/2021[56]	Nepal	>40	500	BSE+CBE+MMG	Quantitative
TPB		Manning et al/2019[57]	America	\	212	Not Specified	Quantitative
TPB		Keshavarzi et al /2022[58]	Iran	>35	800	MMG	Quantitative
TPB		Sun et al/2022[59]	China	>18	3011	Not Specified	Quantitative
TPB		Khani Jeihooni et al/2023[60]	Iran	31.65 ± 7.59	400	BSE	Quantitative
TPB		Mirzaei-Alavijeh et al/2018[61]	Iran	39.61±8.28	408	MMG	Quantitative
TPB		Cadet et al/2015[62]	Spain	≥54	2139128	Not Specified	Quantitative
SCT	Threat Appraisal (Perceived Severity, Perceived Vulnerability, Intrinsic/Extrinsic Rewards), Coping Appraisal (Response Efficacy, Self-Efficacy, Response Costs), Protection Motivation	Lu et al/2024[63]	China	41.62±12.68	430	Not Specified	Quantitative
SCT		Aluko et al/2014[64]	Nigeria	27±5.1	278	BSE+CBE+MMG	Quantitative
SCT		Adegboyega et al/2022[65]	America	43.73±14	132	MMG	Quantitative
PMT	Threat Appraisal (Perceived Severity, Perceived Vulnerability, Intrinsic/Extrinsic Rewards), Coping Appraisal (Response Efficacy, Self-Efficacy, Response Costs), Protection Motivation	Gao et al/2023[66]	China	≈28.4	895	CBE+BSE	Quantitative
PMT		Ghofranipour et al/2020[67]	Iran	40-65	410	BSE	Quantitative
PMT		Zhang et al/2021[68]	China	40-70	412	Not Specified	Quantitative
IMB	Information, Motivation, Behavioral Skills	Talley et al/2017[69]	America	\	278	According to guideline	Quantitative

(*Continued*)

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Table 8 (Continued).

Theory, Model, or Framework	Key Components	Author/Year	Country	Age	Sample Size	Screening Type	Data Type
TTM	Six Stages of Change (Precontemplation, Contemplation, Preparation, Action, Maintenance, Termination), Key Processes of Change (Cognitive/Experiential Processes, Behavioral Processes), Decisional Balance, Self-Efficacy	Tung et al/2024[70]	America	≥40	714	MMG (According to guideline)	Quantitative
SDT	Basic Psychological Needs - Autonomy, Competence, Relatedness Types of Motivation - Amotivation, External Regulation, Introjected Regulation, Identified Regulation, Integrated Regulation, Intrinsic Motivation	Jung et al/2014[71]	South Korea	40-69	905	Not Specified	Quantitative
KEM	Etiology, Timing, Symptoms, Pathophysiology, Treatment	Donnelly et al/ 2013[72]	Qatar	>35	1063	BCS+CBE+MMG (According to guideline)	Quantitative
PEN-3	Health Education (Education/Assessment Domain) - Perceptions, Enablers, Nurturers Educational Diagnosis (Planning/Intervention Domain) - Positive, Existential, Negative Cultural Appropriateness (Evaluation Domain) - Person, Extended Family, Neighborhood	Moghaddam et al/2019[73]	Iran	\	192	BSE+CBE+MMG	Quantitative
CSB	Predisposing Factors - Demographics, Health Beliefs, Social/Cultural Norms Enabling Factors - Economic, Structural, Community Need Factors - Self-Assessed Symptoms, Clinical Urgency Triggering Mechanisms - Symptom Recognition, Social Cues, System Cues	Sarmah et al/2023[74]	South Africa	20-60	22	Not Specified	Qualitative
SMH	Sense of Coherence (SOC) - Comprehensibility, Manageability, Meaningfulness Generalized Resistance Resources (GRRs) - Social Support, Knowledge/Skills, Access to Healthcare Health Ease/Dis-ease Continuum	Conway-Phillips et al/2014[75]	America	57±8.4	134	BSE+CBE+MMG	Quantitative
SMCPC	Patient-Level Factors - Demographics, Health Beliefs, Prior Experiences Provider-Level Factors - Knowledge & Attitudes, Time/Resources, Clinical Reminders Healthcare System-Level Factors - Policies, Workflow Integration, Performance Feedback	Guo et al/2019[76]	America	40-55	3911	MMG	Quantitative
ABM	Predisposing Factors - Demographics, Social Structure, Health Beliefs	An et al/2018[77]	America	19-85	233	CBE+MMG	Quantitative
ABM	Enabling Factors - Personal/Financial, Organizational, Community Need Factors - Perceived Need, Evaluated Need	Lee et al/2019[78]	America	≥45	182	MMG (According to guideline)	Quantitative
ABM	Health Service Utilization	Kim et al/2020[79]	South Korea	40-75	1228	MMG (According to guideline)	Quantitative
ABM		Lee et al/2020[80]	America	18-89	285	MMG	Quantitative
ABM		Narcisse et al/2023[32]	America	50-74	5484	MMG (According to guideline)	Quantitative
ABM		Jin et al/2019[81]	America	50-80	303	MMG	Quantitative
ABM		Agrawal et al/2021[82]	America	40-86	919	MMG	Quantitative
ABM		An et al/2020[83]	America	≥20	233	CBE+MMG	Quantitative
ABM		Lee et al/2017[84]	America	≥40	168	BSE+CBE+MMG	Quantitative
ABM		Zhang et al/2023[85]	China	45. 935±6. 403	1824	Not Specified	Quantitative
ABM		Antabe et al/2020[86]	Kenya	15-49	14734	Not Specified	Quantitative
PMT+SST	Threat Appraisal (Perceived Severity, Perceived Vulnerability, Intrinsic/Extrinsic Rewards), Coping Appraisal (Response Efficacy, Self-Efficacy, Response Costs), Protection Motivation + Emotional Support, Instrumental (Tangible) Support, Informational Support, Appraisal Support	Mirzaei-Alavijeh et al/2016[87]	Iran	39.12±0.41	385	Not Specified	Quantitative
PMT+SST		Bashirian et al/2019[88]	Iran	37.1±8.3	501	BSE	Quantitative
TTM+HBM	Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers, Self-Efficacy, Cues to Action + Six Stages of Change (Precontemplation, Contemplation, Preparation, Action, Maintenance, Termination), Key Processes of Change (Cognitive/Experiential Processes, Behavioral Processes), Decisional Balance, Self-Efficacy	Kim et al/2019[89]	South Korea	\	296	BSE	Quantitative
TTM+HBM		Farajzadegan et al/2016[90]	Iran	37.6±11.6	162	BSE+CBE	Quantitative
KAP+HBM	Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers, Self-Efficacy, Cues to Action + Knowledge, Attitudes, and Practices	Ngan et al/2019[91]	Vietnam	30-74	508	CBE+MMG	Quantitative

HBM+TRA	Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers, Self-Efficacy, Cues to Action + Behavioral Intention (BI), Attitude Toward the Behavior (A), Subjective Norm (SN)	Firouzbakht et al/2020[92]	Iran	35-85	500	BSE+CBE+MMG	Quantitative
SEM+HBM+cancer stigma framework	Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers, Self-Efficacy, Cues to Action + Individual (Intrapersonal), Interpersonal (Social Relationships), Organizational (Institutional), Community (Local Environment), Policy/Public Policy (Societal) + Public Stigma (Societal Attitudes), Self-Stigma (Internalized Shame), Structural Stigma (Institutional Bias), Courtesy Stigma (Affecting Caregivers/Family)	Malope et al/2024[93]	South Africa	35-74	34	BSE+CBE+MMG	Qualitative
HBM+TPB	Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers, Self-Efficacy, Cues to Action + Attitude, Subjective Norms, Perceived Behavioral Control	Wang et al/2019[94]	China	32.2±14.9	422	CBE+MMG	Quantitative
HBM+SCT	Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers, Self-Efficacy, Cues to Action + Observational Learning/Modeling (Attention, Retention, Reproduction, Motivation), Self-Efficacy, Outcome Expectations, Goal Setting, Environmental Influences	Salmani et al/2021[19]	Iran	20-65	1410	CBE+MMG	Quantitative
HBM+SCM	Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers, Self-Efficacy, Cues to Action + Precontemplation, Contemplation, Preparation (Determination), Action, Maintenance, Termination/Relapse	Ramli et al/2019[95]	Malaysia	30-70	520	MMG	Quantitative
HBM+KAB	Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers, Self-Efficacy, Cues to Action + Knowledge (K), Attitude (A), Behavior (B)	Hsieh et al/2021[96]	China-TW	45-69	621	MMG	Quantitative
HBM+HPM	Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers, Self-Efficacy, Cues to Action + Individual Characteristics and Experiences, Behavior-Specific Cognitions and Affect, Commitment to a Plan of Action, Immediate and Competing Demands	Tuzcu et al/2015[97]	Turkey	\	39	Not Specified	Qualitative
HBM+CSM	Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers, Self-Efficacy, Cues to Action + Illness Representations (Cognitive & Emotional), Coping Appraisal, Appraisal Feedback Loop	Marmarà et al/2017[98]	Malta	50-60	404	MMG	Quantitative
HBM+CSEI	Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers, Self-Efficacy, Cues to Action + Structure, Scoring, Clinical & Research Use	Avci et al/2014[99]	Türkiye	22-53	113	BSE+CBE+MMG	Quantitative
HBM+SEM	Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers, Self-Efficacy, Cues to Action + Individual (Intrapersonal), Interpersonal (Social Relationships), Organizational (Institutional), Community (Local Environment), Policy/Public Policy (Societal)	Goh et al/2022[100]	Singapore	40-69	23	MMG	Mix
(TPB+SCT+HBM +Fatalism)	Attitude, Subjective Norms, Perceived Behavioral Control + Observational Learning/Modeling (Attention, Retention, Reproduction, Motivation), Self-Efficacy, Outcome Expectations, Goal Setting, Environmental Influences + Perceived Susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers, Self-Efficacy, Cues to Action + Fatalism (Predetermination, Powerlessness, Pessimism)	Tolma et al/ 2014[101]	America	51±7.64	255	MMG	Quantitative

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Table 9 Classification According to the Theme of Theoretical Models

Theme	HBM	TPB	SCT	PMT	IMB	TTM	SDT	KEM	PEN-3	CSB	SMH	SMCPC	ABM	PMT +SST	TTM +HBM	KAP +HBM	HBM +TRA	SEM+HBM+Cancer Stigma Framework	HBM +TPB	HBM +SCT	HBM +SCM	HBM +KAB	HBM +HPM	HBM +CSM	HBM +CSEI	HBM +SEM	TPB+SCT +HBM +Fatalism
Behavioral and Cognitive Models	21 (30.0%)	8 (11.4%)	3 (4.2%)	3 (4.2%)	1 (1.4%)	1 (1.4%)																					
Health and Social Determinants Models							1 (1.4%)	1 (1.4%)	1 (1.4%)	1 (1.4%)																	
Systems and Contextual Models											1 (1.4%)	1 (1.4%)	11 (15.7%)														
UN-category of model														2 (2.8%)	2 (2.8%)	1 (1.4%)	1 (1.4%)	1 (1.4%)	1 (1.4%)	1 (1.4%)	1 (1.4%)	1 (1.4%)	1 (1.4%)	1 (1.4%)	1 (1.4%)	1 (1.4%)	1 (1.4%)

addressing perceived severity, barriers, and social/psychological factors including depression and smoking behavior.[34,36–51,77,102–104] ABM's key advantage is identifying health insurance and cultural beliefs factors,[32,53,54] emphasizing regular checkups and health education.[82,86] However, psychological factors is limited.[32,50,53,54,78–80,82,84–86] TPB effectively captures the influence of attitudes and subjective norms.[81] But its predictive power for actual behavior is limited in complex social contexts.[55–60,83,87,105] PMT lacks support for emotional factors such as fear and requires further cross-cultural validation, particularly in African and Southeast Asian cohorts, where fear responses vary due to local stigma.[59,62,66,101] SCT integrates multidimensional factors to explain screening decisions, though it overlooks the role of cultural/social support.[63,67,68] The PEN-3 model highlights beliefs and family support,[64] studies reported higher screening rates among women with a history of breast disease.[65] The KEM model emphasizes physician recommendations, health status and cancer prevention beliefs, while barriers include fear and lack of recommendations.[73] The IMB model identifies barriers,[72] such as lack of information, behavioral skills, and practical issues such as financial constraints and transportation.[69] TTM associates age, health cognition, biopsy history, and self-efficacy with mammography stages, particularly in Asian Americans.[106] The SMCPC model identification barriers such as time constraints, distrust in doctors, and smoking.[70] The SMH model shows that spirituality and participation in free screening programs improve screening rates.[76] The SDT model focuses on perceived effort, choice, and stress as screening influences.[75] The CSB model emphasizes the role of entrenched cultural norms in shaping health behaviors.[33] While these models offer strong predictive power in certain contexts, their practical application is often hindered by resource limitations, insufficient healthcare infrastructure, and cultural barriers that prevent effective implementation, especially in low-income and rural areas of sub-Saharan Africa and rural Latin America.[71]

Complexity of Integrated Models

Integrated models' complexity arises from combining multiple theoretical frameworks, each with its own distinct concepts and structures. Combining HBM with TPB allows simultaneously consider the influence of individual beliefs and social norms.[74] Combining HBM with TPB also reveals occupational differences, with higher screening intentions among teachers and medical staff.[74] The HBM-SCT combination emphasizes perceived barriers, benefits, and susceptibility across BSE stages,[19] while the HBM-TTM model suggests stage-specific strategies for better BSE acceptance,[89,94] highlighting the impact of perceived barriers, especially for women with a family history. The HBM-TRA combined model showed that the TRA model had a better model fit than the HBM.[90] The HBM-CSEI found that women scholars who participated in BSE reported higher perceived benefits and self-efficacy.[92] The HBM-CSM believes that lack of trust in the medical team and concerns about procedural pain affect BCS.[99] The HBM-SCM found that women in the action and maintenance stages were more likely to adopt MMG.[98] The HBM-KAB model links health beliefs with screening behaviors,[95] considering factors like age, marital status, and motivation, thereby supporting personalized interventions. The HBM-KAP offers a different view, suggesting that sociodemographic characteristics affect the use of MMG but not the adoption of CBE.[96] The PMT-SST suggests that women who believe in the effectiveness of BSE and have self-confidence are more likely to undergo BSE.[91] The TPB+CDT combination shows that women's decisions are more influenced by family and friends' attitudes than by screening invitations.[88] The HBM+HPM model highlights that lack of information, indifference, and cultural factors are key barriers to screening participation.[100] The SEM, HBM,[93] and cancer stigma framework together reveal that sociocultural misunderstandings, health literacy gaps, and limited healthcare resources contribute to women to seek treatment only when symptoms are severe.[107] For instance, in low-resource settings in Southeast Asia, integrating HBM with local cultural models has shown promise in addressing socioeconomic disparities, though challenges persist in rural vs urban implementations.[108] Integrating social media[52] and digital health tools into these models may help examine how they enhance access to healthcare services and social support, thereby promoting participation in health screenings.[61]

Model Intersections and Hybrid Framework Implications

Our analyses (Figures 2–4) reveal systematic theoretical convergence patterns that inform hybrid framework development for BCS. Hybrid frameworks integrate complementary constructs by addressing multilevel determinants individual cognition, social context, and structural factors that single models are unable to capture adequately. Evidence

demonstrates that multilevel interventions based on integrated theories achieve 1.5–2.3 times higher screening rates than single-theory approaches.[109]

Behavioral and Cognitive Models (Figure 2) show strong HBM-TPB correlation (r = 0.72), indicating complementary mechanisms: HBM addresses threat appraisal and outcome expectations,[110] while the TPB captures normative influences and perceived behavioral control. SCT bridges both through reciprocal determinism, linking individual cognition with social factors and environmental influences.[111] Community-based programs integrating HBM-TPB-SCT increased

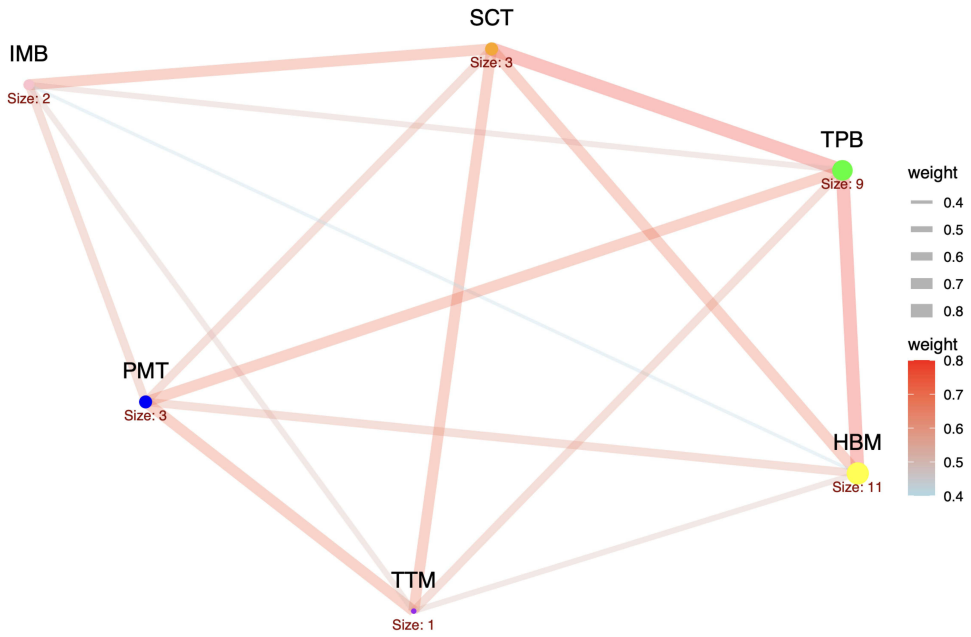

Figure 2 Behavioral and Cognitive Models. This diagram illustrates the relationships between major health behavior theoretical models, including the IMB, TPB, PMT, HBM, SCT and TTM. Node size indicates influence, and line thickness indicates the strength of the association between models.

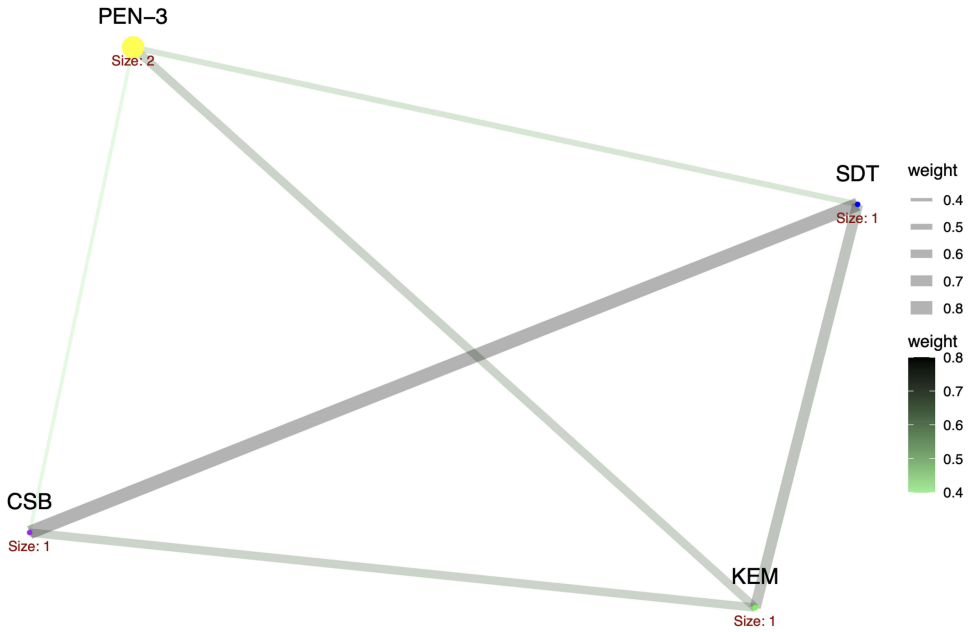

Figure 3 Health and Social Determinants Models. This diagram illustrates a network of models focusing on the relationship between sociocultural factors and health, including the PEN-3, CSB, SDT, and KEM. This model highlights the central role of cultural background and individual motivation in health interventions.

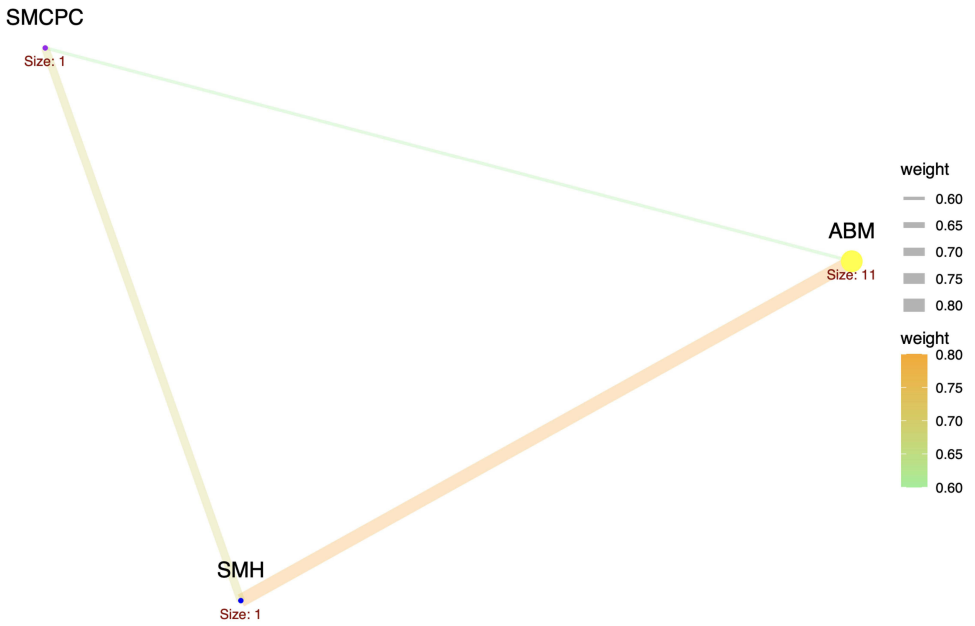

Figure 4 Systems and Contextual Models. This diagram illustrates the synergistic relationship between systems models, including the ABM, SMCPC, and SMH. The strong synergy between the ABM and SMCPC can be used to proactively optimize intervention strategies, reduce costs, and improve efficiency.

mammography rates from 42% to 67% in underserved populations. Weak IMB-TTM correlations (r = 0.31) reflect theoretical incompatibility; however, stage-matched interventions applying these models sequentially achieved 68% versus 41% screening completion over 12 months.

Health and Social Determinants Models (Figure 3) demonstrate PEN-3 and SDT alignment (r = 0.68), both prioritizing cultural context and autonomous agency across minority populations.[112] PEN-3 identifies culturally relevant enablers while SDT provides motivational pathways respecting cultural autonomy.[113] Faith-based screening programs integrating both models achieved 73% participation among African American women versus 48% in culturally non-tailored programs. SDT exhibits minimal overlap with KEM (r<0.25), reflecting distinct intrinsic-motivation versus knowledge-based orientation.

Systems and Contextual Models (Figure 4) reveal ABM-SMCPC synergy (r = 0.74): ABM simulates behavioral dynamics while SMCPC operationalizes communication strategies.[114] This integration enables prospective intervention testing, with simulated pre-testing identifying optimal intervention components that reduced implementation costs by 34% while improving reach by 28%. SMH shows weak ABM convergence (r = 0.29), indicating complementary rather than overlapping application.

These hybrid frameworks provide nurses with more precise assessment tools to identify whether non-adherence stems from knowledge gaps, social barriers, or self-efficacy deficits, enabling targeted interventions. For policy, computational modeling enables evidence-based resource allocation across diverse contexts.[115] Future research should empirically test these theoretical synergies through randomized controlled trials examining both screening outcomes and the feasibility of implementation across diverse populations.

Conclusion

Over the past decade, various theoretical frameworks have been used to explore the complex factors influencing BCS behaviors. However, the evolving nature of health behaviors has led researchers to increasingly adopt mixed methods, integrating multiple theoretical models for a more comprehensive understanding of BCS determinants. These multi-dimensional perspectives, when combined, offer a more robust and nuanced predictive framework. Future refinements to these models are expected to enhance their applicability and validity across diverse populations and contexts. Predictions generated from these models emphasize the importance of incorporating contextual and personal factors to improve

accuracy. Future research should focus on developing hybrid models and validating these frameworks in real-world settings. These findings not only demonstrate that refining theoretical models is crucial to improving their applicability but also highlight the importance of translating these theoretical insights into actionable public health strategies, such as community interventions, targeted education campaigns, and policy changes aimed at reducing barriers to screening. A potential limitation of this review is the inclusion of studies from diverse methodologies and settings, which may limit the comparability and generalizability of the findings. In addition, this review may have introduced biases. Language restrictions could have led to the exclusion of relevant studies published in other languages. The geographical distribution of included studies is concentrated in specific countries, which may limit the global applicability of the findings. Furthermore, the limited inclusion of indigenous or ethnic minority populations may have overlooked the impact of cultural diversity on screening behavior.

Abbreviation

HBM, Health Belief model; TPB, Theory of Planned Behavior; SCT, Social Cognitive Theory; PMT, Protection motivation Theory; IMB, Information-motivation-Behavioral Skills model; TTM, Transtheoretical model; SDT, Self-determinant theory; KEM, Kleinman's Explanatory model; PEN-3, PEN-3 model; CSB, Theory of Care Seeking Behavior; SMH, Salutogenic model of health; SMCPC, Systems model of Clinical Preventive Care; ABM, Andersen's Behavioral model; PMT+SST, Protection motivation Theory+Social Support Theory; TTM+HBM, Transtheoretical model+Health Belief model; KAP+HBM, Knowledge, Attitudes, and Practices+Health Belief model; HBM+TRA, Health Belief model + Theory of Reasoned Action; SEM+HBM+cancer stigma framework, Social Ecological model +Health Belief model+Cancer Stigma Framework; HBM+TPB, Health Belief model + Theory of Planned Behavior; HBM+SCT, Health Belief model + Social Cognitive Theory; HBM+SCM, Health Belief model+Stages of Change model; HBM+KAB, Health Belief model+Knowledge-Attitude-Behavior model; HBM+HPM, Health Belief model +Health Promotion model; HBM+CSM, Health Belief model;del+Common-Sense model; HBM+CSEI, Health Belief model + Coopersmith Self-Esteem Inventory; HBM+SEM, Health Belief model+Social Ecological model; TPB+SCT +HBM+Fatalism, Theory of Planned Behavior + Social Cognitive Theory + Health Belief model + Fatalism.

Disclosure

The authors report no conflicts of interest in this work.

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