"This is the peer reviewed version of the following article: Goodwin B, Anderson L, Collins K, et al. Anticipatory anxiety and participation in cancer screening. A systematic review. *Psychooncology*. 2023; 32(12): 1773-1786, which has been published in final form at <u>10.1002/pon.6238</u> This article may be used for non-commercial purposes in accordance with Wiley Terms and Conditions for Use of Self-Archived Versions. This article may not be enhanced, enriched or otherwise transformed into a derivative work, without express permission from Wiley or by statutory rights under applicable legislation. Copyright notices must not be removed, obscured or modified. The article must be linked to Wiley's version of record on Wiley Online Library and any embedding, framing or otherwise making available the article or pages thereof by third parties from platforms, services and websites other than Wiley Online Library must be prohibited." Anticipatory anxiety and participation in cancer screening. A systematic review.

Authors

Belinda Goodwin^{1,2,3}; Laura Anderson^{1,4}; Katelyn Collins^{1,5}; Saira Sanjida^{6,7}; Marcos Riba⁸; Gursharan K. Singh^{9,10}; Kimberley M. Campbell¹¹; Heather Green¹²; Sana Ishaque¹³; Alastair Kwok^{14,15}; Melissa J. Opozda^{16,17}; Amy Pearn¹⁸; Joanne Shaw¹⁹; Ursula M. Sansom-Daly^{19,20,21}; Joanna M. Tsirgiotis²²; Monika Janda^{23;} and Lisa Grech¹⁴

Affiliations

¹ Viertel Cancer Research Centre, Cancer Council Queensland, Fortitude Valley, QLD, Australia.

²Centre for Health Research, University of Southern Queensland, QLD, Australia.

³ Melbourne School of Population and Global Health, University of Melbourne.

⁴ National Centre for Youth Substance Use Research, The University of Queensland, St Lucia,

QLD, Australia.

⁵ School of Psychology and Wellbeing, University of Southern Queensland, QLD, Australia.

⁶Centre for Health Services Research, Faculty of Medicine, The University of Queensland, Brisbane, QLD, Australia.

⁷ Poche Centre for Indigenous Health, The University of Queensland, Brisbane, QLD, Australia.

⁸ The University of Queensland, QLD, Australia.

⁹Centre for Healthcare Transformation, Faculty of Health, Queensland University of

Technology (QUT), Brisbane, QLD, Australia.

¹⁰ Cancer and Palliative Outcomes Centre, School of Nursing, Queensland University of Technology (QUT), Brisbane, QLD, Australia.

¹¹ IMPACCT, Faculty of Health, University of Technology Sydney, Ultimo, NSW, Australia.

¹² School of Applied Psychology and Menzies Health Institute Queensland, Griffith University,

Gold Coast, QLD, Australia.

¹³ College of Medicine and Public Health, Flinders University

¹⁴ Department of Medicine, School of Clinical Sciences, Faculty of Medicine, Nursing and

Health Sciences, Monash University, Clayton, VIC, Australia.

¹⁵ Department of Oncology, Monash Health, Clayton, VIC, Australia.

¹⁶ Freemasons Centre for Male Health and Wellbeing, South Australian Health and Medical Research Institute and University of Adelaide, Adelaide, SA, Australia.

¹⁷ College of Medicine and Public Health, Flinders University, Darwin, NT, Australia.

¹⁸ The Gene Council, North Perth, WA.

¹⁹ Psycho-oncology Co-operative Research Group, School of Psychology, Faculty of Science, The University of Sydney, NSW, Australia.

²⁰ School of Clinical Medicine, UNSW Medicine & Health, Randwick Clinical Campus,

Discipline of Paediatrics, UNSW Sydney, Kensington, NSW, Australia.

²¹ Behavioural Sciences Unit, Kids Cancer Centre, Sydney Children's Hospital, Randwick, NSW, Australia.

²² Sydney Youth Cancer Centre, Nelune Comprehensive Cancer Centre, Prince of Wales Hospital, Randwick, NSW, Australia.

²³ Faculty of Medicine, The University of Queensland, QLD, Australia.

Abstract

Objectives: To synthesize current evidence on the association between anticipatory anxiety, defined as apprehension-specific negative affect that may be experienced when exposed to potential threat or uncertainty, and cancer screening to better inform strategies to maximize participation rates.

Methods: Searches related to cancer screening and anxiety were conducted in seven electronic databases (APA PsycINFO, Scopus, Web of Science, Embase, Cochrane Library, PubMed, CINAHL), with potentially eligible papers screened in Covidence. Data extraction was conducted independently by multiple authors. Barriers to cancer screening for any type of cancer and relationships tested between anticipatory anxiety and cancer screening and intention were categorized and compared according to the form and target of anxiety and cancer types.

Results: A total of 74 articles (n_{participants} = 119,990) were included, reporting 103 relationships tested between anticipatory anxiety and cancer screening and 13 instances where anticipatory anxiety was reported as a barrier to screening. Anticipatory anxiety related to a possible cancer diagnosis was often associated with increased screening, while general anxiety showed no consistent relationship. Negative relationships were often found between anxiety about the screening procedure and cancer screening.

Conclusion: Anticipatory anxiety about a cancer diagnosis may promote screening participation, whereas a fear of the screening procedure could be a barrier. Public health messaging and primary prevention practitioners should acknowledge the appropriate risk of cancer, while engendering screening confidence and highlighting the safety and comfort of screening tests.

Keywords: anxiety, cancer, delivery of healthcare, early detection of cancer, screening, oncology, patient acceptance of health care, prevention and control

Introduction

There is a clear link between early detection and reduced cancer morbidity and mortality ¹. Correspondingly, population screening programs for cancers that can be detected early, such as breast, bowel, and cervical cancer, have become important public health initiatives in countries such as Australia, the United Kingdom, Spain, Japan, and China².

Despite these lifesaving initiatives, international cancer screening program participation rates are sub-optimal, ranging from 16% and 68% for bowel cancer ³, 11% to 84% for breast cancer ⁴ and 4% to 74% for cervical cancer ⁵. Self-reported barriers associated with low cancer screening participation rates include procrastination, forgetting, and negative attitudes towards screening ⁶. Moreover, some evidence suggests that anticipatory anxiety towards screening may impact participation in cancer screening programs ^{7–10}.

States or traits such as anxiety, worry, fear, stress, and nervousness are examples of apprehension-specific negative affect that may be experienced when exposed to potential threat or uncertainty. Commonly grouped together because they involve apprehension or anticipation of negative outcomes ^{11–13}, herein we refer to this group of terms as "anticipatory anxiety". The potential negative consequences of screening for cancer (e.g., a cancer diagnosis, discomfort of the test of follow up procedures) may elicit or exacerbate this anticipatory anxiety. Unsurprisingly, these traits have been linked to excessive concern about receiving a cancer diagnosis and, in some cases, the avoidance of cancer screening ¹¹. Individuals experiencing anticipatory anxiety may be more likely to avoid cancer screening ^{14,15}.

Some research suggests that higher levels of anticipatory anxiety are associated with reduced participation in cancer screening. For example, fear of mammography has been shown to reduce breast cancer screening participation ¹⁶. Anxiety about a cancer diagnosis ⁸, extreme levels of general anxiety ¹⁷, and a fear of and/or attempt to avoid negative outcomes ⁶ have all been associated with lower likelihood of participation in bowel cancer screening. Similarly, fear of a positive test result has been identified as a barrier to participation in cervical screening ¹⁸.

Conversely, some research has shown that moderate anxiety levels are associated with increased participation in cancer screening, as screening may alleviate uncertainty regarding latent cancer ^{17,19,20}. These mixed findings may indicate that the relationship between anxiety and screening behaviours is neither linear, nor straightforward ¹⁷.

To date, only one other systematic review has examined associations between psychological distress, including anxiety, and cancer screening ²¹. This previous review focussed on anxiety as an outcome of screening rather than a barrier to screening participation. Therefore, all participants in the included studies underwent screening, and intention prior to screening was not considered. Thus, there is a considerable research gap in understanding the relationship between anxiety and screening behaviour and intention.

Aims

The present systematic review aimed to clarify the impact that these constructs may have on cancer screening participation through examining (i) the relationship between anticipatory anxiety and cancer screening or intention to screen; (ii) the prevalence and severity of anticipatory anxiety as self-reported barriers to screening or intention to screen for cancer; and (iii) factors that moderated or mediated the relationship between anticipatory anxiety and cancer screening participation.

Methods

This systematic review methodology followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Liberati et al., 2009; see Supporting Information File 1) and was conducted according to an a priori registered PROSPERO protocol (reg number: CRD42021283663).

Eligibility Criteria

Articles included in this review reported on: (1) relationships between cancer screening participation and anticipatory anxiety; and (2) the prevalence of anticipatory anxiety as a barrier

to undergoing cancer screening (i.e., negative affective states or traits such as anxiety, worry, fear, stress, and nervousness). All types of cancer were included to maximise results aimed at answering the review research questions. Articles were included if they were peer-reviewed, reported original quantitative research, conducted in a sample consisting only of adults (aged 18+ years), and published in English. Articles were excluded if they were not primary research (e.g., reviews, commentaries), published in a language other than English, not full-length (e.g., conference abstracts), or specifically focussed on screening decline due to fears of contracting COVID-19. Qualitative studies were excluded as we focused on quantitative data for generalisable outcomes. Articles where cancer detection methods were applied post-diagnosis or in response to symptoms (i.e., for surveillance for recurrence or diagnostics) were also excluded. Studies with quality ratings lower than 25 (see Supplementary Information File 3 for ratings) and/or omissions or errors in reporting that impeded the interpretation of results were excluded from the review (n = 3).

Search Strategy

Seven electronic databases, PubMed, Embase, APA PsycINFO, CINAHL, Scopus, Cochrane Library, and Web of Science were searched using title, abstract, and keyword for terms such as "cancer screening", "anxiety", "worry", "fear" and "anticipa*" (see Supporting Information File 2 for full syntax). No date limits were applied. The search terms and strategy were developed in collaboration with an experienced research librarian (MR). The initial literature search was conducted from 27 July 2021 to 10 August 2021 by authors SS and MR. The search strategy was replicated between 16 May 2023 and 17 May 2023 by author KC to capture eligible studies published between August 2021 and May 2023.

Selection Process

A total of 2,364 search results was yielded from all database searches, with 459 duplicates removed using EndNote software ²². The remaining 1,905 articles were imported into Covidence

²³ for screening. Title and abstract screening were undertaken independently by two researchers per article with 80% agreement (Cohen's $\kappa = .43$) and discrepancies were adjudicated by a third team member. A total of 1,636 articles were excluded following title and abstract screening. The full text of the remaining 269 articles were screened for inclusion by authors BG and LA, and a further 194 articles were excluded. This resulted in 74 studies (n_{participants} = 119,990) included in the review. The full PRISMA flow chart diagram is provided in Figure 1.

Data Extraction

Data extraction was undertaken independently by several authors. To ensure quality and accuracy, demographic and results data extraction was repeated and compared for discrepancies independently by several research team members and discrepancies were discussed and resolved. Data extracted from each study included authors, date of publication, study title, aims and design, sample size, participant demographics, cancer type, cancer screening method, anticipatory anxiety construct and associated measurement tool, key outcome variables (e.g., cancer screening participation/intention), and results (frequencies, proportions, relationships and differences) relevant to our study aim. For authors extracting data, anticipatory anxiety related constructs were broadly defined as any form of psychological distress and later refined to only include those which the research team agreed reflected apprehension-specific negative affect that may be experienced when exposed to potential threat or uncertainty; see Supporting Information File 3). Data extracts regarding constructs worry, anxiety, stress and fear were retained, while those regarding depression, clinical psychosis or similar were not. Quality appraisal of each article was conducted concurrently with data extraction using the Joanna Briggs Institute (JBI) Checklist for Analytical Cross-Sectional Studies ²⁴.

Data Coding and Synthesis

Results of statistical tests (including correlations, linear and logistic regressions, mean comparisons, and chi square analyses) testing the relationship between anticipatory anxiety and

cancer screening behaviour or intention were coded according to the (i) "domain" of anxiety and (ii) "direction" of the relationship as follows:

Domain: whether the anticipatory anxiety was "general" or related to getting a cancer "diagnosis"; or the "procedure".

Direction: whether the direction of the relationship was "*positive*"; "*negative*" or if there was no statistically significant relationship ("*null*")

Where the key finding was that a proportion of people experienced anticipatory anxiety as a barrier, the relationship was coded as "barrier". Counts and percentages of results were calculated and tabulated to present an overview of the most common findings for each domain of anxiety. Results were synthesised by the cancer type screened and summarised. Studies that reported on multiple cancer types were included in each relevant cancer type synthesis. A meta-analysis was considered unsuitable given the heterogeneity of measures and statistical tests across the studies.

Results

Study Characteristics

Characteristics of the 74 articles included and a summary of relevant findings from each article is presented in Supporting Information 3. The included studies were published between 1991 and 2023, with half (n = 37) published in the last ten years. Over half of the studies were conducted in the USA (n = 42, 57%), and the majority utilised cross-sectional designs (n = 57, 77%). Surveys were used as the primary means of data collection (n = 58, 78%), with 16 different measures of anticipatory anxiety-related constructs used across studies (e.g., Cancer Worry Scale) and several studies using a single item (e.g., "*How fearful are you of the overall colonoscopy procedure*?" ²⁵). In almost all studies (n = 72), the anticipatory anxiety-related constructs were measured via self-report, with exception of two studies that relied on clinical records of the participant^{26,27}. Sample sizes ranged from 51 to 30,233 participants (*Median* =

1,762, SD = 3,919). Studies focused on breast (n = 34), bowel (n = 19), cervical (n = 9), prostate (n = 7), lung (n = 4), ovarian (n = 2), pancreatic (n = 2), gastric (n = 1), oral (n = 1), and oesophageal (n = 1) cancers.

Quality Assessment

The quality of the assessed studies was generally high, with 26% of studies (n = 19) rated at 100% quality, and almost three-quarters (n = 54, 73%) demonstrating at least 75% of the JBI quality indicators. The most frequent cause of lower quality scores was measuring anticipatory anxiety in a non-standardised way, (i.e., failing to utilise previously validated, reliable measurement tools, n = 13), and a failure to identify (n = 9) and control for (n = 8) confounding variables.

Anticipatory Anxiety and Cancer Screening

Within the articles reviewed, 103 associations were statistically tested between cancer screening intention (n = 28) or behaviour (n = 75) and several forms of anticipatory anxiety, including general state or trait anxiety (n = 16), stress (n = 4) and distress (n = 4); as well as worry (n = 44), fear (n = 12), distress (n = 2), and anxiety (n = 6) specifically about receiving a cancer diagnosis; and finally worry (n = 2) and fear (n = 8) about the screening procedure (see Table 1). When anticipatory anxiety regarding a possible diagnosis of cancer was measured, it was associated with a higher likelihood of cancer screening at least half of the time (50.1%), whereas general state or trait anxiety (not specific to cancer or screening) tended to share no relationship with cancer screening (65.4%). In seven of the nine cases where the relationship between worry or fear about the procedure itself and cancer screening was tested, negative relationships were reported. As shown in Table 1, in some cases (n = 7) the nature of the relationship between anxiety and screening was different, or only specified in a particular group of participants.

		Positive	Negative	Null	Group dependent	Total number of relationships <u>tested</u>
General		2 (8.0%)	2 (8.0%)	17 (68%)	4 (16%)	25
an	xiety	0	1	12	3	16
dis	tress	0	0	3	1	4
S	tress	1	1	2	0	4
W	orry	1	0	0	0	2
		33				
Diagnosis		(51.6%)	7 (10.9%)	21 (32.8%)	3 (4.7%)	64
an	xiety	3	1	0	2	6
dis	tress	0	0	2	0	2
	fear	3	2	7	0	12
W	orry	27	4	12	1	45
Procedure		0	8 (80.0%)	2 (20.0%)	0	10
	fear	0	7	1	0	8
W	orry	0	1	1	0	2

Table 1. S	Summary of re	lationships test	ed between a	nticipatory anx	tiety constructs and

screening.

Note that 'positive', 'negative', and 'null' refer to the number of studies for each direction of the relationship between anticipatory anxiety and cancer screening behaviour or intention. Table excludes results involving anticipatory anxiety of an unknown/multiple domains (*n*=4); percentages based on row totals

Thirteen studies reported on anticipatory anxiety as a barrier to cancer screening or intention, without empirically testing the relationship $^{28-40}$. The frequency at which fear of and worry about a cancer diagnosis, or the screening procedure itself were reported as a barrier or deterrent to cancer screening varied greatly across studies. However, in most of these studies (*n* = 9), these barriers were reported by between 10 - 50% of participants.

Table A.1 (see Appendix) summarises the extracted results data from each study arranged according to cancer type, screening procedure, outcome measure, anticipatory anxiety construct and domain and the nature of the finding.

Bowel Cancer

Thirty-one relationships between anticipatory anxiety constructs and screening behaviour (n = 14) and intentions (n = 17) were tested. Moreover, the prevalence of 13

anticipatory anxiety-related barriers to screening were reported across 20 studies focussed on screening for bowel cancer. These studies examined behaviour and intentions to undergo faecal occult blood test (FOBT; n = 5), colonoscopy (n = 4) sigmoidoscopy (n = 2); endoscopy (n = 1); or a combination of these testing procedures (n = 12).

Positive Relationships. Ten positive relationships between worry about (n = 8), or fear of (n = 2), cancer diagnosis and bowel cancer screening behaviour (n = 4) or intention (n = 6) were identified in the studies reviewed ^{41–45}. One USA study (n = 6,149 community members) showed that people with higher worry about cancer were more likely to undergo bowel cancer screening via colonoscopy or sigmoidoscopy, but not via FOBT ⁴¹. Another examined the association between fear of bowel cancer and stages of change readiness and showed that those who had never participated in, or considered participating in, bowel cancer screening had less fear of bowel cancer compared to those who had decided to screen ⁴⁶. In one study, general stress was positively associated with the intention to screen for bowel cancer ⁴³, while another study conducted with a USA community sample (n = 30,223) found a positive relationship between psychological distress and bowel cancer screening in individuals aged 40-49 years but not for participants over 50 (i.e., of eligible screening age) ⁴⁷.

Negative Relationships. Eleven negative relationships between anticipatory anxiety constructs and bowel cancer screening intention and behaviour were identified within the studies reviewed $^{25,43,48-54}$. All but one of the studies examining the worry or fear (n = 6) specific to the testing procedure showed that higher worry or fear was associated with reduced screening intentions and behaviour 25,43,48,50,52 . In one sample of 1,633 African Americans, findings were different when examining behaviour versus intentions. That is, while fear and worry about a cancer diagnosis were associated with lower likelihood of undertaking screening, they shared a null (worry) and positive (fear) relationship with screening intention 48 . In the same study, fear about undertaking colonoscopy was negatively associated with screening

behaviour, but not associated with intention. Of note, Wei et al. (2022) showed that the relationship between fear arousal around a cancer diagnosis and bowel cancer screening intention became statistically non-significant when variables such as risk and severity perception, response efficacy and cost variables were entered into the model ⁵³.

Fear specific to receiving a cancer diagnosis was reported as a reason for not participating in bowel cancer screening for 0 to 50.4% of participants across three studies ^{28,29,31}. For example, one Dutch study found that fear of bowel cancer diagnosis was the second most common barrier to screening, reported by 11% of those who declined an FOBT ³¹. In one urban USA study of 133 publicly insured women, worry about undergoing an endoscopy (28%) was the most common screening barrier, while only 10% reported worry as a barrier to completing an FOBT ³⁰.

Null findings. Seven of the relationships across five studies revealed no significant association between anxiety-related constructs and bowel screening intention and behaviour. This included four null findings regarding the relationship between worry about a cancer diagnosis and behaviour and intention ^{41,48,50,55}; two regarding the relationship between general anxiety and stress and screening intention ⁵⁶; and one regarding the relationship between fear of colonoscopy and intention to screen ⁴⁸.

Breast Cancer

Fifty relationships between anticipatory anxiety constructs and screening behaviour (n = 44) and intentions (n = 6) were tested, and the prevalence of two anticipatory anxiety-related barriers to screening were reported across 34 studies focussed on screening for breast cancer. These studies examined behaviour and intentions to undergo mammogram (n = 27), clinical breast exam (CBE) (n = 5), breast self-examination (BSE) (n = 5); or a combination of these testing procedures (n = 2).

Positive Relationships. Thirteen positive relationships between anticipatory anxiety constructs and breast cancer screening intention (n = 1) and behaviour (n = 12) were identified within the studies reviewed ^{41,46,57,58,58–66}. All these relationships reflected anxiety or worry specifically about a cancer diagnosis. In one case, a USA study (n = 233) found general trait anxiety was associated with a higher frequency of clinical breast examination for Hispanic women, but not for Caucasian, African American or American Indian women ⁶⁷. Furthermore, in one study of 748 Australian women, cancer anxiety was only related to excessive compared to recommended levels of BSE, but there was no difference in cancer anxiety between underscreened and appropriately screened groups for CBE and mammogram ⁵⁸.

One study classified 1,773 Korean women according to their level of intention to screen based on the Transtheoretical Model of Behaviour Change⁴⁶. They showed that worry about a breast cancer diagnosis was related to having undergone mammography within the last 24 months (i.e., action phase) compared to having never undergone mammography and not planning to do so ⁴⁶. Worry levels were not significantly different when comparing women in other stages of change. In two studies involving women with a family history of breast cancer in Australia (n = 748) and the USA (n = 1053), worry about breast cancer diagnosis was associated with excessive BSE ^{58,59}.

Negative relationships.

Eight negative relationships between anticipatory anxiety constructs and breast cancer screening intention (n = 2) and behaviour (n = 6) were identified within the studies reviewed ^{26,68–72}. In three of these relationships, it was not clear what the anticipatory anxiety pertained to. One study found that worry and fear reported by participants while reading a screening decision aid was associated with lower intentions to undergo mammography⁷¹, and another study measured anxiety or worry "about a mammogram", which was negatively associated with mammography adherence ⁷⁰. In the remaining five negative relationships, the anticipatory

anxiety construct reflected general stress or anxiety (n = 2), fear or worry (n = 2) specific to cancer diagnosis^{69,71,73}, and fear of diagnosis and procedure combined ²⁶. In terms of prevalence of barriers, only one small study measured this in breast cancer diagnosis reporting 26% of Italian women (n = 10) who intended to undergo screening perceived fear of a breast cancer diagnosis as a barrier to going through with it.³².

Null findings

Twenty-five null relationships between anticipatory anxiety and breast cancer screening were evident in the studies reviewed. Specifically, fear (n = 5), distress (n = 1), worry (n = 2) and anxiety (n = 2) about a cancer diagnosis were found to have no association with screening intention or behaviour in several studies ^{60,65,73–80}. Notably, multivariate analyses in two recent studies included potential confounders such as perceived risk and severity indicating indirect relationships between cancer worry and screening may exist ^{73,75}. In addition, another study reported that family history may be a moderator whereby women with a first-degree relative with breast cancer and high anxiety about breast cancer were less likely to have had a mammogram⁷⁹. Relationships tested regarding general anxiety (n = 8) and distress (n = 1) or stress (n = 1) were also shown to have no significant effect on breast cancer screening 27,47,58,60,63,63,64,81–84.

Cervical Cancer

Five relationships between anticipatory anxiety constructs and screening behaviour were tested and the prevalence of four anticipatory anxiety-related barriers to screening was reported across eight studies focussed on screening for cervical cancer ^{33,34,38,47,73,85–89}. These studies examined behaviour and intentions to undergo Pap smear, except for one study that did not specify the method of screening ³⁴.

Positive Relationships. Four studies that examined relationships between cancerspecific anxiety or worry and cervical cancer screening showed that women with higher levels

of worry were more likely to report screening ^{73,87–89}. In one study, it was cancer worry that mediated the positive relationship between perceived risk and undergoing a Pap test ⁸⁸ and another suggested that the relationship between worry about a cervical cancer and screening was mediated by factors such as perceived risk, severity, and self-efficacy ⁷³. One Australian study of 338 women found that higher anxiety about receiving a cancer diagnosis was related to a higher likelihood of undergoing screening ⁸⁷ and one study of Chinese women (n = 1000) found 6% of participants reported fear as reason for undergoing a Pap test ⁸⁹.

Negative Relationships. One negative relationship was identified between fear and nervousness and likelihood of undergoing a Pap test in a sample of 90 Ohio Appalachian women ⁸⁵. Women with a history of anxiety, adjustment disorder, or obsessive-compulsive disorder were less likely to participate in a self-sampling Pap test, although this relationship was no longer significant when sociodemographic characteristics were controlled for ⁸⁶. Fear of a cervical cancer diagnosis and of the testing procedure itself were reported as barriers to cervical cancer screening by up to 50% of participants in three studies of women in Uganda, Saudi Arabia and Malaysia ^{33,34,38}.

Null findings. Only one study examined the relationship between general distress and cervical cancer screening, finding no significant relationship between the two ⁴⁷.

Lung cancer

Two relationships were tested and the prevalence of two barriers were reported across four studies examining behaviour (n = 1) and intention to screen for lung cancer screening via a computerised tomography (CT) scan ^{35–37,90}.

Positive Relationship Only one survey study of outpatients with a smoking history (n = 283) demonstrated a positive association between high worry about lung cancer and intention to screen while adjusting for sociodemographic and health variables, however, this was only significant for those with a prior history of malignancy ⁹⁰.

Negative Relationship. No negative associations between anticipatory anxiety and lung cancer screening were identified. However, fear of diagnosis was reported by 10% to 49% of participants across two studies 35,37 with one study (n = 460) showing that non-Latino participants were significantly more like to report this screening barrier than Latino participants 35 . Another study found that 18% of participants reported being too worried about lung cancer to have a screening test³⁶.

Null findings. Only one study examined the relationship between fear of CT scan results and screening participation in participants with a personal history of other malignancy (non-lung cancer), finding no association ³⁷.

Ovarian Cancer

Two studies examined relationships between distress (n = 1) and worry (n = 2) about a cancer diagnosis and participation in ovarian cancer screening via a cancer antigen test or ultrasound ^{78,91}. Both studies reported a positive relationship between worry and screening participation. However, in one study of 216 women with a strong family history of breast or ovarian cancer, this relationship was no longer significant when perceived risk was controlled for ⁷⁸. This study also found no relationship between distress and screening.

Prostate Cancer

Eight relationships between anticipatory anxiety constructs and screening behaviour were tested across six studies focussed on screening for prostate cancer via a Prostate Specific Antigen (PSA) test ^{41,73,92–95}, one in combination with digital rectal examination (DRE)⁹⁴.

Positive relationships. One study found a positive relationship between worry specific to a cancer diagnosis and PSA participation in a sample of 208 African American men aged 40-74⁹².

Negative relationships. Generalised perceived stress was found to be negatively associated with PSA testing, controlling for demographic and psychological variables,

depression and anxiety, in a USA study of over 3,000 men aged between 57-85⁹³. Similarly, this study found a negative relationship between general health-related anxiety and PSA testing, but only in those who had visited their GP less than twice in the previous 12 months. Another study found a negative relationship between fear of the procedure (PSA or DRE) and screening intention in a sample of 389 men living in South Africa⁹⁴.

Null findings. No significant relationship between general health-related anxiety or cancer-specific worry and PSA testing was evident in one UK sample of first-degree male relatives of people with a prostate cancer diagnosis ⁹⁵. Two other studies showed no significant relationship between cancer-specific worry and PSA testing ^{41,73}.

Pancreatic cancer

Three relationships between fear (n = 1) and worry (n = 2) about a cancer diagnosis and undergoing a blood test (n = 1), endoscopic ultrasound (n = 1), and multiple screening procedures (n = 1) were tested across two studies. Both studies showed that higher worry or fear was associated with higher likelihood of screening behaviour ⁹⁶ and intention ⁹⁷.

Other (gastric, oesophageal, and oral cancer)

Two studies showed that people with higher levels of cancer worry were more willing to undergo a screening test for oesophageal and gastric cancer, respectively ^{39,98}. Another study reported that anxiety about being "checked" for oral cancer was negatively associated with screening intention, however, it was not clear if this anxiety was related to the results or the procedure ⁹⁹. In one study conducted in South Eastern China, nearly one quarter of people reported worry about screening results as a reason not to screen for gastric cancer ³⁹.

Discussion

This review highlighted the substantial variability in the way in which anticipatory anxiety is conceptualised and operationalised within the literature, including state and trait anxiety, worry, fear, stress, and distress. With some exceptions, most studies suggested that

anticipatory anxiety relating to a cancer diagnosis is associated with a higher likelihood of participating in screening and intention to screen. This pattern was evident across almost all cancer types included in the review. Conversely, anticipatory anxiety related to the screening procedure itself tended to have a negative effect on cancer screening participation. More general forms of state and trait anxiety, stress, or psychological distress did not appear to be associated with cancer screening.

The proportion of positive associations between cancer worry and screening in the current review was somewhat surprising given the tendency for anticipatory anxiety to lead to riskavoidance ¹⁰⁰. In interpreting this finding, it is important to consider potential confounding factors. In some of the reviewed studies, attitudinal ⁸⁰ and behavioural ⁹³ variables or actual cancer risk ^{79,90} interacted with anticipatory anxiety to increase or decrease cancer screening. For example, several studies in the current review showed either that worry mediated the relationship between perceived risk and screening, or that worry about a cancer diagnosis was not associated with screening when perceived risk was controlled for ^{53,73,75,78,88,89}. In interpreting this finding, it is important to consider potential confounding factors. According to evidence-based models of health behaviour such as the Health Belief Model and the Health Action Process Approach, perceived risk is an important factor motivating health behaviour ^{101,102}. Several studies in the current review showed either that worry mediated the relationship between perceived risk and screening, or that worry about a cancer diagnosis was not associated with screening when perceived risk was controlled for ^{53,73,75,78,88,89}. The complexities in examining cancer worry and its effect on cancer screening have long been a challenge identified in the literature ¹⁰³. Understanding the distinction between knowledge of risk (i.e., cognition), worry about cancer (i.e., emotion), and how each impact screening behaviour will be an important focus for future research aiming to maximise uptake of cancer screening.

It is also important to note that about one third of the studies reviewed demonstrated null relationships between these variables. In addition, the degree to which people reported that worry or fear of cancer or the screening procedure was a barrier to screening varied greatly across the literature (i.e., 0 - 87%) and the relationship between anticipatory anxiety and cancer screening was sometimes only apparent in specific population subgroups. For example, in some cases, the relationship between anticipatory anxiety and screening for breast or bowel cancer varied for Dominican, African American, and Hispanic participants as opposed to Caucasian Americans. Cultural differences in health behaviours including cancer screening have long been reported in the cancer prevention literature ^{104,105}. Although only a few studies in the review examined prostate cancer screening; however, unlike the other cancer types, 75% of the relationships between worry about a cancer diagnosis and prostate cancer screening were nonsignificant. Together, these findings highlight the need for future research into sociodemographic sub-groups and nuanced approaches to promoting cancer screening in different populations with varying attitudes towards disease and health, or access to and use of health care systems. Future research into the impact of cancer type, gender, culture, and other demographic and clinical factors on the relationship between anticipatory anxiety and cancer screening is needed to investigate this further.

Study Limitations

Some limitations are apparent in this review. Many studies reviewed were crosssectional in design, limiting the ability to determine causality, thus it is possible that anxiety levels may have been the result of screening intention or prior cancer screening. Most studies measured cancer screening behaviour via retrospective self-report in self-selected samples, meaning the accuracy of these measures may be impacted by memory and other self-report biases, and responses may be more likely to reflect the opinions of people with an interest in screening ¹⁰⁶. In addition, constructs such as anxiety, worry, and fear were not always clearly

defined or measured using psychometrically validated scales. Clear definitions and validated tools are recommended in future research to improve the quality and consistency of the literature on the topic. Longitudinal research and the use of verified medical records will help researchers draw more confident conclusions regarding causality in the future.

The search terms specified in this review targeted articles that included terms such as anticipation, await, perceived risk, expectation, and nervous. This strategy was in line with our working theory that anticipation or avoidance of threat might negatively impact decisions to screen for cancer. However, this approach likely led to several articles examining general trait anxiety not being included in the review. It is therefore important not to interpret results as a comprehensive review of general anxiety and cancer screening. One recent study not captured in the current review showed that in two large samples, sub-clinical levels of trait anxiety and psychological distress were positively associated with bowel cancer screening, but those reporting extreme symptoms were less likely to screen ¹⁷. Curvilinear relationships were not tested in any of the studies in the current review, however an inverted U effect might be a plausible model to describe the relationship between anxiety and cancer screening, as originally proposed by Hailey (1991) in relation to breast cancer screening¹¹⁰. This is supported by other recent research showing that people with extreme or pathological psychological distress may be less likely to participate in cancer screening ¹⁰⁸. A future review targeted specifically at the effects of general state and trait anxiety on cancer screening is warranted, as is original research investigating whether people with more severe mental health challenges may be at a higher risk of missing early-stage cancer.

Clinical Implications

Our review summarises the research to date relating to anticipatory anxiety and cancer screening. These findings are useful to guide clinicians when counselling patients about screening, and the development of public health campaigns focused on increasing awareness

and uptake of cancer screening among those less likely to engage in screening programs. For example, people experiencing higher anxiety or concern about screening may benefit from reassurance that screening procedures are generally safe and comfortable, while those who express little concern about cancer may be targeted through cancer risk messaging. At an individual level, health professionals counselling individuals about the need for cancer screening should consider an approach that acknowledges the appropriate risk of cancer, whilst also highlighting the screening test as a positive, health protective behaviour. Based on our findings regarding anxiety of the procedure itself forming a barrier to screening attendance, it will also be important for messaging (both at an individual and public health level) to reassure people of the ease, comfort, efficacy, and accuracy of the screening procedure.

Despite the proven effectiveness of population screening for breast, bowel, and cervical cancer, the benefits of screening for other cancers included in this review, such as ovarian or prostate cancer, are less clear. Studies focused on these cancers were included in the review as they provided useful data to inform our research question. It should be noted, however, that in some settings, screening for these cancers is not recommended due to increased risk of physical and mental harm outweighing the population-level benefits of early detection. For example, screening for ovarian cancer is not recommended in the absence of symptoms due to the harms from false-positive results and unnecessary surgeries ¹⁰⁹. Moreover, PSA testing for prostate cancer screening has been shown to result in high false positive rates and overdiagnosis of non-aggressive cancers ¹¹¹ leading to unnecessary treatment, harm, and healthcare costs.

Excessive self-screening was associated with high levels of cancer worry in two of the studies reviewed concerning women with a family history of breast cancer. These results point to the need for clinicians to educate those with familial cancer history about their level of cancer risk and screening behaviours to minimise risk, with an aim of reducing cancer worry to appropriate levels. Future research developing and testing interventions to support individuals

with a family cancer history (and related risk) in concurrently managing their uncertainty whilst also engaging in screening to appropriately manage their risk, will be important¹¹².

Conclusion

In summary, this review suggests that anticipatory anxiety related to a cancer diagnosis is often associated with a higher likelihood of participating in screening and intention to screen for various cancers. In contrast, anxiety related to the screening procedure tends to have a negative effect on cancer screening. These findings have clinical implications for healthcare providers in counselling patients about screening and developing targeted public health campaigns. However, researchers and clinicians alike should be aware of confounding factors and contextual differences, and future research should examine mediating and moderating factors more precisely.

Acknowledgements, Conflicts of Interest, Funding and Ethical Standards

The authors acknowledge the Psycho-oncology Co-operative Research Group (PoCoG) who supported the development of this research. The Psycho-oncology Co-operative Research Group is funded by Cancer Australia through their Support for Clinical Trials Funding Scheme. Ursula Sansom-Daly is supported by an Early Career Fellowship from the Cancer Institute of New South Wales (ID: 2020/ECF1163).

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. None of the authors have any conflicts of interest to declare.

The authors would also like to thank the following people for their contributions to this review: Mr Cruz Perez (for assisting with data extraction and collation of results), Nicole Perry

(for assisting with data extraction) and Isabella Rixon, Bianca Viljoen, Anna Stiller and Thamsanqa Musarira (for assisting with initial screening of search results).

Data Availability Statement

The data that support the findings of this review are presented in Supplementary

Material 3. Further inquiries can be directed to the corresponding author.

Author Contributions

The authors of this review made the following contributions:

Conceptualisation: AP, BG, HG, JS, LG, SI, USD

Conducted searches: KC, MR, SS

Screening for inclusion: BG, GKS, KC, LA, SI, SS

Data extraction and analysis: AK, AP, BG, GKS, HG, JS, JT, KC, LG, MJ, SS, USD

Drafted manuscript: BG, JS, JT, KC, LA, LG, USD

Revised manuscript: AK, AP, BG, GKS, HG, JS, JT, KC, KMC, LA, LG, MJ, MO, MR, SI,

SS, USD

References

- 1. Etzioni R, Urban N, Ramsey S, et al. The case for early detection. *Nat Rev Cancer*. 2003;3(4):243-252. doi:10.1038/nrc1041
- 2. Miles A, Cockburn J, Smith RA, Wardle J. A perspective from countries using organized screening programs. *Cancer*. 2004;101(S5):1201-1213. doi:10.1002/cncr.20505
- 3. Navarro M, Nicolas A, Ferrandez A, Lanas A. Colorectal cancer population screening programs worldwide in 2016: An update. *World J Gastroenterol*. 2017;23(20):3632.
- 4. Luo C, Wang L, Zhang Y, et al. Advances in breast cancer screening modalities and status of global screening programs. *Chronic Dis Transl Med.* 2022;8(2):112-123. doi:10.1002/cdt3.21
- 5. Bruni L, Serrano B, Roura E, et al. Cervical cancer screening programmes and agespecific coverage estimates for 202 countries and territories worldwide: a review and synthetic analysis. *Lancet Glob Health*. 2022;10(8):e1115-e1127. doi:10.1016/S2214-109X(22)00241-8
- 6. Goodwin BC, Myers L, Ireland MJ, et al. Barriers to Home Bowel Cancer Screening. *Psychooncology*. 2021;30(10):1756-1764.
- Bukowska-Durawa A, Luszczynska A. Cervical cancer screening and psychosocial barriers perceived by patients. A systematic review. *Contemp Oncol Onkol.* 2014;18(3):153-159. doi:10.5114/wo.2014.43158
- 8. Goodwin BC, March S, Crawford-Williams F, Chambers SK, Dunn J. "I'm not doing that." An in-depth examination of nonparticipation in mail-out bowel cancer screening programs. *Transl Behav Med*. 2020;10(6):1515-1524.
- 9. Hall NJ, Rubin GP, Dobson C, et al. Attitudes and beliefs of non-participants in a population-based screening programme for colorectal cancer. *Health Expect*. 2015;18(5):1645-1657.
- 10. Lim JNW, Ojo AA. Barriers to utilisation of cervical cancer screening in Sub Sahara Africa: a systematic review. *Eur J Cancer Care (Engl)*. 2017;26(1):e12444. doi:10.1111/ecc.12444
- 11. Clark LA, Watson D. Tripartite model of anxiety and depression: psychometric evidence and taxonomic implications. *J Abnorm Psychol*. 1991;100(3):316.
- 12. Behar E, Alcaine O, Zuellig AR, Borkovec TD. Screening for generalized anxiety disorder using the Penn State Worry Questionnaire: A receiver operating characteristic analysis. *J Behav Ther Exp Psychiatry*. 2003;34(1):25-43.
- Brosschot JF, Gerin W, Thayer JF. The perseverative cognition hypothesis: A review of worry, prolonged stress-related physiological activation, and health. *J Psychosom Res.* 2006;60(2):113-124. doi:10.1016/j.jpsychores.2005.06.074

- Jørgensen MD, Mikkelsen EM, Erichsen R, Thomsen MK. Mental illness and participation in colorectal cancer screening: a scoping review. *Scand J Gastroenterol*. Published online May 31, 2022:1-11. doi:10.1080/00365521.2022.2073185
- 15. Kisely S, Crowe E, Lawrence D. Cancer-Related Mortality in People With Mental Illness. *JAMA Psychiatry*. 2013;70(2):209-217. doi:10.1001/jamapsychiatry.2013.278
- 16. Moodi M, Rezaeian M, Mostafavi F, Sharifirad GR. Determinants of mammography screening behavior in Iranian women: A population-based study. *J Res Med Sci Off J Isfahan Univ Med Sci*. 2012;17(8):750-759.
- Anderson LE, Ireland MJ, Myers L, Avenell C, Connaughton, Goodwin BC. Psychological distress and bowel cancer screening participation. *Psychooncology*. Published online 2022. doi:10.1002/pon.6072
- 18. Austin LT, Ahmad F, McNally MJ, Stewart DE. Breast and cervical cancer screening in Hispanic women: a literature review using the health belief model. *Womens Health Issues*. 2002;12(3):122-128. doi:10.1016/S1049-3867(02)00132-9
- 19. Consedine NS, Magai C, Krivoshekova YS, Ryzewicz L, Neugut AI. Fear, Anxiety, Worry, and Breast Cancer Screening Behavior: A Critical Review. *Cancer Epidemiol Prev Biomark*. 2004;13(4):501-510.
- 20. Hay JL, McCaul KD, Magnan RE. Does worry about breast cancer predict screening behaviors? A meta-analysis of the prospective evidence. *Prev Med.* 2006;42(6):401-408. doi:10.1016/j.ypmed.2006.03.002
- 21. Chad-Friedman E, Coleman S, Traeger LN, et al. Psychological distress associated with cancer screening: A systematic review. *Cancer*. 2017;123(20):3882-3894. doi:10.1002/cncr.30904
- 22. Clarivate. EndNote | The best reference management tool. EndNote. Published 2023. Accessed June 15, 2023. https://endnote.com/
- 23. Veritas Health Innovation. Covidence systematic review software. Published online 2022. Accessed September 12, 2022. www.covidence.org.
- Joanna Briggs Institute. © Joanna Briggs Institute 2017 Critical Appraisal Checklist for Analytical Cross Sectional Studies. Published online 2020.
- Jibara G, Jandorf L, Fodera MB, DuHamel KN. Adherence to Physician Recommendation to Colorectal Cancer Screening Colonoscopy Among Hispanics. *J Gen Intern Med*. 2011;26(10):1124-1130. doi:10.1007/s11606-011-1727-4
- Castaldi M, Smiley A, Kechejian K, Butler J, Latifi R. Disparate access to breast cancer screening and treatment. *BMC Womens Health*. 2022;22(1):249. doi:10.1186/s12905-022-01793-z
- 27. Prathibha S, Westanmo AD, Hui JYC, et al. Breast Cancer and Women Veterans: What Is the Impact of Mental Health on Screening Rates? *Med Basel Switz*. 2022;10(1). doi:10.3390/medicines10010001

- 28. Davis SN, Christy SM, Chavarria EA, et al. A randomized controlled trial of a multicomponent, targeted, low-literacy educational intervention compared with a nontargeted intervention to boost colorectal cancer screening with fecal immunochemical testing in community clinics. *Cancer*. 2017;123(8):1390-1400. doi:10.1002/cncr.30481
- 29. Ojinnaka C, Vuong A, Helduser J, et al. Determinants of Variations in Self-reported Barriers to Colonoscopy Among Uninsured Patients in a Primary Care Setting. *J Community Health*. 2015;40(2):260-270. doi:10.1007/s10900-014-9925-8
- 30. Robinson CM, Cassells AN, Greene MA, Beach ML, Tobin JN, Dietrich AJ. Barriers to colorectal cancer screening among publicly insured urban women: no knowledge of tests and no clinician recommendation. *J Natl Med Assoc*. 2011;103(8):746-753. doi:10.1016/s0027-9684(15)30414-4
- 31. van Dam L, Korfage IJ, Kuipers EJ, et al. What influences the decision to participate in colorectal cancer screening with faecal occult blood testing and sigmoidoscopy? *Eur J Cancer Oxf Engl 1990.* 2013;49(10):2321-2330. doi:10.1016/j.ejca.2013.03.007
- 32. Gordon DR, Venturini A, Rosselli Del Turco M, Palli D, Paci E. What healthy women think, feel and do about cancer, prevention and breast cancer screening in Italy. *Eur J Cancer Clin Oncol*. 1991;27(7):913-917. doi:10.1016/0277-5379(91)90146-5
- Salem MR, Amin TT, Alhulaybi AA, Althafar AS, Abdelhai RA. Perceived Risk of Cervical Cancer and Barriers to Screening among Secondary School Female Teachers in Al Hassa, Saudi Arabia. *Asian Pac J Cancer Prev APJCP*. 2017;18(4):969-979. doi:10.22034/APJCP.2017.18.4.969
- 34. Wanyenze RK, Bwanika JB, Beyeza-Kashesya J, et al. Uptake and correlates of cervical cancer screening among HIV-infected women attending HIV care in Uganda. *Glob Health Action*. 2017;10(1):1380361. doi:10.1080/16549716.2017.1380361
- 35. Percac-Lima S, Ashburner JM, Atlas SJ, et al. Barriers to and Interest in Lung Cancer Screening Among Latino and Non-Latino Current and Former Smokers. *J Immigr Minor Health*. 2019;21(6):1313-1324. doi:10.1007/s10903-019-00860-2
- 36. Quaife SL, Marlow LAV, McEwen A, Janes SM, Wardle J. Attitudes towards lung cancer screening in socioeconomically deprived and heavy smoking communities: informing screening communication. *Health Expect*. 2017;20(4):563-573. doi:10.1111/hex.12481
- Raju S, Khawaja A, Han X, Wang X, Mazzone PJ. Lung Cancer Screening: Characteristics of Nonparticipants and Potential Screening Barriers. *Clin Lung Cancer*. 2020;21(5):e329-e336. doi:10.1016/j.cllc.2019.11.016
- 38. Prisha P, Tan KS, Lee CP. Malaysian Women's Viewpoint on HPV Screening and Vaccination: A Study on Barriers. *Vaccines*. 2023;11(1). doi:10.3390/vaccines11010139
- 39. Huang Z, Liu W, Marzo RR, Hu Z, Wong LP, Lin Y. High-risk population's knowledge of risk factors and warning symptoms and their intention toward gastric cancer screening in Southeastern China. *Front Public Health.* 2022;10:974923. doi:10.3389/fpubh.2022.974923

- 40. Gordon NP, Green BB. Factors associated with use and non-use of the Fecal Immunochemical Test (FIT) kit for Colorectal Cancer Screening in Response to a 2012 outreach screening program: a survey study. *BMC Public Health*. 2015;15:546. doi:10.1186/s12889-015-1908-x
- Moser RP, Mccaul K, Peters E, Nelson W, Marcus SE. Associations of Perceived Risk and Worry with Cancer Health-protective Actions: Data from the Health Information National Trends Survey (HINTS). *J Health Psychol*. 2007;12(1):53-65. doi:10.1177/1359105307071735
- 42. Vrinten C, Stoffel S, Dodd RH, Waller J, Lyratzopoulos Y, von Wagner C. Cancer worry frequency vs. intensity and self-reported colorectal cancer screening uptake: A population-based study. *J Med Screen*. 2019;26(4):169-178. doi:10.1177/0969141319842331
- 43. Wardle J, McCaffery K, Nadel M, Atkin W. Socioeconomic differences in cancer screening participation: comparing cognitive and psychosocial explanations. *Soc Sci Med*. 2004;59(2):249-261. doi:10.1016/j.socscimed.2003.10.030
- 44. Sach TH, Whynes DK. Men and women: beliefs about cancer and about screening. *BMC Public Health*. 2009;9(1):431. doi:10.1186/1471-2458-9-431
- 45. Ferrer RA, Hall KL, Portnoy DB, Ling BS, Han PKJ, Klein WMP. Relationships among health perceptions vary depending on stage of readiness for colorectal cancer screening. *Health Psychol.* 2011;30:525-535. doi:10.1037/a0023583
- Choi E, Lee YY, Yoon HJ, et al. Relationship between Cancer Worry and Stages of Adoption for Breast Cancer Screening among Korean Women. *PLOS ONE*. 2015;10(7):e0132351. doi:10.1371/journal.pone.0132351
- 47. Honda K, Goodwin RD, Neugut AI. The associations between psychological distress and cancer prevention practices. *Cancer Detect Prev.* 2005;29(1):25-36. doi:10.1016/j.cdp.2004.08.004
- Klasko-Foster LB, Jandorf LM, Erwin DO, Kiviniemi MT. Predicting Colonoscopy Screening Behavior and Future Screening Intentions for African Americans Older than 50 Years. *Behav Med.* 2019;45(3):221-230. doi:10.1080/08964289.2018.1510365
- 49. Choi E, Lee YY, Suh M, et al. Associations of perceived risk and cancer worry for colorectal cancer with screening behaviour. *J Health Psychol*. 2018;23(6):840-852. doi:10.1177/1359105316679721
- 50. Jimbo M, Sen A, Plegue MA, et al. Correlates of Patient Intent and Preference on Colorectal Cancer Screening. *Am J Prev Med.* 2017;52(4):443-450. doi:10.1016/j.amepre.2016.11.026
- Sun WY, Basch CE, Wolf RL, Li XJ. Factors associated with colorectal cancer screening among Chinese-Americans. *Prev Med*. 2004;39(2):323-329. doi:10.1016/j.ypmed.2004.04.029
- 52. Bynum SA, Davis JL, Green BL, Katz RV. Unwillingness to Participate in Colorectal Cancer Screening: Examining Fears, Attitudes, and Medical Mistrust in an Ethnically Diverse Sample of Adults 50 Years and Older. doi:10.4278/ajhp.110113-QUAN-20

- 53. Wei W, Zhang M, Zuo D, et al. Screening Intention Prediction of Colorectal Cancer among Urban Chinese Based on the Protection Motivation Theory. *Int J Environ Res Public Health*. 2022;19(7). doi:10.3390/ijerph19074203
- 54. Watts BG, Vernon SW, Myers RE, Tilley BC. Intention to be Screened Over Time for Colorectal Cancer in Male Automotive Workers. Published online 2003.
- 55. Llanos AA, Pennell ML, Young GS, Tatum CM, Katz ML, Paskett ED. No association between colorectal cancer worry and screening uptake in Appalachian Ohio. *J Public Health*. 2015;37(2):322-327. doi:10.1093/pubmed/fdu031
- 56. Rogers CR, Robinson CD, Arroyo C, Obidike OJ, Sewali B, Okuyemi KS. Colorectal Cancer Screening Uptake's Association With Psychosocial and Sociodemographic Factors Among Homeless Blacks and Whites. Published 2017. Accessed February 21, 2023. https://journals-sagepubcom.ezproxy.library.ug.edu.au/doi/full/10.1177/1090198117734284
- 57. Antill YC, Reynolds J, Young MA, et al. Screening behavior in women at increased familial risk for breast cancer. *Fam Cancer*. 2006;5(4):359-368. doi:10.1007/s10689-006-0006-8
- 58. Price MA, Butow PN, Charles M, et al. Predictors of breast cancer screening behavior in women with a strong family history of the disease. *Breast Cancer Res Treat*. 2010;124(2):509-519.
- 59. Epstein SA, Hsiang Lin T, Audrain J, Stefanek M, Rimer B, Lerman C. Excessive Breast Self-Examination Among First-Degree Relatives of Newly Diagnosed Breast Cancer Patients. *Psychosomatics*. 1997;38(3):253-261. doi:10.1016/S0033-3182(97)71462-2
- 60. Aro AR, de Koning HJ, Absetz P, Schreck M. Psychosocial predictors of first attendance for organised mammography screening. *J Med Screen*. 1999;6(2):82-88. doi:10.1136/jms.6.2.82
- 61. Hersch J, McGeechan K, Barratt A, et al. How information about overdetection changes breast cancer screening decisions: a mediation analysis within a randomised controlled trial. *BMJ Open*. 2017;7(10):e016246. doi:10.1136/bmjopen-2017-016246
- 62. Tran ATN, Hwang JH, Choi E, et al. Impact of Awareness of Breast Density on Perceived Risk, Worry, and Intentions for Future Breast Cancer Screening among Korean Women. *Cancer Res Treat.* 2021;53(1):55-64. doi:10.4143/crt.2020.495
- 63. Bowen DJ, Helmes A, Powers D, Andersen MR, al et. Predicting breast cancer screening intentions and behavior with emotion and cognition. *J Soc Clin Psychol*. 2003;22(2):213. doi:10.1521/jscp.22.2.213.22875
- 64. Diefenbach MA, Miller SM, Daly MB. Specific worry about breast cancer predicts mammography use in women at risk for breast and ovarian cancer. *Health Psychol*. 1999;18(5):532-536. doi:10.1037/0278-6133.18.5.532
- 65. Kudadjie-Gyamfi E, Consedine N, Magai C, Gillespie M, Pierre-Louis J. Breast selfexamination practices among women from six ethnic groups and the influence of cancer worry. *Breast Cancer Res Treat*. 2005;92(1):35-45. doi:10.1007/s10549-005-0154-9

- 66. Williams-Piehota P, Schneider TR, Pizarro J, Mowad L, Salovey P. Matching Health Messages to Information-Processing Styles: Need for Cognition and Mammography Utilization. *Health Commun.* 2003;15(4):375-392. doi:10.1207/S15327027HC1504_01
- 67. Foxall MJ, Barron CR, Houfek JF. Ethnic Influences on Body Awareness, Trait Anxiety, Perceived Risk, and Breast and Gynecologic Cancer Screening Practices. Published 2001. Accessed June 15, 2023. https://web.p.ebscohost.com/abstract?direct=true&profile=ehost&scope=site&authtype=cr awler&jrnl=0190535X&AN=9521935&h=pc3Xh3DS1oS0O1%2f%2bvGNzhMuJTvstrg 01iDDCwSvhamPjCbTFucISGPf2rolnUqZxe7GEh5SrxB50Aou9985ohQ%3d%3d&crl=c &resultNs=AdminWebAuth&resultLocal=ErrCrlNotAuth&crlhashurl=login.aspx%3fdire ct%3dtrue%26profile%3dehost%26scope%3dsite%26authtype%3dcrawler%26jrnl%3d01 90535X%26AN%3d9521935
- 68. Jensen LF, Pedersen AF, Andersen B, Vestergaard M, Vedsted P. Non-participation in breast cancer screening for women with chronic diseases and multimorbidity: a population-based cohort study. *BMC Cancer*. 2015;15(1):1-10.
- 69. Kash KM, Holland JC, Halper MS, Miller DG. Psychological Distress and Surveillance Behaviors of Women With a Family History of Breast Cancer. *JNCI J Natl Cancer Inst.* 1992;84(1):24-30. doi:10.1093/jnci/84.1.24
- Lerman C, Rimer B, Trock B, Balshem A, Engstrom PF. Factors associated with repeat adherence to breast cancer screening. *Prev Med.* 1990;19(3):279-290. doi:10.1016/0091-7435(90)90028-I
- Seitz HH, Schapira MM, Gibson LA, et al. Explaining the effects of a decision intervention on mammography intentions: The roles of worry, fear and perceived susceptibility to breast cancer. *Psychol Health*. 2018;33(5):682-700. doi:10.1080/08870446.2017.1387261
- Young RF, Waller JB, Smitherman H. A breast cancer education and on-site screening intervention for unscreened African American women. *J Cancer Educ*. 2002;17(4):231-236.
- 73. Zhuang J, Guan M. Modeling the Mediating and Moderating Roles of Risk Perceptions, Efficacy, Desired Uncertainty, and Worry in Information Seeking-Cancer Screening Relationship Using HINTS 2017 Data. *Health Commun.* 2022;37(7):897-908. doi:10.1080/10410236.2021.1876324
- 74. Ahmed N, Fort J, Malin A, Hargreaves M. Barriers to mammography screening in a managed care population. *Public Adm Manag.* 2009;14.
- 75. López-Panisello MB, Pérez-Lacasta MJ, Rué M, Carles-Lavila M. Factors influencing intention to participate in breast cancer screening. An exploratory structural model. *PloS One*. 2023;18(2):e0281454. doi:10.1371/journal.pone.0281454
- 76. Flores-Luevano S, Shokar NK, Dwiveldi AK, Shokar GS, Defeu SN. Breast Cancer Fear Among Mexican American Women in the United States. Published 2020. Accessed June 15, 2023. https://journals.sagepub.com/doi/full/10.1177/1178223420952745

- 77. Graves KD, Huerta E, Cullen J, et al. Perceived Risk of Breast Cancer among Latinas Attending Community Clinics: Risk Comprehension and Relationship with Mammography Adherence. *Cancer Causes Control.* 2008;19(10):1373-1382.
- 78. Isaacs C, Peshkin BN, Schwartz M, DeMarco TA, al et. Breast and ovarian cancer screening practices in healthy women with a strong family history of breast or ovarian cancer. *Breast Cancer Res Treat*. 2002;71(2):103-112.
- 79. B. Jo Hailey CLC Darla R Burnett. Breast Cancer Attitudes, Knowledge, and Screening Behavior in Women with and Without a Family History of Breast Cancer. *Health Care Women Int.* 2000;21(8):701-715. doi:10.1080/073993300300340529
- 80. Miller SJ, O'Hea EL, Lerner JB, Moon S, Foran-Tuller KA. The Relationship between Breast Cancer Anxiety and Mammography: Experiential Avoidance as a Moderator. *Behav Med.* 2011;37(4):113-118. doi:10.1080/08964289.2011.614291
- 81. Sutton S, Bickler G, Sancho-Aldridge J, Saidi G. Prospective study of predictors of attendance for breast screening in inner London. *J Epidemiol Community Health*. 1994;48(1):65-73. doi:10.1136/jech.48.1.65
- 82. Sutton S, Saidi G, Bickler G, Hunter J. Does Routine Screening for Breast Cancer Raise Anxiety? Results from a Three Wave Prospective Study in England. *J Epidemiol Community Health 1979-*. 1995;49(4):413-418.
- 83. Walker LG, Cordiner CM, Gilbert FJ, et al. How distressing is attendance for routine breast screening? Published 1994. Accessed June 15, 2023. https://onlinelibrary-wiley-com.ezproxy.library.uq.edu.au/doi/abs/10.1002/pon.2960030406
- Perez LG, Elder JP, Haughton J, Martinez ME, Arredondo EM. Socio-demographic Moderators of Associations Between Psychological Factors and Latinas' Breast Cancer Screening Behaviors. *J Immigr Minor Health*. 2018;20(4):823-830. doi:10.1007/s10903-017-0633-1
- Krok-Schoen JL, Oliveri JM, Young GS, Katz ML, Tatum CM, Paskett ED. Evaluating the stage of change model to a cervical cancer screening intervention among Ohio Appalachian women. *Women Health*. 2016;56(4):468-486. doi:10.1080/03630242.2015.1101736
- Harder E, Thomsen LT, Hertzum-Larsen R, et al. Determinants for Participation in Human Papillomavirus Self-Sampling among Nonattenders to Cervical Cancer Screening in Denmark. *Cancer Epidemiol Biomarkers Prev.* 2018;27(11):1342-1351. doi:10.1158/1055-9965.EPI-18-0480
- 87. Brown RF, Muller TR, Olsen A. Australian women's cervical cancer screening attendance as a function of screening barriers and facilitators. *Soc Sci Med.* 2019;220:396-402. doi:10.1016/j.socscimed.2018.11.038
- Zhao X, Nan X. The Influence of Absolute and Comparative Risk Perceptions on Cervical Cancer Screening and the Mediating Role of Cancer Worry. *J Health Commun*. 2016;21(1):100-108. doi:10.1080/10810730.2015.1033114

- 89. Wong AOY, Ho KS, Chan WM. Factors affecting participation in cervical cancer screening among elderly Chinese women. *Hong Kong Pract.* 2005;27(6):223-229.
- 90. See K, Manser R, Park ER, et al. The impact of perceived risk, screening eligibility and worry on preference for lung cancer screening: a cross-sectional survey. *ERJ Open Res*. 2020;6(1). doi:10.1183/23120541.00158-2019
- Andersen MR, Peacock S, Nelson J, et al. Worry about Ovarian Cancer Risk and Use of Ovarian Cancer Screening by Women at Risk for Ovarian Cancer. *Gynecol Oncol.* 2002;85(1):3-8. doi:10.1006/gyno.2001.6556
- 92. Bloom JR, Stewart SL, Oakley-Girvans I, Banks PJ, Chang S. Family History, Perceived Risk, and Prostate Cancer Screening among African American Men. *Cancer Epidemiol Biomarkers Prev.* 2006;15(11):2167-2173. doi:10.1158/1055-9965.EPI-05-0738
- 93. Kotwal AA, Schumm P, Mohile SG, Dale W. The Influence of Stress, Depression, and Anxiety on PSA Screening Rates in a Nationally Representative Sample on JSTOR. Published 2012. Accessed June 15, 2023. https://www-jstororg.ezproxy.library.uq.edu.au/stable/41714630?sid=primo
- 94. Benedict MOA, Steinberg WJ, Claassen FM, Mofolo N, van Rooyen C. Knowledge, beliefs and intentions of African men in the Free State about prostate cancer screening. *Health SA SA Gesondheid*. 2022;27:2081. doi:10.4102/hsag.v27i0.2081
- 95. Sweetman J, Watson M, Norman A, et al. Feasibility of familial PSA screening: psychosocial issues and screening adherence. Published 2006. Accessed June 15, 2023. https://www-nature-com.ezproxy.library.uq.edu.au/articles/6602959
- 96. Franke FS, Matthäi E, Slater EP, Schicker C, Kruse J, Bartsch DK. German National Case Collection for familial pancreatic Cancer (FaPaCa) - acceptance and psychological aspects of a pancreatic cancer screening program. *Hered Cancer Clin Pract*. 2018;16(1):17. doi:10.1186/s13053-018-0100-6
- 97. Breitkopf CR, Sinicrope PS, Rabe KG, et al. Factors influencing receptivity to future screening options for pancreatic cancer in those with and without pancreatic cancer family history. *Hered Cancer Clin Pract*. 2012;10(1):8. doi:10.1186/1897-4287-10-8
- 98. Peters Y, van Grinsven E, van de Haterd M, van Lankveld D, Verbakel J, Siersema PD. Individuals' Preferences for Esophageal Cancer Screening: A Discrete Choice Experiment. *Value Health.* 2020;23(8):1087-1095. doi:10.1016/j.jval.2020.03.013
- 99. Humphris GM, Ireland RS, Field EA. Randomised trial of the psychological effect of information about oral cancer in primary care settings. *Oral Oncol.* 2001;37(7):548-552. doi:10.1016/S1368-8375(01)00017-3
- 100. Maner JK, Schmidt NB. The Role of Risk Avoidance in Anxiety. *Behav Ther*. 2006;37(2):181-189. doi:10.1016/j.beth.2005.11.003
- 101. Schwarzer R, Luszczynska A. How to overcome health-compromising behaviors: The health action process approach. Published 2008. Accessed January 11, 2023. https://psycnet-apa-org.ezproxy.library.uq.edu.au/fulltext/2008-06444-006.html

- 102. Rosenstock IM. The health belief model: Explaining health behavior through expectancies. In: *Health Behavior and Health Education: Theory, Research, and Practice*. The Jossey-Bass health series. Jossey-Bass/Wiley; 1990:39-62.
- 103. Hay JL, Buckley TR, Ostroff JS. The role of cancer worry in cancer screening: A theoretical and empirical review of the literature. *Psychooncology*. 2005;14(7):517-534. doi:10.1002/pon.864
- 104. Flynn PM, Betancourt H, Ormseth SR. Culture, Emotion, and Cancer Screening: an Integrative Framework for Investigating Health Behavior. Ann Behav Med. 2011;42(1):79-90. doi:10.1007/s12160-011-9267-z
- 105. Facione NC, Katapodi M. Culture as an influence on breast cancer screening and early detection. *Semin Oncol Nurs*. 2000;16(3):238-247. doi:10.1053/sonc.2000.8118
- 106. Smith LH. Selection Mechanisms and Their Consequences: Understanding and Addressing Selection Bias. *Curr Epidemiol Rep.* 2020;7(4):179-189. doi:10.1007/s40471-020-00241-6
- 107. Hailey BJ. Family history of breast cancer and screening behavior: An inverted U-shaped curve? *Med Hypotheses*. 1991;36(4):397-403. doi:10.1016/0306-9877(91)90019-U
- 108. Kirkøen B, Berstad P, Hoff G, et al. Type and Severity of Mental Illness and Participation in Colorectal Cancer Screening. Am J Prev Med. 2023;64(1):76-85. doi:10.1016/j.amepre.2022.08.011
- 109. US Preventative Services Taskforce. Screening for Ovarian Cancer: US Preventive Services Task Force Recommendation Statement | Cancer Screening, Prevention, Control | JAMA | JAMA Network. Published 2018. Accessed June 16, 2023. https://jamanetwork.com/journals/jama/article-abstract/2672638
- 110. Duffy MJ. Chapter One PSA in Screening for Prostate Cancer: More Good than Harm or More Harm than Good? In: Makowski GS, ed. *Advances in Clinical Chemistry*. Vol 66. Elsevier; 2014:1-23. doi:10.1016/B978-0-12-801401-1.00001-3
- 111. Chou R, Croswell JM, Dana T, et al. Screening for prostate cancer: a review of the evidence for the US Preventive Services Task Force. Ann Intern Med. 2011;155(11):762-771.
- 112. Dean M, Davidson LG. Previvors' Uncertainty Management Strategies for Hereditary Breast and Ovarian Cancer. *Health Commun.* 2018;33(2):122-130. doi:10.1080/10410236.2016.1250187

Figure 1. PRISMA Flow Chart

