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Received: 5 March 2021 | Revised: 26 May 2021 | Accepted: 2 June 2021

DOI: 10.1111/phn.12944

PHN PUBLIC HEALTH NURSING WILEY

SPECIAL FEATURES - EDUCATION

The application of health behavior theories to promote cervical cancer screening uptake

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Funding information
"Coopération au développement"

Abstract

Background: While cervical cancer is a major cause of mortality, its progress and survival rate can be improved through screening. Yet despite their wide availability, women's participation in cervical cancer screening (CCS) programs is often suboptimal, especially in low- and middle-income countries. Besides demographic and organizational characteristics, screening uptake is influenced by psychological factors, most of which are included in health behavior theories. This systematic review compared different health behavior theories in terms of their capacity to explain CCS uptake and inform CCS promotion campaigns.

Methods: A comprehensive search and analysis of published intervention and non-intervention (observational) studies that applied at least one health behavior theory to CCS participation.

Results: After quality screening, 48 observational and 21 intervention studies were identified that applied the Health Belief Model (HBM), Theory of Reasoned Action (TRA), Theory of Planned Behaviour (TPB), Transtheoretical model (TTM), Social-ecological Model (SEM), and/or Theory of Triadic Influence (TTI) to CCS. The HBM was most frequently used to explain behavior, whereas the TPB was better at explaining screening intentions. Tailored intervention studies focusing on all theoretical constructs were most effective in modifying perceptions and increasing CCS uptake.

Conclusions: Despite their inconsistent use, health behavior theories can explain CCS intentions and behavior and contribute to the development of targeted interventions to promote screening uptake.

KEYWORDS
beliefs, cancer, health behavior theories, health behaviors, interventions, public health nursing education, screening, women's health

1 | BACKGROUND

Cancer of the cervix uteri is the fourth most common cancer among women worldwide, and accounts for 7.5% of all female cancer deaths (Ferlay et al., 2015). The projected number of deaths due to cervical cancer by 2030 is estimated at approximately 80%, with the highest mortality occurring in low- middle-income countries (LMICs). While vaccination is increasingly practiced in economically developed countries, most LMICs restrict cancer prevention to screening. Screening helps to detect and treat infections that may progress into cancer at an early stage, which results in a better prognosis and higher survival rate (Edge & Compton, 2010). Yet, despite the wide availability of screening, the participation of women in CCS programs is often suboptimal, especially in LMICs (Islam et al., 2017).

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To enhance women's participation in CCS, it is important to understand the factors that contribute to screening uptake. Apart from socio-demographic factors like economic status, education level, or cultural and religious barriers, and the characteristics of the health system such as the affordability, availability, accessibility, and acceptability of screening services, participation in screening also depends on the psycho-social make-up, perceptions, beliefs, and motivation of the woman in the target group and of their partners and significant relatives. To account for these psychological factors in a comprehensive way, it is useful to apply existing health behavior theories. These theories typically rely on constructs deriving from social, cognitive and motivational psychology, and have been empirically shown to partially explain health related behaviors. As such, they can also inform the development of contextually suitable and effective cervical cancer screening (CCS) strategies.

1.1 | Health behavior theories and their application

Various psychological theories and models have been proposed to explain human behavior related to health. The most well-known and often-used ones are the *Health Belief Model* (HBM; (Champion & Skinner, 2008; Glanz et al., 2008), (Janz & Becker, 1984)), the *Protection Motivation Theory* (PMT; (R. W. Rogers, 1975)), and the *Theory of Planned Behaviour* (TPB; (Ajzen, 1991)) which in itself is an extension of the *Theory of Reasoned Action* (TRA;(Fishbein & Ajzen, 1977)). These so-called social cognitive models try to understand and predict health related behaviors by referring to people's beliefs, perceptions, expectancies, and intentions. Other models focus on the different stages that people go through to initiate and maintain health-related behavior. The most well-known of these, the *Trans-Theoretical Model of change* (TTM; (Prochaska & DiClemente, 1983)), identifies five stages of health behavior change: pre-contemplation, contemplation, preparation, action and maintenance. In a similar vein, the *Health Action Process Approach* (HAPA; Schwarzer, 2016) posits that the adoption, initiation, and maintenance of health behaviors should be conceived of as a structured process which includes a motivation phase (the intention formation) and a volitional phase (initiating action, maintenance, and recovery). A last category of health behavior theory, the *Social Ecological Model* (SEM; (McLeroy et al., 1988)), emphasizes how individual health behavior both shapes, and is shaped by, the social environment, by identifying five levels of influence for health related behaviors: intrapersonal factors, interpersonal networks and support systems, institutional (organizational) factors, community factors, and public policies. The assumption that people both influence and are influenced by those around them is also present in the Theory of Triadic influence (TTI; (Snyder & Flay, 2012)), which identifies seven "tiers" of behavioral causes that range from very proximal (knowledge, values, attitudes, self-determination/control, self-efficacy) to distal (social skills, social bonding, social learning), to ultimate (social normative beliefs), and three "streams of influence" that flow through the tiers (cultural- environmental influences, social situation-context influences, and intrapersonal influences).

Health behavior theories have been successfully applied to a broad range of health-related behaviors, including healthy eating, physical activity, alcohol consumption, safety behavior, safe sex practices and screening. Yet, despite the availability of several systematic reviews (Armitage & Conner, 2001; Austin et al., 2002; Godin & Kok, 1996; Johnson et al., 2008; Jones et al., 2014), only a few of these have compared different theories in terms of their explanatory value. Taylor and colleagues conducted a review of 25 studies that used HBM, TPB, TRA, and TTM to evaluate the degree to which these theories could predict health behavior in general (Taylor et al., 2006). They concluded that the TPB is a better predictor of health behavior than the HBM and TRA, while the TTM can inform the delivery of health behavior change interventions by defining the stages of health behavior change. Armitage and Connor concluded from their structured review of studies using the HBM, PMT, TRA, TPB, and Social Cognitive Theory (SCT) that motivational models provide an incomplete account of health behavior compared to behavioral enaction and multi-stage models. They suggest that an integration of different approaches to the study of health behavior may prove fruitful.

By identifying the factors that may influence health behavior change, health behavior theories can contribute to explaining screening behavior (Dehdari et al., 2014) or the intention to participate in screening (Cooke & French, 2008; Roncancio et al., 2013). As such, they can help to develop more effective screening interventions (Painter et al., 2008; Parsa et al., 2017). Indeed, while demographic factors that influence screening behavior can be taken into account but not modified (Acera et al., 2017) psychological factors that determine screening behavior can be addressed directly. As such, the use of theories about health behavior can inform the development of more effective strategies for encouraging women to participate in CCS.

While some empirical studies have been published that compared the HBM and the TPB in terms of their capacity to explain vaccination against cervical cancer (Gerend & Shepherd, 2012; McClenahan et al., 2007; Nejad et al., 2005), self-screening (Gerend & Shepherd, 2012; McClenahan et al., 2007; Nejad et al., 2005), or screening participation (Bish et al., 2000; Hennig & Knowles, 1990; Hill et al., 1985; Nyambe et al., 2016; Ritchie et al., 2020), reviews of studies comparing health behavior theories applied to screening behavior are scarce. To our knowledge, only two such comparative reviews have been published thus far. Nyambe, Van Hal, and Kampen compared the validity of the SEM and the TTI for cervical screening and vaccination, and concluded that both models are often found effective, but that the empirical basis for that conclusion is often unclear or incompletely specified (Nyambe et al., 2016). Ritchie et al., found that both the HBM and the TPB can explain mammographic screening (Ritchie et al., 2020), but that most studies using these models only examine the individual constructs and fail to consistently report on the effectiveness of the models as a whole. As with other existing reviews, neither of these two systematic reviews differentiated between studies that explained CCS uptake, and those that used health behavior theories to develop interventions to improve women's participation in screening.

The present review aimed to explore published studies that applied health behavior theories to CCS with an aim to document (1) the use of health behavior theories in explaining CCS uptake; (2) the value of different health behavior theories to explain CCS uptake or intention; and (3) the use of health behavior theories in development of effective interventions to promote CCS uptake. Since cervical cancer is especially prevalent in LMICs, and access to screening facilities often comparatively more difficult, behavioral factors may play a different role in these countries than in economically more developed countries. Therefore, this review paid particular attention to the use and applicability of the theories to CCS in LMICs.

2 | METHOD

2.1 | Selection of studies for the review

This systematic review followed the PRISMA guidelines (Moher et al., 2009). To be included in the review, studies had to meet the following inclusion criteria: (a) be available in full text in the English language, irrespective of the publication date; (b) be concerned with CCS of women, irrespective of any ethnicity or cultural group, country, socio-economic status and irrespective of education, occupation, religion, income or context; CCS is described as the testing of women at risk of cervical cancer, mostly those without symptoms, with the aim to detect precancerous changes, which, if not treated, may lead to cancer; (c) be either observational studies that explained CCS uptake or intention to participate in screening, or interventional studies that improved screening uptake or the intention for screening participation; (d) explicitly refer to one or more specific health behavior theories, defined as a psychosocial theory or model that predicts, explains, and/or aims to change health related behavior. Studies that used less than 50% of the constructs represented in a behavioral theory, qualitative studies, studies with missing key information (abstract, author information), or other formats (e.g., editorial, case report, opinion, letters) were excluded. To find and select studies for inclusion in the review a three-step approach was followed (see Annex 1 for details). First, an initial search was performed in PubMed and Scopus, followed by an analysis of the words contained in the title and abstract, and the index terms used to describe the articles. The initial keywords used were: (1) cervical cancer, uterine cervical neoplasms [MeSH], PAP smear, VIA VILLI, HPV testing; (2) screening, early detection of cancer [MeSH], diagnosis, Participation, uptake, diagnosis [MeSH], intention, response, coverage; (3) health behavior theory/Health Belief Model OR HBM, Transtheoretical Model OR TTM OR Stages of Change Model, TPB OR TRA, Health Action Process Approach OR HAPA, Protection Motivation Theory OR PMT, Social-Cognitive theory, social learning, Socio-ecological model, health behavior theory. In the second step, an electronic search was performed in PubMed, Scopus, PsycINFO, Web of Science, Sociological abstracts, CINAHL and the Cochrane central register of controlled trials. Studies were searched separately in each database using the above terms with and without Boolean operators to include topic relevant articles related to the study. In the third step, the reference list of all relevant articles was examined for additional relevant studies. Finally, a hand search across eight peer reviewed journals, three non-indexed journals, clinical trials.gov, and ProQuest current control trials was also undertaken to find additional articles. The study authors were contacted in case further information was required. A PRISMA checklist was used to report the findings (Annex 2).

2.2 | Quality assessment

Prior to the content review all studies were assessed for methodological quality by two independent assessors, using the standardized quality appraisal tool developed by Effective Public Health Practice Project (EPHPP; Annex 3). This tool allows to assess the quality of each study by giving a rating of one (strong), two (moderate) or three (weak) for each of eight methodological criteria: selection bias; study design; confounders; blinding; data collection methods; withdrawals and dropouts; intervention integrity; and analysis based on predetermined standards. Scores were added into an overall quality score allowing to classify each study as methodologically strong, moderate or weak. A study was considered as strong (S) if all criteria were given a "moderate" or "strong" rating; as moderate (M) if at least one of the criteria was considered "weak"; and as weak (W) if two or more criteria were considered as "weak." Studies with a "weak" rating on 4 or more criteria were excluded from the review. Any disagreements between the reviewers were resolved through discussion with a third reviewer.

2.3 | Data extraction and synthesis

The information retrieved from the studies was summarized by narrative description. For the observational studies, this description contained the variance in CCS uptake and in the intention to participate in screening explained by the theoretical constructs, as well as the significance of the contribution of each construct to the prediction when applicable. For the intervention studies, it concerned the type of intervention and its outcomes in terms of CCS uptake for each theory, along with a description of the risk of bias and other factors that may have influenced screening uptake. Due to the high level of clinical heterogeneity and inconsistent use of theories across studies a meta-analysis could not be performed.

3 | RESULTS

Out of 12,125 records, 129 were retained based on the titles and abstracts. The PRISMA flow diagram shown in Figure 1 summarizes the study selection process. The final sample consisted of 69 articles, of which 48 were concerned with observational studies and 21 with intervention studies. Only five studies (7.1%) were conducted in LMICs. All studies targeted women aged 18 or more from diverse cultural backgrounds, regardless of education, age, or income level. Some of the studies also included women with comorbidities (Lambert, 2013),

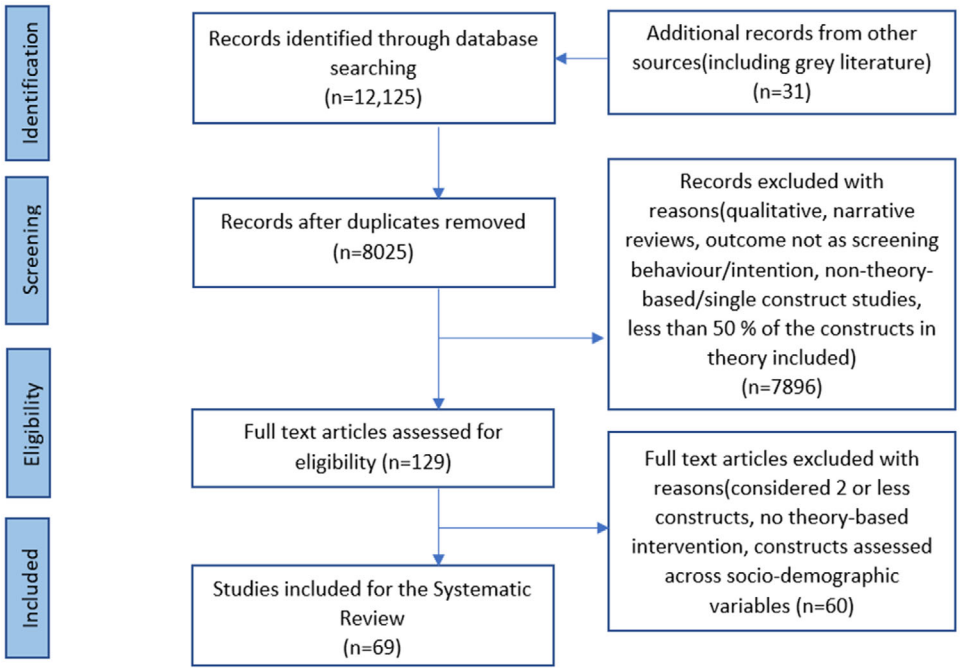

FIGURE 1 PRISMA flow chart for the systematic review

lesbian women (Ben-Natan & Adir, 2009; Tracy et al., 2013) or transgenders (S. L. Rogers, 2017). Most studies considered pap-smear at a health facility as a screening method, while one study (Smith et al., 2014) used self-collection of samples. The overall quality of the papers included in the review was medium to weak according to the EPHPP tool. Details regarding the study objectives, sample size, sample characteristics, study design, theories and constructs used, analyses conducted, type of intervention, outcome, quality score and additional comments for each of the observational and intervention studies are presented in the Tables 1 and 2.

3.1 | Observational studies

Of the 48 observational studies that investigated the degree to which behavioral theories could explain CCS uptake, 26 focused on the HBM, eight on the TPB, three on the PMT, two on the TRA, and nine combined theories.

3.1.1 | Health belief model

About 70% (34) of the observational studies included in this review (Acar & Pinar, 2015; Allahverdipour & Emami, 2008; Babazadeh et al., 2018; Bayu et al., 2016; Ben-Natan & Adir, 2009; Bish et al., 2000; Boonpongmanee & Jittanoon, 2007; Burak & Meyer, 1997; De Peralta et al., 2015; Demirtas & Acikgoz, 2013; Esin et al., 2011; Hajializadeh et al., 2013; Hennig & Knowles, 1990; Hill et al., 1985; Ho et al., 2005; Hoque et al., 2014; Jeihooni et al., 2015; Jiang et al., 2018; Jirojwong et al., 2001; Karimy et al., 2017; Lambert, 2013; Lee et al., 2012; Ma et al., 2013; McFarland, 2013; Mehraban et al., 2018; Miri et al., 2018; Orbell et al., 1996; Pandey & Karmacharya, 2017; Tracy et al., 2013; W.-C. Tung, 2010; W.-C. Tung et al., 2010; W.-C. Tung et al., 2016; W. C. Tung et al., 2017; Visanuyothin et al., 2015) used HBM to explain CCS practices, which makes the HBM by far the most often-used theoretical model for this behavior. Of these studies, 25 (Acar & Pinar, 2015; Allahverdipour & Emami, 2008; Babazadeh et al., 2018; Bayu et al., 2016; Ben-Natan & Adir, 2009; Boonpongmanee & Jittanoon, 2007; Burak & Meyer, 1997; De Peralta et al., 2015; Demirtas & Acikgoz, 2013; Esin et al., 2011; Hajializadeh et al., 2013; Ho et al., 2005; Hoque et al., 2014; Jeihooni et al., 2015; Jirojwong et al., 2001; Karimy et al., 2017; Lambert, 2013; Lee et al., 2012; Ma et al., 2013; McFarland, 2013; Mehraban et al., 2018; Orbell et al., 1996; Pandey & Karmacharya, 2017; Tracy et al., 2013; Visanuyothin et al., 2015) looked at screening participation as the outcome, while six considered screening intention as outcome (Ben-Natan & Adir, 2009; Bish et al., 2000; Burak & Meyer, 1997; Hennig & Knowles, 1990; Hill et al., 1985; Jiang et al., 2018). Only a few studies considered all four the constructs of the extended HBM (perceived susceptibility of cervical cancer, perceived severity, perceived benefits of screening and perceived barriers to screening). Ten studies also included self-efficacy with the four basic constructs (Babazadeh et al., 2018; Bish et al., 2000; De Peralta et al., 2015; Jirojwong et al., 2001; Karimy et al., 2017; Lambert, 2013; Ma et al., 2013; Mehraban et al., 2018; Miri et al., 2018; Visanuyothin et al., 2015), and 11 included motivation (Acar & Pinar, 2015; Ben-Natan & Adir, 2009; Burak & Meyer, 1997; Demirtas & Acikgoz, 2013; Hennig & Knowles, 1990; Hill et al., 1985; Hoque et al., 2014; Jirojwong et al., 2001; Mehraban et al., 2018; Orbell et al., 1996; Visanuyothin et al., 2015). Three studies (De Peralta et al., 2015; Hoque et al., 2014; Miri et al., 2018) combined perceived susceptibility with severity and

TABLE 1 Theory based observational studies

Author name, year of publication, country	Study objective	Sample size (N), sampling technique	Study population	Study design, theory used, theoretical constructs considered.	Analysis outcome	Study quality (SCORE[a])	Author's comment
1. Ma, Grace X., et al. (2013), US (United States)	Association between factors of HBM and cervical cancer screening behavior	N = 1450 Sampling: unclear	Vietnamese Americans from Vietnamese communities, 18 to 70 years, no history of cervical cancer or pap test done in the last 12 months	Design: Cross sectional Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers, Perceived self-efficacy	Analysis: Chi-square test of Construct scores and screening Behavior. Reported P values, ORs (odds ratios), Adjusted ORs Outcome: All constructs were significantly associated with screening uptake	SCORE: M	Study conducted on Vietnamese women residing in United states. All constructs were significantly associated with screening uptake
2. Pandey, R. A., & Karmacharya, E. (2017), Nepal	To assess Cervical cancer screening behavior and associated factors	N = 180 Sampling: Purposive sampling of location, systematic random sampling of participants	Women aged 30–60 years, residing in a selected town	Design: Cross sectional Theory: HBM Constructs: Perceived severity, Perceived benefits, Perceived barriers	Analysis: Chi-square of constrict scores with behavior. Reported: contingency table, *p* value Outcome: No significant association between screening and HBM constructs	SCORE: W	Participants were already aware of cervical cancer due to awareness given. Perceived susceptibility was not measured due to error because of small sample size
3. Karimy et al. (2017), Iran	To assess differences in adherence to PAP test guidelines using HBM	N = 305 Sampling: two stage random sampling from selected health centers	Iranian women aged 15–49 years, married, passed at least 6 months from marriage, visiting health centers	Design: Cross sectional Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers, Perceived self-efficacy	Independent sample *T* test, log regression of constructs and knowledge, variance in screening behavior explained by theory constructs and knowledge Outcome: About 34.2% of variance in screening behavior explained by theory. Significant association between three constructs and screening uptake	SCORE: W	Women visiting health centers were included in the study
4. Demirtas B & Acikgoz I (2013), Turkey	To identify relationship between "HBM scale for Cervical cancer and Pap test" and demographic/gynaeco obstetric characteristics	N = 256 Sampling: Unclear (women who applied for Gynae OPD) (Out-Patient Department)	Women who applied for Gynae OPD, aged above 21years, no history of disease or treatment for cancer, no hysterectomy done	Design: Cross sectional Theory: HBM Constructs: Perceived benefits, Perceived barriers, Health motivation	Mean and SD of construct scores in screened and unscreened, Mean and Standard deviation of baseline and barriers/ben and h motivation, *p* value Outcome: Significant relationship found between barriers and benefit-motivation and baseline variables	SCORE: W	Women who applied for OPD for some reason were included. Benefits and health motivation constructs were combined. Women aged 30–39 had highest barriers and perceived seriousness. Barriers were associated with husband's education level and family history of cancer

(Continues)

TABLE 1 (Continued)

Author name, year of publication, country	Study objective	Sample size (N), sampling technique	Study population	Study design, theory used, theoretical constructs considered.	Analysis outcome	Study quality (SCORE[a])	Author's comment
5. Bayu, H et al. (2016), Ethiopia	Cervical cancer screening service uptake and its associated factors among age eligible women	N = 1186 Sampling: systematic sampling	Women aged above 21 years, residing in Mekelle zone for at least 6 months	Design: Cross sectional Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers	Chi square, ORs for constructs for screening behavior, Multiple log regression of significant constructs only Outcome: Those women with higher Perceived susceptibility and severity and low perceived barriers had higher odds of screening uptake	SCORE: M	The study setting consisted of 2 screening centers Odds ratio reported for all constructs. AOR reported for significant constructs only History of multiple sexual partners, STDs (sexually transmitted diseases) and positive serology status was also associated with screening uptake
6. Gokce Banu Acar & Gul Pinar (2015), Turkey	To assess health perspectives of Women, and factors influencing health perspectives	N = 300 Sampling: Simple random sampling	Menstruating, non-pregnant women aged between 15 and 49 years, who applied for cervical cancer screening, no history of cervical cancer or hysterectomy	Design: Cross sectional Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers, Health motivation	Mean and standard deviation of construct scores among all women, Significance of constructs mentioned for screening uptake Outcome: Perceived Benefit, Barriers and Health motivation were associated with screening uptake	SCORE: W	Women who applied for screening were included Only mentioned that few constructs were significant and significant constructs were only reported
7. De Peralta et al. (2015), US	To explore beliefs, attitudes, socio-economic and cultural factors influencing Hispanic women's decisions about Cervical cancer screening	N = 205 Sampling: convenient sampling	Hispanic women aged between 18 and 65 years from selected sites	Design: Cross sectional Theory: HBM Constructs: Perceived Threat, Perceived benefits, Perceived barriers, Perceived Self-efficacy	Generalized linear modeling, regression co-efficient of HBM constructs and corresponding *p* values reported Outcome: HBM was found significant for cervical cancer screening behavior, Perceived threat and self-efficacy was associated with compliance with screening guidelines	SCORE: W	Modified HBM used. Susceptibility and severity were combined as Perceived threat. Modifying effect of familism, fatalism and acculturation was also analyzed Other significant covariates were marital status, parity, English speaking, cues, knowledge, acculturation, familism and fatalism

(Continues)

TABLE 1 (Continued)

Author name, year of publication, country	Study objective	Sample size (N), sampling technique	Study population	Study design, theory used, theoretical constructs considered.	Analysis outcome	Study quality (SCORE[a])	Author's comment
8. Ditsapelo M McFarland (2013) Botswana,	To present findings on associations of demographic variables and Health Belief Model constructs	N = 353 Sampling: nonprobability convenient sampling	Women aged above 30, urban dwelling, black women, English knowing, No history of Cervical cancer or hysterectomy	Design: Cross sectional Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers *p* value not given	Chi square analysis of Demographic variables and screening status Mean scores of constructs given in screened and non- screened Outcome: No association between HBM and screening uptake in past	SCORE: W	Women were Mostly aged between 30 and 59 years Having a health care provider and having an insurance were directly related to screening uptake
9. M. Ben-Natan and Adir (2009), Israel	To explore factors influencing lesbian women to undergo Pap smear tests and to determine whether the Health Belief Model (HBM) can predict whether lesbian women would be willing to undergo the test	N = 108 Sampling: convenience sampling	Lesbian women aged 18–41 years.	Design: Cross sectional Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers, Health motivation	Independent sample *t* test, (mean and SD in screened and non-screened and in who intend and do not intend), *p* values, correlations between constructs Outcome: Perceived benefit and barriers were associated with screening uptake while Perceived susceptibility, Perceived Benefits and motivation was related to screening intention	SCORE: W	Lesbian women Intention is closer to beliefs than actual behavior Significant correlation between Health motivation and Perceived Benefit. Women aged above 30 years had twice odds to be screened and three times odds of having a positive intention for screened compared to those aged between 18 and 29 years
10. Lee et al. (2012), US	Age related differences in Health beliefs regarding Cervical cancer screening among Korean American women	N = 2200 Sampling: Random sampling (telephone survey)	Korean American, above 40 years	Design: Cross sectional Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers	Correlation between constructs and outcome, independent sample *t* test and *p*-Value, crude ORs for variables in two groups (40-64 years & above 65years old) for screening behavior Stepwise log regression for having a recent PAP test and beta values of significant constructs included in final model for two groups Outcome: Perceived barriers was significantly associated with screening	SCORE: W	Low Cronbach's alpha for P benefit and p barriers Korean American Women aged above 40 years Younger women were screened more than the older women Routine physical examinations and Perceived barriers were significantly associated with screening among older women(>65years) Routine examinations were the only significant factor (40-64 years)

(Continues)

TABLE 1 (Continued)

Author name, year of publication, country	Study objective	Sample size (N), sampling technique	Study population	Study design, theory used, theoretical constructs considered.	Analysis outcome	Study quality (SCORE[a])	Author's comment
11. Tracy, J. Kathleen et al. (2010), US	To evaluate cervical cancer screening practices and barriers to screening in a sample of lesbians	N = 225 Sampling: who self-volunteered following advertisement in newspaper	Lesbian women aged 18–70 years, no history of hysterectomy, who can understand English	Design: Cross sectional Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers	Independent sample *t* tests with reported *p* value only, MLR with significant variables Outcome: Perceived Benefits, Perceived barriers were significantly related to screening uptake among screeners	SCORE: W	In routine screeners (had PAP in last 2 years), and non-routine screeners (screened before 2 years). Those who can understand English Knowledge about risk factors and screening guidelines was associated with screening
12. Esin Melek Nihal et al. (2011), Turkey	To determine the beliefs of women about cervical cancer and influencing factors	N = 300 Sampling: Unclear (women attending public education centers)	Turkish married women aged 16–79 in public education centers	Design: Cross sectional Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers	Frequency and percentages of item responses in each construct, chi-square analysis to rule out significant variables, Log regression with significant variables. Outcome: Perceived barriers was significantly associated with screening uptake	SCORE: W	Women usually from low Socio-economic status represented the sample Age between 35 and 44 years, using birth control was significantly associated with screening uptake along with Perceived barriers(three ORs given for three items for barriers) No values reported for Other constructs
13. Chapman Lambert, (2015), US	To evaluate HIV-infected women's Knowledge of perceived susceptibility	N = 300 convenience sampling	Women aged above 18 years, HIV infected, Able to understand English, No history of hysterectomy	Design: Cross sectional Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers, Self-efficacy	Pearson's correlation between Age, BMI, CD4 count, knowledge and HBM components MLR conducted for significant variables. R square for model for reported behavior and documented behavior P susceptibility, Barriers, was associated with PAP smear uptake	SCORE: W	HIV infected women who understand English were included in the study Knowledge was associated with Perceived Benefits, Barriers, self- efficacy P susceptibility, Barriers, CD4 count was associated with participant reported PAP smear Self-reported uptake was relevant when matched with medical charts (72%)

(Continues)

TABLE 1 (Continued)

Author name, year of publication, country	Study objective	Sample size (N), sampling technique	Study population	Study design, theory used, theoretical constructs considered.	Analysis outcome	Study quality (SCORE[a])	Author's comment
14. M.E. Hoque et al. (2014), South Africa	To investigate knowledge and beliefs of female university students of South Africa	N = 243 Sampling: Multistage sampling	Female university students aged 18–26 years	Design: Cross sectional Theory: HBM Constructs: Perceived threat, Perceived benefit, Motivation, Self-efficacy	Correlation of constructs, mean difference of constructs between having Had PAP and not had PAP reported Outcome: Significant difference in knowledge, Perceived threat, benefit & motivation, and self-efficacy among the screened and non-screened	SCORE: W	Perceived susceptibility and severity combined as perceived threat, Perceived benefit and motivation combined Number of screened and non-screened not provided. Mean difference, P and t given
15. Visanuyothin et al. (2015), Thailand	To determine the factors associated with cervical cancer screening adherence. (at least 1 screen in 5 years	N = 675 Sampling: Stratified random sampling with PPS	Women in urban areas, aged 30–60 years, who registered at a unit of primary care	Design: Cross sectional Theory: HBM Constructs: Perceived threat, Perceived benefit, Perceived barrier, Motivation, Self-efficacy Univariate and Multivariate log regression	Chi square and Odds ratio for variables and screening at least once in 5 years MLR for model to predict screening adherence Outcome: Perceived barriers and knowledge were significantly associated with screening uptake with Marital status, occupation, number of children	SCORE:M	Women residing in urban areas Screening once in 5 years
16. Kobra Hajializad, (2013), Iran	To determine predictive factors of conducting PAP smear among women by Health belief model structures	N = 727 Sampling: Two stage random sampling	Married women referring to health center.	Design: Cross sectional Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers Log regression analysis of HBM constructs only	Correlation of HBM constructs and screening behavior Mann Whitney *U* test of difference in scores between screened and non-screened Log regression analysis of HBM constructs, Beta values given Outcome: Significant association between education and perceived susceptibility and severity and between age and perceived severity	SCORE: W	Women referring to health center. Age not described. Perceived susceptibility, Perceived benefits and Perceived barriers could be good predictors of screening uptake

(Continues)

TABLE 1 (Continued)

Author name, year of publication, country	Study objective	Sample size (N), sampling technique	Study population	Study design, theory used, theoretical constructs considered.	Analysis outcome	Study quality (SCORE[a])	Author's comment
17. Lydia J. Burak & Margaret Meyer (2009), US	To predict college women's cervical cancer screening beliefs and behavior, using HBM	N = 400 Sampling: convenient sampling	Female undergraduate students	Design: Cross sectional Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers, Cues	Independent sample *t* test for HBM scores between screened and non-screened (screening behavior) *p* value given. Independent sample *t* test for HBM scores between intenders and non-intenders (screening intention) *p* value given. Multiple regression analysis of HBM to predict screening behavior, r square given Multiple regression analysis of HBM to predict screening intention, R square given Outcome: Perceived benefit minus barriers and Cues were associated with screening uptake Perceived susceptibility, Perceived benefit minus barriers and self-efficacy were associated with screening intention	SCORE: W	Participants mean age was 19.1 years Perceived Susceptibility was very low. Perceived severity about the disease and benefit of gynae examination was high Perceived benefits and Barriers were presented as Perceived benefits minus Barrier Regression: HBM explained 15% of the variance in screening uptake. Benefits minus barrier component contributed the strongest beta weight Regression analysis showed that HBM could explain 11% of the variance in screening intention. Benefits minus barrier and cues to action component contributed the strongest beta weight

(Continues)

TABLE 1 (Continued)

Author name, year of publication, country	Study objective	Sample size (N), sampling technique	Study population	Study design, theory used, theoretical constructs considered.	Analysis outcome	Study quality (SCORE[a])	Author's comment
18. Towhid Babazadeh (2018), Iran	To assess cognitive determinants of cervical cancer screening behavior	N = 280 Sampling: Multistage cluster sampling	Housewives aged 30–40 years, referring to selected health centers	Design: Cross sectional Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers, Self-efficacy	Independent sample *T* test of HBM constructs among screened and non-screened (in last 3 years), *p* values given. Correlation of constructs and screening behavior, and knowledge MLR to predict factors related to screening, odds ratios given Outcome: Regression analysis showed that Perceived benefits, barriers, and self-efficacy was elated to PAP uptake in last 3 years	SCORE: W	Women referring to health centers. Age range 30–40 years, mostly Housewives Significant difference in HBM scores (except Perceived susceptibility), among screened and non-screened. Significant correlation between Cervical cancer screening behavior and Knowledge and all the HBM constructs except for perceived severity. Perceived barriers were negatively associated with Behavior Barriers: Hating the examination and sampling procedure, preferring not to be aware of, and being too busy
19. Sansnee Jirojwong et al. (2001), Australia	Health Beliefs and Pap Smears (regular/non regular) Among Thai Women in Brisbane, Australia	N = 145 Sampling: Snowball sampling	Thai migrant women	Design: Cross sectional Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers, cues, Self-efficacy	Chi-square of constructs for regular /non regular screening, crude OR given. Outcome: Barriers and Self-Efficacy was significantly associated with PAP smear uptake	SCORE: W	Summary HBM index remained strongly associated with screening uptake
20. Boonpongmanee and Jittanoon (2007), Thailand	Predictors of Papanicolaou testing	N = 189 Sampling: convenient	Working women, employed full time, above 25 years, able to understand Thai, Able to complete the self-report questionnaire	Design: Cross-sectional Theory: HBM Constructs: Perceived susceptibility, Perceived benefits, Perceived barriers.	Independent sample T test to check diff, *p* values given. Log regression of HBM variables only, Beta values of constructs, R square of HBM constructs for Pap smear testing Outcome: Significant difference in Perceived barriers in screened and non-screened	SCORE: W	Log regression showed that Perceived barriers was a significant predictor of screening uptake and was negatively associated with screening uptake. (R squared 37%)

(Continues)

TABLE 1 (Continued)

Author name, year of publication, country	Study objective	Sample size (N), sampling technique	Study population	Study design, theory used, theoretical constructs considered.	Analysis outcome	Study quality (SCORE[a])	Author's comment
21. Shadan et al. (2017), Iran	To evaluate different HBM factors about cervical cancer preventive behavior in Fasa, Iran	N = 200 Sampling: 2 stage stratified	Women aged 17-64 years, visiting heath centers	Design: Cross sectional Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, perceived barriers, self-efficacy, motivation	Correlation between demographic and HBM components, and between HBM components, r given. MLR (multiple logistic regression) with HBM constructs MLR with all significant variables, beta and *p* values given Outcome: Age, low income, knowledge, self-efficacy, Perceived severity, and Perceived benefits were the final predictors of participation in screening	SCORE: W	Women visiting Health centers Positive correlation between marital age and HBM components. Timing of pap test had positive correlation with all HBM constructs except barriers. High parity had negative impact on behavior
22. Hamid Allahverdipour & Azita Emami (2008), Iran	To assess associations between HBM variables and participation in cervical cancer screening programs	N = 333 Sampling: Clustered random sampling for each area, PPS for each region, random Selection of subjects	Married women aged 15–49 years, literate, no history of cervical cancer or hysterectomy	Design: Cross-sectional Theory: HBM Constructs: Perceived susceptibility, Perceived Severity, Perceived Benefits, Perceived Barriers	Correlation between HBM variables, Knowledge, and previous PAP test MLR Of HBM constructs, Beta, and *p* values given for only significant constructs that is, Perceived benefits and Perceived Barriers Outcome: Perceived benefits and Perceived Barrier were significantly associated with screening uptake.	SCORE: W	Beta values of only significant constructs provided Correlation analysis concluded that knowledge was associated with most HBM constructs. Knowledge and perceived benefits were significantly associated with previous PAP test
23. Khani Jaihooni A et al. (2015), Iran	To assess factors affecting pap smears in women based on HBM in health centers of Fasa, Iran	N = 200 Sampling: Random	Women referred to health centers, married for at least 6 months	Design: Cross-sectional Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived Benefits, Perceived Barriers	Independent sample *t* test of HBM scores in screened versus unscreened MLR Of HBM with other factors Outcome: Perceived susceptibility and Perceived benefits were significant predictors of screening uptake. R square (age, education, HBM constructs) 35% to screening behavior	SCORE: W	Women referred to health centers. 95% of participants were housewives All four HBM constructs were significantly associated with screening uptake among the screened

(Continues)

TABLE 1 (Continued)

Author name, year of publication, country	Study objective	Sample size (N), sampling technique	Study population	Study design, theory used, theoretical constructs considered.	Analysis outcome	Study quality (SCORE[a])	Author's comment
24. HO Vi et al. (2005), US	Characterize demographic factors, beliefs, and barriers to cervical and breast cancer screening in the study population and test the effect of these on PAP test use, Breast self-examination and mammography use	N = 209 Sampling: cluster	Women above18, Vietnamese living for more than 6 months in US	Design: cross sectional Theory: HBM Constructs: Perceived susceptibility, perceived seriousness, perceived benefits, perceived barriers	Pearson's chi square test Outcome: Poor education, being unmarried and high perceived Barriers were significantly associated with low PAP test uptake	SCORE: W	Well educated married women, those who had telephones were included. Only percentages of each item and p value of constructs given. Only significance of Perceived barriers mentioned as *p* value
25. Tao Jiang et al. (2018), China	To investigate relationships between demands for cervical cancer screening and Breast cancer screening and related health beliefs	N = 805 Sampling: cluster randomized sampling	Women aged 40–75 years	Design: Cross sectional Theory: HBM Constructs Perceived susceptibility, Perceived Severity, Perceived benefits, Perceived Barriers, Perceived effectiveness	Mean and SD, P scores of HBM constructs across Age, education, family income, Health insurance MLR given Beta of constructs with other variables for demands Outcome: Perceived severity, perceived effectiveness, and perceived difficulties along with age and education were significant predictors of Cervical cancer screening demand	SCORE: W	Demand for screening was significantly associated with age, income, education, and Health insurance None of the singular constructs predicted demand, hence all constructs should eb used together to predict demand for screening

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TABLE 1 (Continued)

Author name, year of publication, country	Study objective	Sample size (N), sampling technique	Study population	Study design, theory used, theoretical constructs considered.	Analysis outcome	Study quality (SCORE[a])	Author's comment
26. Hill, 1985, Australia	Factors predisposing women to take precautions against breast and cervical cancer	N = 123 Sampling: Unclear	Women aged 18–70 years	Design: Cross sectional Theory: HBM, TRA, Subjective Probability model. Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers, Motivation, attitude, subjective norms	Multiple log regression for HBM, TRA constructs for screening Intention, beta, *p* values and R square given for constructs. comparing HBM and TRA Outcome: TRA could explain 26% of the variance in screening intention. Global norm was a significant predictor of screening intention HBM could explain 32% of the variance in screening intention. Perceived barrier was a significant predictor of screening intentions	SCORE: W	Breast and CCS, HBM and TRA comparison Models could explain cervical screening intentions better than breast cancer screening intention
27. Patricia Hennig and Ann Knowles (1990), Australia	Whether TRA or HBM would predict older women's intention to get pap, PAP	N = 144 Sampling: Unclear	Women above 40 years who had contact with a community. health center	Design: Cross-sectional Theory: HBM, TRA Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers, Motivation, attitude, subjective norms	Multiple log regression, R square of HBM and TRA to PAP smear screening intention. Outcome: HBM could explain 27% of variance in screening intentions and TRA could explain about 12% of variance in PAP smear screening intention	SCORE: W	For older women the HBM was a better predictor of intention than was the TRA For older women, the global norm was a significant predictor of intention
28. Orbell et al. (1996), Scotland	To test the utility of cognitions specified by the Health. Belief Model to distinguish participants versus non-participants and to mediate the effects of marital status, social class, and sexual experience in screening uptake	N = 614 Sampling: two stage random sample	Women aged 20–64 years	Design: Cross sectional Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers, Motivation	Hierarchical logistic regression, beta values provided Outcome: All HBM constructs, General practitioner cue, number of sexual partners, Marital status, were associated with screening uptake The model with demographic variables could explain up to 52% of the variance in screening behavior	SCORE: W	Study conducted following a campaign to encourage uptake of cervical screening

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TABLE 1 (Continued)

Author name, year of publication, country	Study objective	Sample size (N), sampling technique	Study population	Study design, theory used, theoretical constructs considered.	Analysis outcome	Study quality (SCORE[a])	Author's comment
29. Alison Bish et al. (2000), London	Predicting uptake of routine cervical cancer smear test	N = 133 Sampling = unclear	Women due for screening, identified by GPs	Design: Cross sectional Theory: HBM, TPB Constructs: Perceived susceptibility, Perceived severity, Perceived Benefits, Perceived Barriers, Attitude, Subjective norms, self-efficacy	Multiple log regression of HBM and TPB to screening intention Beta values of constructs and R square given Outcome: HBM explained 4% of variance in intention compared to 51% explained by TPB	SCORE: W	Subjective norms are explored as injunctive subjective norm (Significant people suggest screening) and descriptive subjective norm (Significant people get screened) Comparing HBM, TPB, Sent invitation and explanation on need for pap. Adding anticipated affect did not increase predictability of TPB
30. Norman Barling (1996), Australia	To evaluate factors related to intention and behavior related to CCS using TRA	N = 72 Sampling: Convenient	Women aged 18–62 years, well-educated	Design: Cross sectional, Theory: TRA Constructs: attitude, subjective norm	Regression analysis of TRA to predict intention. *p* value of constructs, R square given for TRA Outcome: TRA predicted screening intention, more positive attitudes and stronger social norms significantly predicted intention to engage in a Pap screening test. TRA could explain 36% of the variance in screening intention. Intention and age predicted 24% of the variance of actual screening behavior	SCORE: W	Well educated women were participants
31. Armstrong (2001), US	Predicting cervical screening in college women: A test of the theory of reasoned action	N = 123 Sampling: Convenient	Women aged above 18 years, no history of pap in last 5 years	Design: Cross sectional, Theory: TRA Constructs: Attitude, Subjective Norm	Correlation TRA versus intention, intention versus past behavior, log regression. *p* values Outcome: Stage of change was not a significant predictor of pap obtainment. Regression: TRA could explain 21% of the variance in screening intention. With each increase in intention level, the odds of acquiring the exam increased by 142%.	SCORE: W	Knowledge was significantly associated with PAP smear obtainment Intention and oral contraceptives were significant predictors of Pap uptake. Pap test history and intention was positively related to screening uptake

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TABLE 1 (Continued)

Author name, year of publication, country	Study objective	Sample size (N), sampling technique	Study population	Study design, theory used, theoretical constructs considered.	Analysis outcome	Study quality (SCORE[a])	Author's comment
32. Farzad Jalilian & Shohreh Emdadi (2011), Iran	To determine the factors related to doing regular Pap-smear test based on the theory of planned behavior	N = 400 Sampling: multistage random	Women aged 20–70 years, married, referred to health centers	Design: Cross sectional Theory: TPB Constructs: Attitude, Subjective norms, Perceived Behavioral control, Intention	Correlation between components of TPB, Log regression TPB and intention to behavior/screening, chi square *t* test, log regression. Outcome: Behavioral intention and subjective norms were most influential predictors of Pap smear uptake	SCORE: W	Women who were referred to health centers. Expanded theory of Planned behavior used (intention included) to predict screening uptake. Correlation: mild to moderate correlation between the TPB components Older women were screened more than younger
33. Roncancio et al. (2013), US	Utility of an expanded Theory of Planned Behaviour (TPB) model in predicting cervical cancer screening intentions among Latinas	N = 400 Sampling: Unclear (women attending a fair)	20-70 years, Latinas in United states	Design: Cross-sectional Theory: TPB Constructs: Attitude, Subjective norm, Perceived behavioral control	Structural equation modeling, Beta and *p* values of each constructs, R square of TPB to intention Outcome: TPB with acculturation and past behavior could explain 65% of the variance in screening intention	SCORE: W	Expanded Theory of Planned Behavior (Acculturation and past screening added) Acculturation more than 10 years was associated with positive screening behavior
34. Chirayil et al (2014), Singapore	To analyze the role of attitudes, subjective norms, and perceived behavioral control as predictors of intentions to obtain Human Papillomavirus (HPV) vaccinations or a Papanicolaou (Pap) smear in a sample of young Singaporean women	N = 206 Sampling: snowball sampling	Women aged 18–26 years, residing in Singapore for more than 2 years, no history of cervical cancer or hysterectomy	Design: Cross- sectional Theory: TPB Constructs: Attitude, Subjective norm, Perceived Behavioral control	Structural equation modeling, Beta and *p* values of each constructs Outcome: Subjective norm and Perceived behavioral control were significantly associated with screening intention	SCORE:M	Participants: Young women Subjective norms measured as injunctive (approval/disapproval by significant people) and descriptive (screening/participation by significant people) norm Knowledge was not a significant predictor when added to TPB model. High levels of perceived behavioral control predicted lower intentions (suppression phenomena)

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TABLE 1 (Continued)

Author name, year of publication, country	Study objective	Sample size (N), sampling technique	Study population	Study design, theory used, theoretical constructs considered.	Analysis outcome	Study quality (SCORE[a])	Author's comment
35. Abamecha et al. (2019), Ethiopia	Psychographic predictor of intention to use CCS service among women attending MCH services in southern Ethiopia, unclear	N = 422 Sampling: systematic sampling of individuals in screening centers	Women aged 30–49 years attending Maternal health care and family planning services of selected health institutions	Design: cross-sectional Theory: TPB Constructs: Attitude, intention, perceived social pressure, perceived ability to control	Pearson correlation, independent sample *T* test, one-way Anova, Multiple log regression (past behavior knowledge) Outcome: All TPB constructs were associated with screening intention	SCORE:M	Indirect and direct measures of each construct of TPB Correlation: Intention was correlated with Perceived behavioral control, indirect subjective norm was correlated to indirect attitude Knowledge and past screening experience were positively associated with screening intention
36. Duffet-Leger et al. (2008), Canada	To assess predictors of young women's intentions to be screened for cervical cancer	N = 904 Sampling: convenient. (Women attending selected university)	University women aged less than 25 years	Design: cross- sectional Theory: TPB Constructs: Attitude, Subjective norm, Perceived behavioral control	Independent sample *T* test, Multiple logistic regression. Outcome: Attitude, Subjective norm and age at which participants first learned about the Pap test were significant predictors of intention and could explain 39% of the variance in screening intentions	SCORE: W	Web- based survey Norms and Perceived behavioral control were significant predictors of screening intentions. Correlation: Significant correlation between knowledge and perceived behavioral control. Perceived behavioral control and attitude
37. Jennings dozier (1999), US	To determine the empirical adequacy of the theory of planned behaviour (TPB) to explain Pap smear use intentions in African American and Latina women	N = 204 (African American n = 108 and Latina n = 96 women) Sampling: convenient sampling	Women who can read and comprehend English or Spanish, no history of cervical cancer or hysterectomy, residing in US for at least 1 year	Design: Cross sectional Theory: TPB Constructs: Attitude, Subjective norms, Perceived behavioral control	Regression TPB constructs to intention Outcome: Attitude provided the best explanation of intention among African American women to obtain an annual Pap smear, followed by perceived behavioral control	SCORE: W	Participants: Latina women Direct relationship between attitude, perceived behavioral control and intention were found Only one item for subjective norm Empirical adequacy of TPB not supported

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TABLE 1 (Continued)

Author name, year of publication, country	Study objective	Sample size (N), sampling technique	Study population	Study design, theory used, theoretical constructs considered.	Analysis outcome	Study quality (SCORE[a])	Author's comment
38. Susan rogers (2017), US	To determine to what extent fear of cancer (FOC) served as a predictor of Pap screening behaviors, over and above the predictive value of TPB	N = 93 Sampling: Convenient sampling	Women/transgender with female reproductive organs aged 21–65 years	Design: Cross-sectional Theory: TPB Constructs: Attitude, Subjective norm, Perceived behavioral control.	Multiple log regression Outcome: Demographics accounted to 2% variance in screening intention. Addition of TPB could explain 43% variance in screening intention. addition of Fear of cancer could explain up to 44.5% of the screening intention TPB alone could explain 11% of variance in screening intentions	SCORE: W	Convenience sample recruited via social media. Transgender men with female sex organs were included in the sample Fear of cancer may not be a better predictor over and above TPB to predict screening intentions
39. Laurie smith (2014), US	Intention to self-collect HPV samples.	N = 981 Sampling: convenient (voluntary participation)	Women aged 25–65 years	Design: Cross sectional Theory: TPB Constructs: Attitude, Subjective norm, Perceived behavioral control	Chi square t test, Kruskal Wallis, log regression Outcome: Attitude predicted behavior (self-collection of samples)	SCORE:M	Online survey Prior to the study women were provided with some brief background information on human papillomavirus, which included information on HPV prevalence, transmission, its role in cervical cancer and the reasons for use of HPV testing in cervical cancer screening.
40. Mirzaei alavijeh et al. (2016), Iran	(How Much Fear Explain Cancer Early Detection Behaviors among college Students	N = 400 Sampling: random	College students aged 19–30 years	Design: Cross sectional Theory: PMT Constructs: Perceived susceptibility, Perceived severity, response cost, response efficacy, self-efficacy, motivation	Correlations of constructs versus behavior, multiple log regression of PMT and screening behavior Outcome: self-efficacy, Perceived severity, response efficacy were strong predictors of screening behavior. R squared for behavior was 48% (self-efficacy, severity, response efficacy)	SCORE: M	Young women Significant correlation between constructs and the constructs versus screening behavior

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TABLE 1 (Continued)

Author name, year of publication, country	Study objective	Sample size (N), sampling technique	Study population	Study design, theory used, theoretical constructs considered.	Analysis outcome	Study quality (SCORE[a])	Author's comment
41. Can Gu et al. (2012), China	To adopt PMT to examine Chinese women's knowledge and perceptions of cervical cancer risk and factors influencing utilization of cervical screening.	N = 167 Sampling: convenient sampling	Women aged 25–50 years of age; community-dwelling, Chinese-speaking; and sexually active (married or have a sexual partner)	Design: Cross sectional, Theory: PMT Constructs: Perceived susceptibility, Perceived severity, Fear arousal, response cost, response efficacy, self-efficacy	Chi-square/man-Whitney *U* test for demographics Log regression of baseline factors- significant were. Comparison of PMT between screened and unscreened (no difference) Outcome: No association between past behavior and PMT	SCORE: W	Individuals referred by participants. Factors associated with screening were having children, positive attitude towards health check-up, knowledge Association with Screening is related to knowledge and culturally relevant health behavior and beliefs about CCS.
42. Yang bai et al. (2017), China	To test the protection motivation theory (PMT) in predicting screening intentions	N = 3000 Multistage stratified sampling	Rural Chinese women aged 35–65 years, no history of cervical cancer and sexually active	Design: Cross sectional Theory: PMT Constructs: Perceived Risk, Fear Arousal, Perceived Severity, Response Efficacy, Response Cost and Self-Efficacy.	Correlation between age, income, PMT variables, awareness, knowledge. SEM (structural equation modeling) analysis of factors related to screening intention. Beta values given Outcome: Perceived risk and response cost were associated with screening intentions.	SCORE:M	Rural Chinese women. Embarrassment and anxiety were commonly related to non-uptake of screening. PMT and intention: participants with screening intention were more likely to recognize these factors than participants without an intention
43. Nyambe et al. (2019), Zambia	Knowledge, attitudes, and practices of cervical cancer prevention among Zambian women and men, unclear	N = 600(300 + 300) Sampling: random walk selection from conveniently selected provinces.	Zambian men and women residing in selected provinces	Design: cross-sectional Theory: SEM, TTI Constructs: Intrapersonal, interpersonal, and environmental levels	Chi square Outcome: Social interactions were also found to greatly influence screening. Religion in relation to practice of screening suggested no significance	SCORE: W	Women and men Questionnaires were not self-administered. There was a strong association between having awareness of cervical cancer and practicing screening. (odds ratio = 20.5)

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TABLE 1 (Continued)

Author name, year of publication, country	Study objective	Sample size (N), sampling technique	Study population	Study design, theory used, theoretical constructs considered.	Analysis outcome	Study quality (SCORE[a])	Author's comment
44. Miri et al. (2018), Iran	Cognitive predictors of cervical cancer screening's stages of change among sample of Iranian women health volunteers: A path analysis, PAP	N = 1253 Sampling: Multistage random sampling (women health volunteers)	Women aged 20–65, no history of cervical cancer or hysterectomy	Design: Cross sectional Theory: HBM, TTM Constructs: Precontemplation, contemplation, preparation, action, maintenance, Perceived threat, Perceived benefit, barriers, self-efficacy	Correlation of HBM constructs, knowledge to behavior Path analysis of HBM to Stage of change Outcome: Perceived Benefit, Barriers and self-efficacy were related to stage of change. Women in maintenance stage demonstrated higher levels of perceived benefits, higher levels of perceived self-efficacy, and lower levels of perceived barriers than women in pre-contemplation	SCORE: W	Study conducted in Selected province All HBM constructs were significantly associated with behavior Knowledge had indirect effect on HBM and on behavior
45. Tung et al. (2010), US	To assess pap test screening behaviors of Taiwanese women, to explore factors affecting stages of change and to determine whether constructs from the transtheoretical model are applicable to Taiwanese women about pap screening.	N = 222 Sampling: convenient	Taiwanese Women aged 20–65 years residing in US with no history of hysterectomy	Design: Cross sectional Theory: HBM, TTM Constructs: pre-contemplation, contemplation, action/maintenance, relapse, Perceived benefits, Perceived barriers, Self-efficacy	Chi-square test for demographics and TTM stages MLR for TTM and perceived Benefit, Barrier, and self-efficacy Outcome: Significant difference in Self-efficacy and perceived barriers across TTM stages	SCORE: W	Participants were Female hospital workers, Taiwanese American women Stages of cervical cancer screening were significantly associated with Age, marital status, history of HPV, abnormal pap test
46. Tung et al. (2008), US	To describe Pap smear screening behaviors of Vietnamese American women, and to examine whether constructs (stages of change, self-efficacy, and perceived benefits/barriers) from the TTM are applicable to Vietnamese American women relative to Pap testing	N = 80 Sampling: Snowball	Women aged 20–65 years, self-identified as a Vietnamese American woman, residing in the USA and were able to read Vietnamese or English and no history of hysterectomy	Design: Cross sectional Theory: TTM, HBM Constructs: Pre-contemplation, Contemplation-action. Maintenance, Relapse Self-efficacy, perceived benefits, and barriers	ANOVA tests were performed to compare the means of self-efficacy and perceived benefits and barriers among TTM stage Outcome: There was a significant difference in the score of self-efficacies, Perceived benefits, perceived barriers across stages	SCORE: W	Vietnamese American women Those able to read were included in the study TTM stages were combined

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TABLE 1 (Continued)

Author name, year of publication, country	Study objective	Sample size (N), sampling technique	Study population	Study design, theory used, theoretical constructs considered.	Analysis outcome	Study quality (SCORE[a])	Author's comment
47. Tung et al. (2016), US	To assess differences in perceived benefits, perceived barriers, and self-efficacy among Latina women to obtain Pap smears using the framework of the Transtheoretical Model	N = 121 Sampling: Snowball	Latina women in US 21–65, English/Spanish knowing, no history of hysterectomy	Design: Cross sectional Theory: TTM, HBM Constructs: Perceived benefits, perceived barriers, and self-efficacy among TTM stages (Pre-contemplation-relapse, Contemplation-preparation, Action-maintenance)	Percentage and frequency to assess demographics and TTM stages; Mean and SD to describe efficacy, benefits, and barriers; Chi-square to find association between TTM stages and HBM variables; Multiple linear regression models were performed to compare individual values of HBM constructs Outcome: Significant association among stages of pap test and history of abnormal pap tests	SCORE: W	TTM stages were merged Latina women in US, Spanish speaking women TTM stages were combined. Significant difference between stages and Self-efficacy and barriers Participants in precontemplation and relapse perceived greater barriers than those in action and maintenance.
48. Tung et al. (2016), US	To use the transtheoretical model (TTM) as a framework to examine correlates of Pap testing and stages of change	N = 121 Sampling: snowball	Women aged 21–65 years, self-identified Chinese, residing in US	Design: Cross sectional Theory: TTM, HBM Constructs: Precontemplation/relapse, contemplation/preparation, action/maintenance and Self-efficacy, Perceived benefits, and Perceived barriers	Multiple linear regression models were applied to compare the averages of self-efficacy and perceived benefits and barriers among TTM stages, after controlling for potential confounders, such as age and education Outcome: Significant difference in perceived barrier scores across stages	SCORE: W	Chinese American women were the participants included in the study TTM stages were combined

Notes: [a]Score is given based on the criteria by EPHPP (Annex 2).
Abbreviations: W, weak; M, moderate.

TABLE 2 Theory based interventional studies

Author name, year of publication, country	Study objective	Sample size (N) sampling technique	Inclusion criteria	Study design, theory used, theorical constructs considered.	Analysis	Intervention duration, follow up	Intervention outcome	Study Quality (SCORE[a])	Author's comment
1. Asiyeh Pirzadeh & Maryam Amidi Mazaheri (2012), Iran	To determine the effectiveness of education based on HBM about giving pap smear in women	N = 35 + 35	Women referred to health facility, no history of pap smear, married, who understood questions	Study Design: Quasi experimental Theory: HBM Two group pre-tests post-test design Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers	Independent sample *t* test of scores of HBM and Knowledge between groups, paired t test in intervention group Percentage participation in two groups post intervention given	Education Content and method: 1. Talk by Health educator and video of affected patient to increase Susceptibility. 2. Discussion and video of pap for by health educator and midwife 3. Education to family by specialist Duration: Three sessions of (45-60 min each)	Significant increase in all HBM constructs and knowledge in intervention group following intervention, but not in control group Significant increase in Screening participation in Intervention group than in control group post intervention (34/35 participants in intervention group vs 1/35 in control group)	SCORE: M	Women who understood the questionnaire were included Barrier: cost of procedure Influencer Health educator was involved Families were involved
2. Shobeiri et al. (2016), Iran	To assess knowledge and behavior regarding Pap smear test based on HBM in women referred to Premarital counseling classes	N = 165 + 165	Women referred to premarital counseling classes	Design: quasi-experimental Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers, Self-efficacy Two group pre-test post-test design	T test, chi-square, McNemar test of construct score to screening intention.	Duration: Two 45–60 min for 1 week Method: Consultation and training (lectures, group discussion, Question & answer, power-point presentations, educational pamphlets) for detailed information on anatomy, physiology and cervical cancer, complication, prevention, screening methods, emphasis on pap Outcome pre-post measures of constructs in both groups	Significant increase in Perceived susceptibility, severity, benefit barrier and knowledge in intervention group following intervention, but not in control group Intervention group scored higher in knowledge and HBM scores than the Individuals in control group post intervention. Tendency to screen (Intention) changed from 33% to 96% intervention group compared to 44% to 47% in control group. OR 25 times higher in intervention group	SCORE: M	Women referred to health centers for counseling Major influencer-Parents Education was related to knowledge about Pap, preventive behavior, HBM constructs except Perceived severity

(Continues)

TABLE 2 (Continued)

Author name, year of publication, country	Study objective	Sample size (N) sampling technique	Inclusion criteria	Study design, theory used, theorical constructs considered.	Analysis	Intervention duration, follow up	Intervention outcome	Study Quality (SCORE[a])	Author's comment
3. Park et al. (2005), Korea	To examine the effects of an emotion -cognition focused program on the decision of taking Pap tests in Korean women	N = 48 + 48 Sampling: convenient sample- from church	Married women with no history of cervical cancer or hysterectomy. Mentally competent and able to communicate	Design: Non-equivalent control group Theory: HBM and TTM Two group Post-test only design Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers, Self-efficacy Precontemplation, Contemplation, Preparation, Action, Maintenance	CHI Square, *t* test (scores in intervention and scores in control group) Mean and SD of intention scores in two groups given. Mean and SD of scores of women in TTM stages in Intervention and Control group	Education Content: Introduction, Anatomy and physiology of female genitalia, Cervical cancer (risk factor, symptom, treatment), PAP smear (preparation, process, results), Case presentation (lucky case, unlucky case) Method: Short note, Group discussions, CD Audio-visual material, Video tape, Pap kits, Vaginal speculum Duration: 60 min program (designed based on results of qualitative study conducted earlier), post-test time unclear	Significant increase in Knowledge, P benefit, Perceived Barriers, self-efficacy, in intervention group compared to control group post Intervention Experiment group had significantly high intention to undergo screening compared to ctrl group	SCORE: M	The study was Designed after results derived from a qualitative study to identify culture specific characteristics Many in intervention group were in active stage of adoption
4. Khademol-hosseini et al. (2017), Iran	To investigate the effect of education based on HBM through telegram instant messaging services on Pap smear	N = 106 (48 vs 47) Sampling: random sampling (through records of households in randomly selected Health centers)	Women able to read and write, married for at least 6 months, having smart cell phone, No history of genital tract cancer in family or Pap test in last 3 years	Design: quasi-experimental study Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers, Health motivation	*T* test conducted to compare HBM scores and knowledge, Outcome as mean difference of scores before and immediately after intervention in intervention and control group Mean difference also calculated for scores pre and post-test after 3 months in intervention and control Participation rate in Intervention and control group	Educational content through telegram for 1 month Content: Information on benefits of Pap smear and performing behavior. Decreasing barriers of Pap test Method: Text messages, electronic posters, Infographics, podcasts, video tutorial Duration: 6 messages per week for 4 weeks Post-test immediately and after 3 months	Significant increase in knowledge and all HBM constructs in intervention group than in control group when measured immediately after intervention and 3 months after intervention Screening Participation increased in intervention group 23/48(47.9%) compared to control group 4/47(5.8%) Odds of screening was 9 times higher in intervention group	SCORE: M	Telegram Instant Messaging applicable for those who had smart phones HBM construct scores pre-test was not similar in both groups Mean difference given Post-test for two groups for time 1 and, time 2

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TABLE 2 (Continued)

Author name, year of publication, country	Study objective	Sample size (N) sampling technique	Inclusion criteria	Study design, theory used, theorical constructs considered.	Analysis	Intervention duration, follow up	Intervention outcome	Study Quality (SCORE[a])	Author's comment
5. Parisa Parsa et al. (2017), Iran	Effects of Group Counseling Based on Health Belief Model on Cervical Cancer Screening practices if Iranian	N = 40 versus 40, Sampling: multistage random sampling	Women under the coverage of a rural health center, married, aged between 18 and 60 years, residing in village for at least 2 years, no history of cervical cancer or hysterectomy	Design: Quasi-experimental study Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers, Self-efficacy	Paired sample T test and Independent sample *T* test Assessment of Pap test uptake 2 months after intervention	Duration:3 sessions of 45–60 mins each with interval of 1 week Content: initial questioning of participants, introduction to cervical cancer and symptoms, risk factors, prevention, benefits of pap test and counseling to reduce barriers Method: posters and pamphlets in health houses of villages Reminder after 1 month Follow up and post-test: After 2 months	Paired sample t test: There was increase in HBM constructs in intervention group post intervention. Independent sample t-test: There was significant difference in HBM constructs between the two groups post intervention Pap test uptake was significantly higher in intervention group intervention (17/40) compared to control group (4/40) Pap test intention was significantly higher in intervention group (92.5%) than in control group (40%)	SCORE:M	Biggest barriers were costs, feeling test was not important, lack of time, travelling, embarrassment
6. Shojaeizadeh et al. (2011), Iran	To assess the effect of education on health beliefs and practice of women eligible for Pap test using HBM	N = 70 Sampling: Records from health centers	Women aged 16–54 years who never had a pap test	Design: quasi-experimental Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers One group pre-test-post-test study	Wilcoxon sign rank test for HBM construct and knowledge score pre- and post-intervention	Duration 2 h Content: Training session Method: lecture, question & answer, group discussion, power-point presentation, pamphlets Post-test and Follow up: Follow up after 2 months. HBM constructs and behavior checked after 4 months	Wilcoxon sign rank test: There was significant increase in HBM constructs and knowledge after intervention About 81% were screened during 4-month follow-up. There was significant increase in participation	SCORE: W	The Scores varied across age groups and level of education Study among Unscreened women. Knowledge had effect on HBM constructs increase in knowledge improved scores of all the HBM constructs

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TABLE 2 (Continued)

Author name, year of publication, country	Study objective	Sample size (N) sampling technique	Inclusion criteria	Study design, theory used, theorical constructs considered.	Analysis	Intervention duration, follow up	Intervention outcome	Study Quality (SCORE[a])	Author's comment
7. Sara Daryani et al. (2015), Iran	To determine the effect of education based on HBM in women's practice concerning Pap smear test	N = 60 + 69 (120) Sampling: convenient (women referred to selected health centers)	Women aged 20–65 years, women referred to health centers, married for at least 6 months, no history of cervical cancer or hysterectomy.	Design: Quasi experimental Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers, Self-efficacy	Mann Whitney *U* test, Wilcoxon sign rank. Percentage of women screened pre- and post-intervention in two groups.	2 education sessions Duration: 1.5 h Content: Understanding cervical cancer and pap smear, risk factors, symptoms and prevention, specific conditions, high risk groups, interest to undergo pap smear Method: practical displays, films, lectures, question & answers Follow-up: post after 2 months	There was significant increase in HBM construct scores except for Perceived severity in intervention group. Pap test uptake was higher in intervention group after intervention (19/60,31%) than before intervention (14/60,23.3%) Participation was higher in intervention group (31.7%) compared to control group (3.3%) post intervention. Odds increased by 15 times	SCORE: M	There was increase in perceived susceptibility and severity in control group post intervention
8. Hanaa et al. (2014), Egypt	To estimate the effect of self-learning package, based on Health belief model on cervical cancer prevention among female university friends	N = 157 + 157Sam-pling: Purposive sampling	Female University Students, married students	Design: Quasi experimental Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers	Independent sample *t* test, between two groups pre and post Correlation coefficient of total HBM scores and intention post-test given	Content: self-learning package with chapters about meaning of cervical cancer, causes, risk factors, signs and symptoms, diagnosis, methods of treatment and prevention, cervical cancer screening, its time, benefits, purposes and technique of pap smear and HPV vaccination Method: chapters with information, Question and Answers after every chapter to be answered Duration: Post-test after 2 months	Significant difference in HBM scores and knowledge in between the groups post intervention. After 2 months post intervention, Total HBM scores were significantly associated with screening intentions in both groups. Those in intervention group had 5 times higher odds of positive screening intention	SCORE: W	Young women Self-learning package applicable to who can read and understand information

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TABLE 2 (Continued)

Author name, year of publication, country	Study objective	Sample size (N) sampling technique	Inclusion criteria	Study design, theory used, theorical constructs considered.	Analysis	Intervention duration, follow up	Intervention outcome	Study Quality (SCORE[a])	Author's comment
9. Xingjie Wang et al. (2010), US	To evaluate the effects of a community-based pilot intervention that combined cervical cancer educations with patient navigation on CCs behavior among Chinese American woman	N = 134 (80+50) Sampling: Judgmental	Chinese women who did not have pap in last 12 months, above 18 years, no history of cervical cancer or Pap in last 12 months	Design:2 arm quasi experimental Theory: HBM and SCT Constructs: Unclear	ANOVA in 2 groups Log regression with screening as outcome and variables	Education & navigation assistance (information, arranging appointments, Language translation and transportation assistance to cancer screening and sites that conducted free screening) Content: cervical cancer risk factors, prevalence rates, and benefits of screening and early detection Duration: 2 education sessions Follow-up after 12 months.	Screening was significantly higher in intervention group (56/80, 70%) than in control group (6/54, 11.1%) 12 months post intervention. Screening was 5 times higher in Intervention group Log regression showed that older age was facilitator, lack of health insurance and poor English language proficiency were barriers. Only perceived severity[a] was associated with screening uptake	SCORE: W	Community leaders were involved in the development and pilot testing Poor English proficiency and health insurance was associated with screening intake
10. Guvenc et al. (2013), Turkey	To determine the effect of three-stage nursing intervention to increase Turkish women's participation in Pap smear testing	N = 2500, Sampling: simple random	Women aged above 21, no history of cervical cancer, literate, sexually active, not in 2nd or 3rd trimester of pregnancy	Design: Quasi experimental, One group Post-test only design Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, Perceived barriers, motivation	Paired *T* test for scores ANOVA(Analysis of variance) for scores of HBM and knowledge after each intervention	3 step nursing intervention Content: 1 step-(education brochure containing risk factor, symptoms, and pap smear test with invitation) 2 step-(telephone interview) to understand non-participation with screening invitation = 83.7 screened. 3 step- (face-to face interview) to understand barriers	After 1 intervention step 510/2500 (20%) had pap, 2 step 158/302 (52.3%) had pap, 3 step 20/54 (37%) had pap test Paired test: significant rise in knowledge post brochure Difference in barrier perception score was significantly higher after telephone interview than after brochure. Third stage: Individuals who had less knowledge, more barriers was overcome by face to face	SCORE: W	Literate women 3 step intervention For few women just one intervention was enough with a nudge to improve uptake Reason for non-participation post brochure inter-vention was no time, ignoring it, embarrassment, religion (Muslim society, reinforces great modesty in women) Most women requested for reminders post intervention.

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TABLE 2 (Continued)

Author name, year of publication, country	Study objective	Sample size (N) sampling technique	Inclusion criteria	Study design, theory used, theorical constructs considered.	Analysis	Intervention duration, follow up	Intervention outcome	Study Quality (SCORE[a])	Author's comment
11. Cullerton et al. (2016), Australia	To determine the impact of education sessions on knowledge, attitude, and intentions to participate in screening for culturally and linguistically diverse communities	N = 21 Sampling: convenient sample	Culturally and linguistically diverse communities	Design: Quasi experimental study, One group pre-test, post-test design Theory: HBM Constructs: Perceived susceptibility, Perceived severity, Perceived benefits, self-efficacy	Wilcoxon sign rank or Mc Nemar's test for categorical or continuous variables. Percentage screened in both groups	Two cervical cancer screening education sessions Content: Risk of cancer, fear of detection of cancer, benefits of early detection and action to take (how, when, where), targeting fatalism and embarrassment, cues through multicultural health workers Duration: unclear	Increased knowledge and Perceived susceptibility increased post intervention Screening uptake increased from 76% to 91% (not significant) No significant difference in intentions	SCORE: W	Culturally and linguistically diverse communities The education session was prepared by cancer screening expert with consultation of Health worker to suit culturally acceptable methods
12. Peterson et al. (2013), US	To assess the efficacy of an intervention to promote mammography and pap testing among women with mobility impairments overdue for screening	N = 156(80.76) Sampling: unclear (Via multiple channels)	Women from urban and sub urban regions, aged 35–64, not had pap in last 3 years, English speaking, have health Insurance and some mobility impairment	Design: RCT, Two group pre-test post-test Theory: HBM Constructs: Perceived susceptibility, Perceived benefits, Self-efficacy, Intention	Chi-square to compare the proportion of intervention and control groups. Analysis of covariance to compare post-test scores for theoretical constructs by group.	Duration: 90–120 min workshop (participatory workshop, activity book, formal brochures, copy of training presentation.), with 6 months of structured telephone support Method: participatory workshop and telephone support	No significant changes in intervention group when compared to control group with construct score. Screening uptake significantly increased in intervention group 61% than in control group 27%.	SCORE: W	Participants had Mobility impairments. Majority of participants were not employed and had income <10,000 dolars per annum. They had Health insurance.

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TABLE 2 (Continued)

Author name, year of publication, country	Study objective	Sample size (N) sampling technique	Inclusion criteria	Study design, theory used, theorical constructs considered.	Analysis	Intervention duration, follow up	Intervention outcome	Study Quality (SCORE[a])	Author's comment
13. Coronado et al. (2015), Jamaica	To evaluate effectiveness of an education intervention based on TTM and HBM models of behavior change in increasing cervical cancer knowledge and intention to screen and assess screening rates post intervention.	N = 123 Sampling: convenient,	Women aged above 18 years, no pap in last 5 years	Design: quasi-experimental participatory workshop, activity book, formal brochures, copy of training presentation. Theory: HBM & TTM 1 group pre-test post-test Constructs: Pre-contemplation, contemplation and preparation, Barriers	Paired t test, test for correlated proportions for change in scores	Culturally sensitive, educational presentation Content: Cervical cancer causes, symptoms, risk, protective factors, location of cervix, screening procedure, location of nearest facility, Jamaican screening guidelines. Method: Presentation, culturally relevant images Follow up: 6 months post intervention.	Significant increase in knowledge post intervention Less women in pre-contemplation and contemplation stage post intervention Participation /screening uptake increased after intervention (50/123), 40.7%, post six months. Screening significantly increased in naïve (46%) and pre-screened (those who never had screening earlier) women. Intention to screen of those in Preparation increased from82% to 96.2%	SCORE: W	Source of knowledge for women was doctor/media/family members/friends
14. Fauzia Abdulla & Tin Tin Su (2013), Malaysia	To evaluate the effect of call-recall approach in enhancing pap smear practice by changes of motivation stage among non-complaint women	N = 403(201- Sampling: cluster randomized control trial	Secondary school teachers who never or infrequently attended for pap.	Design: randomized control trial Theory: TTM Constructs: Pre-contemplation, contemplation, preparation, action	MLR to see effect of intervention on action stage at 24 weeks.	Invitation and reminder Content: Personal invitation letter with an information pamphlet of cervical cancer screening, telephone reminder after 4 weeks. Follow up: Participation checked after 24 weeks	Significant difference in changes of stage at 24 weeks in both groups Higher proportion were in action stage (or2.44) in intervention arm than in ctrl arm (controlled for demographics)	SCORE: W	Invitation and reminders posted

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TABLE 2 (Continued)

Author name, year of publication, country	Study objective	Sample size (N) sampling technique	Inclusion criteria	Study design, theory used, theorical constructs considered.	Analysis	Intervention duration, follow up	Intervention outcome	Study Quality (SCORE[a])	Author's comment
15. Krok-Schoen et al. (2016), US	To evaluate data from participants receiving LHA intervention designed to increase movement toward the action stage/completing cervical cancer screening	N = 90, Sampling: randomized	Females above 18 years, resident of Ohio, no history of Cervical cancer or hysterectomy, those who are due for pap test, women visiting health centers	Design: Randomized control trial Theory: HBM, Social learning, TTM Constructs: perceived severity, Social cognitive, Pre-contemplation, contemplation, preparation, action, maintenance. 1 group pre-test post-test	Univariate log regression to explore demographic and health factors associated with screening uptake. Regression Association between barriers and stage of change	Duration:10 month Content: (2 visits, 2 phone calls, e- mailed postcards) Information about the pap test and value of completing the pap test as per guidelines, importance of abnormal pap test follow-up, support to schedule a pap test with a health care provider. Post cards addressing importance of pap screening	Women between 30 and 50 had higher odds of screening uptake OR = 4.20 Action stage participants had less barriers. 63% had forward stage movement post intervention after 10 months	SCORE: W	Intervention by LHA (Tailored cancer screening messages by lay health advisor) Barriers: Lack of provider recommendation, embarrassment, time constrains, Forgetful, cost related issues
16. Temel et al. (2017), Turkey	To evaluate the effect of structured teaching program on breast and cervical cancer screening on knowledge and practice of teachers	N = 37 teachers+64 students Sampling: unclear	Teachers and students	Design: Quasi experimental Theory: TTM Constructs: Pre-contemplation, contemplation, preparation, action, maintenance, relapse one group pre-test post- test	Wilcoxon sign rank, Mc Nemar's for difference in scores, mean and Stand deviation of knowledge pre and post, number of participants in each stage groups pre and post	Structured training program Content: training session on anatomy, physiology of reproductive system, Breast cancer, cervical cancer, symptoms, risk factors, early detection, prevention and treatment methods, BSE, Cervical cancer, and Pap smear test. Method: training, video films Duration 60 minute Follow up: 6-month follow up (1 month, 3-month, 6 month) for teachers and post 6 months for students	Knowledge significantly increased post intervention Significant change in action and maintenance phase comparing before intervention and after 6 months) 24.3% to 45.9% in action and maintenance (pre vs post among teachers) teachers also taught students (knowledge transfer was significant)	SCORE: W	Sampling method unclear Teachers and their students included in the study

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TABLE 2 (Continued)

Author name, year of publication, country	Study objective	Sample size (N) sampling technique	Inclusion criteria	Study design, theory used, theorical constructs considered.	Analysis	Intervention duration, follow up	Intervention outcome	Study Quality (SCORE[a])	Author's comment
17. Luszczynska et al., 2011, Poland	To evaluate the effects of a pros enhancing intervention on intention to uptake of cervical cancer screening	N = 1436 (712+724) Sampling: Unclear (online advertisement for participation)	Women aged 18–60 years.	Design: Randomized control trial Theory: HAPA, TTM Constructs: Pre-intentional, intentional, action phase, pros, and cons of Cervical cancer screening	Analysis of covariance Decisional balance pre- and post-intervention and moderation mediation analysis to see the effect of age, past screening, baseline intention to lead a healthy life, change in decisional balance	Education materials and intervention forms (positive outcome of screening behavior, gaining control over one's body, help to detect minor changes in reproductive health, easy accessibility of actual examination	Decisional balance and intention to screen was higher in the intervention group than in the control group Baseline intention to live a healthy life and past behavior influenced intention Intervention had direction effects to intention mostly in pre intentional stage Intention to screen had covariates-intention to lead a healthy life, past behavior. Intention was marginally related to decisional balance	SCORE:M	Web based session
18. Paschal Sheeran & Sheina Orbell (2000), England	To evaluate intervention based on implementation intentions	N = 114 Sampling: unclear	Women aged 20–67, registered at medical practice in rural England	Design: Randomized control trial, Two group post-test only design (for TPB variables) Theory: TPB Constructs: Attitude, subjective norm, perceived behavioral control, intention	Correlation, MANOVA When and where she would go and get screened) Variables/predictors for attendees and non-attendees and comparison of TPB constructs of 2 groups Pre-test post-test frequency of screening uptake	Write implementation intentions (participants were asked to write down when, where and how they would make an appointment) Follow up/ screening uptake: Checked after 3 months Variables related to screening uptake (TPB variables + no screening delay in past+ intention measured in attendees and non-attendees) 92% in Intervention and 69%in control group got screened 3 months post intervention. Implementation intention	Both groups had similar construct score, good intention, post intervention People's belief on smear and intention had less effect on uptake Intervention could increase intention Screening was more related to previous delay in screening Implementation intentions helped those who delayed screening in the past to uptake screening	SCORE: W	Invitation pre intervention provided to both groups Postal reminders post intervention sample over represents regular attenders

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TABLE 2 (Continued)

Author name, year of publication, country	Study objective	Sample size (N) sampling technique	Inclusion criteria	Study design, theory used, theorical constructs considered.	Analysis	Intervention duration, follow up	Intervention outcome	Study Quality (SCORE[a])	Author's comment
19. Walsh (2005), Ireland	To investigate the role of anticipated regret within the framework of the Theory of Planned behavior in predicting attendance for a cervical smear test in prior non-attendees	N = 156 Sampling: Random	Women aged 25–60 years, who were prior non-attenders	Design: randomized control trial, Two group post-tests only design (for TPB variables) Theory: TPB Constructs: Attitude, subjective norm, Perceived behavioral control, anticipated regret, intention	T test multivariate predictors of intention and behavior R square of TPB variables to intention Pre-test post-test frequency of screening uptake	Write implementation intentions (participants were asked to write down when, where and how they would make an appointment)	Intervention effect: those who did not make action plan (control group) had significantly lower intention to get screened but action plan forming did not increase screening. Predictors of screening uptake: Best predictors to uptake were Perceived behavioral control and anticipated regret and to less degree subjective norms. Regression: TPB +anticipated regret explained (R square) 42 % variance in screening intention TPB +anticipated regret and intervention (action planning) explained (R square)13% of variance in screening intention	SCORE: W	Prior non attenders Anticipated regret increased predicting intention

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TABLE 2 (Continued)

Author name, year of publication, country	Study objective	Sample size (N) sampling technique	Inclusion criteria	Study design, theory used, theorical constructs considered.	Analysis	Intervention duration, follow up	Intervention outcome	Study Quality (SCORE[a])	Author's comment
20. Dehdari et al. (2014), Iran	To determine the effectiveness of an educational intervention based on the protection motivation theory (PMT) variables and implementation intentions in the first and second Pap test practice among Iranian women	N = 200 Sampling: unclear	Women referred to PHCs, no history of cervical cancer, married or sexually active, no history of pap test or hysterectomy, able to read and write in farsi	Design: quasi randomized control trial Theory: Protection motivation theory(PMT) Constructs: Perceived susceptibility, Perceived severity. Response cost, response efficacy, self-efficacy, fear Two group pre-test post-test design	Independent sample *T* test between groups, repeated analysis to see difference pre- and post-intervention Chi-square to check for screening uptake in two groups in three and 15 months	PMT based education. Duration: 60-minute educational session over 4-weeks Content: tailored instructions for pap-test practice Method: group discussions, lectures, question, and answers. Intervention: sent invitation letter to attend free screening+ implementation intention (participants were asked to write down when, where and how they would make an appointment to go for a cervical smear test) +reminders 2 week after writing implementation intentions Method: Mobile text messages Follow-up: screening uptake and scores seen after 3 months and after 15 months	Significant increase in self-efficacy, perceived susceptibility, and behavior intention in intervention group than in control group No significant difference in PMT scores 15-month post intervention in both groups At 3-month, more women in intervention group (61.9%) obtained pap than in control group (9.7%) At 15-month, more women in intervention group (58.6%) obtained pap than in control group (0%)	SCORE: W	Women who attended the primary healthcare clinics

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TABLE 2 (Continued)

Author name, year of publication, country	Study objective	Sample size (N) sampling technique	Inclusion criteria	Study design, theory used, theorical constructs considered.	Analysis	Intervention duration, follow up	Intervention outcome	Study Quality (SCORE[a])	Author's comment
21. Mosavel & Genderson (2017), US	To report on findings from a community-based study that assessed the feasibility of an upward communication by adolescent females to influence their female family member to obtain recommended breast and cervical cancer screenings, or to consult with their doctor regarding their need for a colonoscopy	N = 22+18 Sampling: unclear	Adult 40 years or above with a female daughter aged 14–17 years 2 group Pre-test post tests	Design: Randomized control trial Theory: Elaboration Likelihood Model (ELM) and the Theory of Planned Behaviour (TPB)	Chi square test for pap smear uptake pre- and post-intervention	The baseline and exit interview each lasted approximately one hour. Duration: The face-to-face 60 min workshop Content: how to prepare a factual and emotional appeal to their mothers	More women in the intervention group reported that they obtained a screen For the Pap smear, one-third(33%) reported making an appointment and one obtained a Pap smear	SCORE: W	Training daughters to make an emotional appeal to convince mothers to get screened

Note: *Score is given based on the criteria by EPHPP (Annex 2).
Abbreviations: W, weak; M, moderate.

named it perceived threat, and one combined perceived benefits with motivation (Allahverdipour & Emami, 2008).

Four studies reported the degree of variance in CCS behavior or intention that is explained by the HBM constructs (expressed as Rš). When only the intention to participate in screening is considered as an outcome, the four HBM constructs of perceived susceptibility, severity, benefits, and barriers explain 4% of the variance in screening intention. This increases to 37% when health motivation is added (Burak & Meyer, 1997; Hennig & Knowles, 1990; Hill et al., 1985). When participation in screening is considered as an outcome, the model explains 35–37% of the variance in CCS uptake (Boonpongmanee & Jittanoon, 2007; Jeihooni et al., 2015). The inclusion of health motivation increases the explained variance of CCS behavior to 52% (Orbell et al., 1996). Of the different constructs, perceived benefits, barriers, self-efficacy, and health motivation are most significantly associated with CCS behavior, while perceived susceptibility and severity generally do not contribute significantly, even after adjusting for covariates and socio-demographic variables. In contrast, perceived susceptibility is a significant predictor of screening intentions, along with motivation and self-efficacy.

3.1.2 | Protection motivation theory

Three studies used the PMT to explain CCS. Two of these considered actual CCS uptake as an outcome, and one screening intention. One study reported that perceived severity, self-efficacy and response efficacy explain about 48% of the variance in screening behavior (Mirzaei-Alavijeh et al., 2016), while another (Gu et al., 2013) did not find any significant difference of constructs between screened and unscreened. Among the constructs in the model, perceived risk and response cost are significantly associated with screening intention (Bai et al., 2018).

3.1.3 | Theories of reasoned action and of planned behavior

Four studies used the TRA to predict CCS uptake, and 10 studies used TPB. Of these studies, two (Duffett-Leger et al., 2008; Smith et al., 2014) considered screening participation, while the others only considered intention to participate. Across studies, the TRA was found to explain 12–36% of the variance in CCS intentions, and the TPB between 11 and 53% (Hennig & Knowles, 1990; Jennings-Dozier, 1999; Orbell et al., 1996). The addition of the age of first knowing about CCS, socio-economic status, anticipated regret, and acculturation with past screening behavior as covariates enhance the explained variance to 40%, 42%, and 65%, respectively (Walsh, 2005). Of the constructs, attitude, subjective norms and PBC are all significantly associated with screening intention, with attitude having the strongest association with CCS intention, followed by subjective norms and PBC. Furthermore, screening intention explains 27% of the actual screening uptake (S. L. Rogers, 2017) and increases the odds of getting screened to an OR of 1.8 (Smith et al., 2014).

3.1.4 | Transtheoretical model (TTM)

Five studies (Miri et al., 2018; W.-C. Tung, 2010; W.-C. Tung et al., 2010; W.-C. Tung et al., 2016; W. C. Tung et al., 2017) used the TTM in combination with the HBM to explain CCS, looking at the HBM constructs across the stages of the TTM (pre-contemplation, contemplation, preparation, action, maintenance, and relapse). Women in the maintenance phase demonstrate higher levels of self-efficacy and perceived advantages of screening, and lower levels of perceived barriers and disadvantages related to CCS, than those in the pre-contemplation phase. This implies that higher levels of perceived advantages and self-efficacy are associated with more regular screening uptake and positive intention to get screened in the future.

3.1.5 | Social-ecological model

One study (Nyambe et al., 2016) combined the SEM and the TTI to explain CCS practices. This study looked at the impact of knowledge, social support and religious beliefs on screening practice and intention to participate in screening. Knowledge and religion were found not to be significant factors, whereas knowing someone who had been screened significantly increases the odds of screening uptake (OR 18.7, $p < .01$), in addition to support by the partner, family members or friends.

3.2 | Intervention studies

A total of 21 studies made use of a health behavior theory to develop an intervention to promote CCS uptake. Fourteen of these studies used the HBM (Coronado Interis et al., 2016; Cullerton et al., 2016; Daryani et al., 2016; Guvenc et al., 2013; Hanaa & Hend, 2014; Khademolhosseini et al., 2017; Krok-Schoen et al., 2016; Park et al., 2005; Parsa et al., 2017; Peterson et al., 2012; Pirzadeh & Mazaheri, 2012; Shobeiri et al., 2016; Shojaeizadeh et al., 2011; Wang et al., 2010), three used the TPB (Mosavel & Genderson, 2016; Sheeran & Orbell, 2000; Walsh, 2005), five the TTM (Abdullah & Su, 2013; Coronado Interis et al., 2016; Krok-Schoen et al., 2016; Luszczynska et al., 2011; Temel et al., 2017), one used the PMT (Dehdari et al., 2014), and one the HAPA (Luszczynska et al., 2011). Some studies combined these models, for instance the Elaboration Likelihood Model with the TPB (Mosavel & Genderson, 2016) or the HBM with the Socio-cognitive Theory (Wang et al., 2010). The interventions varied in duration between 1 h and 10 months, and their content ranged from sending an invitation letter to educating participants by means of specific education materials over various sessions and helping them frame their intention to participate in screening and develop an action plan to get screened. Four studies provided a cue or reminder to take up screening (Abdullah & Su, 2013; Dehdari et al., 2014; Guvenc et al., 2013; Parsa et al., 2017), typically in the form of an invitation letter or telephone call. Effects were evaluated using a pretest-post-test design with control group, single group

pre-test -post-test, or post-test only design, with screening uptake or intention as an outcome measure, assessed post-intervention or up to 6 months later. Eleven of the intervention studies included a follow-up test, conducted after 3 to 12 months (Abdullah & Su, 2013; Coronado Interis et al., 2016; Daryani et al., 2016; Dehdari et al., 2014; Hanaa & Hend, 2014; Khademolhosseini et al., 2017; Parsa et al., 2017; Sheeran & Orbell, 2000; Shojaeizadeh et al., 2011; Temel et al., 2017; Wang et al., 2010).

3.2.1 | Health belief model

Fourteen studies (Abdullah & Su, 2013; Coronado Interis et al., 2016; Cullerton et al., 2016; Daryani et al., 2016; Guvenc et al., 2013; Hanaa & Hend, 2014; Khademolhosseini et al., 2017; Krok-Schoen et al., 2016; Park et al., 2005; Parsa et al., 2017; Peterson et al., 2012; Pirzadeh & Mazaheri, 2012; Shobeiri et al., 2016; Shojaeizadeh et al., 2011; Temel et al., 2017; Wang et al., 2010) were concerned with HBM based interventions to enhance women's participation in CCS. All of these involved educational activities with the constructs of the HBM to modify the participants' perception of cervical cancer or of screening, in order to improve their screening behavior or intention. Nine of the studies (Daryani et al., 2016; Guvenc et al., 2013; Hanaa & Hend, 2014; Khademolhosseini et al., 2017; Park et al., 2005; Parsa et al., 2017; Pirzadeh & Mazaheri, 2012; Shobeiri et al., 2016; Shojaeizadeh et al., 2011) used the four basic constructs of the HBM (perceived susceptibility, perceived severity, perceived benefits, and perceived barriers) to develop the intervention; six addressed self-efficacy (Cullerton et al., 2016; Daryani et al., 2016; Park et al., 2005; Parsa et al., 2017; Peterson et al., 2012; Shobeiri et al., 2016), and two included health motivation (Guvenc et al., 2013; Khademolhosseini et al., 2017). One study (Wang et al., 2010) combined the HBM with Socio-cognitive Theory. Two studies (Coronado Interis et al., 2016; Park et al., 2005) combined the HBM with the TTM, and one with Social Learning Theory (Krok-Schoen et al., 2016), linking the intervention and its evaluation to the participants' stage in the change process. The evaluation of the interventions showed a significant change of the scores on the HBM dimensions post intervention in 11 of the 14 studies (Cullerton et al., 2016; Daryani et al., 2016; Guvenc et al., 2013; Hanaa & Hend, 2014; Khademolhosseini et al., 2017; Krok-Schoen et al., 2016; Park et al., 2005; Parsa et al., 2017; Pirzadeh & Mazaheri, 2012; Shobeiri et al., 2016; Shojaeizadeh et al., 2011), thus proving that interventions based on this model can modify the perceptions and enhance uptake. In five studies (Coronado Interis et al., 2016; Hanaa & Hend, 2014; Park et al., 2005; Parsa et al., 2017; Shobeiri et al., 2016) these changes in perceptions were also linked to a change of the intentions of the women to participate in screening. Furthermore, the odds of participation in screening increased significantly when the educational interventions targeted each of the HBM constructs or when tailored education was provided (Coronado Interis et al., 2016; Cullerton et al., 2016; Daryani et al., 2016; Guvenc et al., 2013; Hanaa & Hend, 2014; Khademolhosseini et al., 2017; Parsa et al., 2017; Peterson et al., 2012; Pirzadeh & Mazaheri, 2012; Shobeiri et al., 2016; Shojaeizadeh et al., 2011; Wang et al., 2010). Specifically, enhancing the perceived susceptibility and severity of cervical cancer through providing detailed information about the anatomy of the cervix and the cause, symptoms and risk factors of cervical cancer; addressing the perceived benefits of screening through highlighting protective factors and screening recommendations with culturally relevant images; and reducing perceived barriers by giving information on the nearest screening facility and providing assistance to reach the screening location improved screening intentions and screening uptake among never-screened women (Wang et al., 2010). Involving women in discussions, using films and multiple audio-visual aids (Dehdari et al., 2014; Park et al., 2005; Pirzadeh & Mazaheri, 2012; Shobeiri et al., 2016; Shojaeizadeh et al., 2011), or using self-learning materials(Hanaa & Hend, 2014) during interventions were also found to be effective. Cues to action reminding women to uptake screening after the intervention were also found to be helpful (Cullerton et al., 2016; Guvenc et al., 2013).

3.2.2 | Protection motivation theory

One study (Dehdari et al., 2014) used the PMT as a basis to develop an educational intervention to increase CCS, focusing on increasing the perceived susceptibility, perceived severity and perceived benefits of screening and decreasing the perceived barriers through tailored instruction, group discussion and lectures. The PMT dimensions as well as screening intentions and participation in screening were used as outcome measures. The intervention significantly increased the level of self-efficacy and perceived susceptibility, as well as the screening intention and actual uptake (58% uptake in intervention group against 0% in the control group).

3.2.3 | Theory of planned behavior

Three studies used the TPB in interventions to enhance CCS (Mosavel & Genderson, 2016; Sheeran & Orbell, 2000; Walsh, 2005). Two of these studies drew on the TPB dimensions to make the objectives of the intervention more focused (Sheeran & Orbell, 2000; Walsh, 2005), while the third combined the TPB with the Elaboration Likelihood Model to develop an educational intervention (Mosavel & Genderson, 2016). The evaluation results showed that the interventions produced significant changes in attitudes, subjective norms, perceived behavioral control, and intentions (Sheeran & Orbell, 2000; Walsh, 2005). Furthermore, making participants formulate implementation intentions and write up an action plan stating when, where and how they would make an appointment reduced the delay in screening uptake, which has been shown to be a significant predictor of non-participation in screening. Another factor that was accounted for is anticipated regret, which in combination with action planning and PBC seems to have an important impact on screening uptake (Sheeran & Orbell, 2000).

3.2.4 | Transtheoretical model

Six studies (Abdullah & Su, 2013; Coronado Interis et al., 2016; Krok-Schoen et al., 2016; Luszczynska et al., 2011; Park et al., 2005; Temel et al., 2017) drew on the TTM to develop and evaluate interventions to enhance CCS. Three of these used the TTM in combination with the HBM (Coronado Interis et al., 2016; Krok-Schoen et al., 2016), and one with the HAPA (Luszczynska et al., 2011). One study assessed the change in the HBM constructs across the phases of behavior change outlined in the TTM, finding that participants in the intervention group were more likely to be in the action or maintenance phase (OR = 2.44) than those of the control group (Abdullah & Su, 2013; Coronado Interis et al., 2016). Providing culturally sensitive education on cervical cancer causes, symptoms, risk and protective factors, screening procedures, and the location of the nearest facility based on the HBM model increased, the screening intentions of individuals in the intervention group more than of those in the control group (Coronado Interis et al., 2016). Two studies evaluated stage-matched interventions in the behavior change process through tailored interventions, provided as personal invitations to participate in the screening (Abdullah & Su, 2013) or through lay health advisors (Krok-Schoen et al., 2016). Their results showed that structured training programs facilitated a forward movement through the stages of behavior change. Tailored interventions addressing the perceived pros and cons of screening and highlighting the benefits also improved screening intentions (Luszczynska et al., 2011).

3.2.5 | Health action process approach

One study used the HAPA in combination with the TTM to inform an intervention through a structured motivation and planning process, enhancing self-efficacy (Luszczynska et al., 2011). The intervention led to a significantly higher increase of the intention to screen in the intervention group compared to the control group.

4 | DISCUSSION

This study reviewed empirical studies that were published between 1985 and 2019 and presents the use of health behavior theories applied to women's participation in CCS. It compares the strength of different health behavior theories in explaining CCS uptake and explains the role of health behavior theories in developing effective CCS promotion.

The results show that, despite the existence of health behavioral theories since the late 1950s and their wide application to other health related behaviors, they are not yet systematically used to explain CCS uptake or develop interventions to promote this uptake. Of the studies that investigated health behavior theories in relation to CCS, a majority drew on the HBM, followed by the TRA/TPB. Other, more recent models, such as the PMT, ELM (Elaboration Likelihood Model), SEM, TTI, or HAPA are less often used, although combinations of the HBM or TPB with the TTM were observed in several studies. This may be because, unlike the other models, the TTM describes the stages individuals go through when adopting a new behavior. As such, the TTM can be a useful addition to assess the change following an intervention that is based on another model, such as the HBM or TPB.

4.1 | Explaining screening intentions and behavior

The majority of the studies in this review that investigated the ability of a health behavior theory to explain CCS practices used only one theory, which makes it difficult to directly compare the different theories in terms of their explanatory value. However, across studies the TPB seems to be better at explaining screening *intentions*, with up to 53% of the variance in intention to participate in screening explained by the variables of this model, and even 65% when the model is extended with concepts like anticipated regret, acculturation, or past screening behavior. The TPB-dimensions of attitude, subjective norms and perceived behavioral control of TPB are all associated with intention, attitude showing the strongest relationship. In contrast, the HBM as a model shows only a weak relationship with screening intention, although its individual constructs of perceived susceptibility, motivation, and self-efficacy do explain intentions. The same applies to certain dimensions of the PMT, of which the dimensions of perceived risk and response cost are also significantly associated with screening intention.

When actual screening *behavior* is considered as an outcome, the HBM scores better, explaining 35–37% of the variance in CCS uptake and even 52% when health motivation is added to the basic constructs of perceived susceptibility, perceived severity, perceived benefits, and perceived barriers. In comparison, findings regarding the PMT's capacity to explain screening uptake are inconsistent, and only very few studies involving the TRA/TPB considered actual screening uptake as an outcome variable. This confirms the conclusion from previous research that the PMT provides a useful account of choice motivation, but does not address the psychological processes by which intention is translated into action (Orbell & Sheeran, 1998). On the other hand, the difference between the explanation of intentions and of actual screening behavior suggests that intention serves as a mediator between the variables of the TRA/TPB or HBM and actual screening behavior. In this regard, it is worth considering its addition to the HBM to improve prediction of behavior, as some authors suggest e.g., (Hill et al., 1985).

It is also worth noting that the approaches that are used to explain or predict screening behavior or intention vary between studies. While the variance in outcome that is achieved by a full model can be explained by logistic regression, many studies only considered the association of single constructs with the outcome (i.e., screening or intention), which does not allow to draw conclusions about the entire model. Moreover, nearly all studies use a cross-sectional design, which does not allow to draw conclusions about the models' capacity to actually predict CCS practices.

4.2 | Promoting screening uptake

Interventions that aim to encourage women to participate in CCS seldom make use of theoretical models of health behavior. Only 21 studies could be identified for this review that explicitly used a behavior theory to develop an intervention to promote CCS uptake. Of these, the majority relied on the HBM, sometimes in combination with the TTM, while only a few interventions were based on other theoretical models, notably the TPB, PMT, or HAPA. Since none of these studies compared the theory-informed intervention with a non-theory informed one, the findings of this review do not allow to conclude whether the use of a health behavior theory enhances the effectiveness of an intervention. However, there are good reasons to assume that it does (Green, 2000; Van den Broucke, 2012). As meta-analyses of effect studies in various subfields of health education have shown, a planned and systematic application of social science theory in intervention development is a strong determinant of effectiveness (Kok et al., 1997). This is because the health behavior theory helps to focus the intervention on factors that have been empirically proven to influence screening uptake. Furthermore, it facilitates the choice of outcome measures that allow for a more focused effect evaluation, so that more relevant and valid conclusions can be drawn about the changes caused by the intervention in terms of these determinants and the screening behavior itself. Thus, the studies included in this review could demonstrate that, regardless of the actual model that was used, many of the interventions resulted in significant change. Specifically, interventions like group discussions with involvement of women and their families, use of audio-visual aids, reminders that targeted each of the dimensions of the HBM (perceived susceptibility, perceived severity, perceived benefits, and perceived barriers) were successful in modifying the perceptions of women with respect to cervical cancer and cancer screening, which resulted in a higher intention to participate in screening. Similarly, interventions based on the TPB produced significant changes in attitudes, subjective norms, perceived control, and intentions, which, in combination with anticipated regret, and action planning had a significant impact on screening uptake. Interventions based on the PMT and on the HAPA could increase the level of perceived susceptibility and self-efficacy as well as the screening intention and the adoption, initiation, and maintenance of actual screening behavior. When change was assessed across the phases of behavior change outlined in the TTM, participants in the intervention group were more likely to be in the action phase than those of the control group.

4.3 | The socio-ecological context

The findings of this review indicate that most studies involving health behavior models, and especially the TPB and HBM, explain CCS intention and/or uptake and can be usefully applied to inform the development and implementation of interventions to enhance screening uptake. However, it should be acknowledged that these models only consider individual characteristics, and do not take the social or physical context into account. Yet participation in screening does not only depend on a person's intention, but also on the accessibility and affordability of the health system, on economic conditions, and on social and cultural norms (Simon, 2006). While the psychological barriers to screening such as a lack of awareness, low perceived susceptibility or severity, low perceived benefits of screening, negative attitudes due to embarrassment, discomfort or fear of positive results, and low self-efficacy are to varying degrees accounted for in most health behavior models, practical constraints such as a lack of time, long waiting hours, overlap with working hours, high costs of screening, lack of transport or lack of social support can also represent significant barriers to screening uptake.

These factors, in combination with individuals' psychological determinants, are included in the social-ecological model. While conceptually there is much value in using a more encompassing and integrated multilevel approach to understand and promote behavioral changes at the community, health care service, stakeholder and individual decision-maker level (Maar et al., 2016), our review shows that this approach is very rarely applied to CCS. Only one study was found that relied on the SEM to explain CCS practices (Nyambe et al., 2016), showing that social ecological factors are an important addition to the individual determinants of screening behavior that are focused upon in most traditional health behavior theories.

This finding is all the more important in the light of the need to enhance the effectiveness of screening for cervical cancer in resource limited countries. In most of low- and middle income LMICs screening is opportunistic, and the uptake is low (Islam, Bell, Billah, Hossain, & Davis, 2015; Sankaranarayanan, Gaffikin, Jacob, Sellors, & Robles, 2005). This may be attributed to the fact that the organization of health care, the economic situation and cultural norms are often less conducive to participation in screening. Applying a social-ecological approach then allows to integrate individual-level, psychological determinants of CCS participation deriving from health behavior models into a broader socio-ecological framework that accounts for contextual, cultural, and organizational influences. In this regard, it is important to note that while this review made efforts to include studies from LMICs by including non-indexed journals, clinical trials.gov, and ProQuest in the search process, very few studies were found that had been conducted in LMICs like Ethiopia (Abamecha et al., 2019; Bayu et al., 2016), Nepal (Pandey & Karmacharya, 2017) and Zambia (Nyambe et al., 2016). They were observational and used HBM or TPB to identify factors of CCS uptake or intention. Only one study by Nyambe et al., used socio-ecological approach and argued that social interactions have an influence on cervical cancer behavior. With the majority of studies being performed in upper- and middle income or high-income countries, as such, there is a need for studies that test the applicability of health behavior models to explain CCS and improve the effectiveness of CCS promotion campaigns in LMICs.

4.4 | Limitations

This study is not without its limitations. Some of these are concerned with the choices that were made for the selection of studies to be

included in the review, such as the limitation to studies described in articles that were published in English since 1985 or the exclusion of studies that did not test full theoretical models but only some of the variables. It is possible that this resulted in the omission of some interesting and good quality studies. However, given that the purpose of this review was to investigate the heuristic value of specific theories, we think that the choice to not include studies that did not include complete models was warranted.

Secondly, to assess and compare the predictive value of different health behavior theories in predicting CCS uptake, it would have been ideal to analyze studies that conceptualized and operationalized these theories in similar ways. This is not the case for this review. Many studies even modified the models or extended them by adding variables, with the purpose of adding explained variability. To some extent this allows to compare the explanatory value of the central dimensions of a theory with the extended version, but it also complicates the comparability of models across studies. Moreover, the dimensions of the theories considered here were measured in different ways, using different combinations of items/questions, which resulted in variable levels of construct validity. Although the quality assessment of the studies ensured that only operationalizations with sufficient internal consistency and reliability were included in the review, it could not rule out the differences between the studies in terms of measures used. In a similar way, various screening techniques were used in different studies, which brings about a considerable diversity in the studies. For the intervention studies, there was also a large variation of context, type, methods and duration of the intervention, which may have influenced the outcomes.

A third complication concerns the reporting of the results, in the sense that different effect measures were used across studies. For the observational studies, these included explained variance (expressed as Rš), odds ratios, and Pearson correlations; in the intervention studies, effects were mostly reported in terms of difference scores (pre-post), but in several cases only *p*-values were reported. In addition, some articles only reported significant effects or differences, and did not give non-significant results. These various differences made it impossible to perform a meta-analysis on the data.

Lastly, it is important to consider that the studies explaining screening were cross-sectional, hence the relationship between screening behavior (referring to past behavior) and the theoretical constructs may not reflect a causal relationship. Moreover, past screening behavior as reported by the participants in these studies may be subjected to recall bias or to cultural influences. For instance, the stigma related to pre-marital sex might discourage unmarried women to reveal that they had undergone CCS and may lead to an under-reporting due to social desirability bias.

Despite these limitations, however, the findings of this review of studies representing a variety of countries and participants from diverse cultural backgrounds, socio-economic status, and sexual orientation, are sufficiently robust to provide an overview of the current state of play in the application of health behavior theories to explore the determinants of CCS, their strength in explain (intended) cervical screening uptake, and their use in designing interventions to promote CCS.

5 | CONCLUSION

The findings of this review indicate that health behavior theories, and especially the TPB and HBM, significantly predict CCS intention and/or uptake. As such, they provide a useful theoretical framework for policy makers and CCS program officers to understand the psychological determinants of CCS behavior and to inform the development and implementation of interventions to enhance screening uptake. In that regard, our findings are similar to those regarding mammography, where a recent review also pointed at the validity of behavioral theories to predict mammographic screening. However, one should be aware that these models only consider individual characteristics, and do not take the social or physical context into account. Future research should consider adding social ecological factors as a complement to the individual-level determinants of screening behavior, to arrive at a comprehensive approach targeting individual, interpersonal, organizational, and health system factors.

ACKNOWLEDGMENTS

This study is funded through the scholarship "Coopération au développement" and is carried out as part of the PhD thesis of the first author.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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How to cite this article: Dsouza, J. P., Van den Broucke, S., Pattanshetty, S., & Dhoore, W. (2021). The application of health behavior theories to promote cervical cancer screening uptake. *Public Health Nursing*, 1–41. https://doi.org/10.1111/phn.12944