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Understanding the mechanisms underlying the socioeconomic disparities in cancer screening among Australian women

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Abstract

Background Little is known about individual, as opposed to area-level, variance in socioeconomic status (SES) and how this impacts screening participation. This study explores potential mechanisms underlying the relationship between SES and cancer screening amongst women eligible for breast, cervical, and bowel cancer screening.

Methods Australian women aged 50–74 years ($N=874$) took part in an online survey examining participants' health and cancer screening behaviours. Relationships between individual and area-level SES, cancer screening participation, stress, general self-efficacy, and screening literacy were examined using structural equation modelling. Frequency of cancer screening barriers were calculated for each cancer type and compared for SES categories.

Results The structural equation model including stress and screening literacy as mediators yielded excellent fit, $\chi^2(26)=33.322$, $p=.153$, TLI = 0.992. Lower individual level SES was associated with higher stress and lower screening literacy. Higher stress was related to lower screening participation in all three programs, and lower screening literacy was associated with low cervical and breast cancer screening. The only significant relationship between area-level SES and screening participation was with participation in cervical screening. All indirect effects between area level SES and screening were non-significant. The types of barriers reported for each cancer screening type were similar between high and low socioeconomic individuals. In all three screening programs, intending to participate in cancer screening but not getting around to it, and not liking the screening method were commonly reported reasons for non-participation.

Conclusions This study is the first to investigate the effects of individual level SES on cancer screening in Australia and one of the few studies to examine underlying mechanisms simultaneously across various screening programs. Reducing stress and improving screening literacy may help to improve cancer screening participation among low SES individuals. Our results also suggest that tailoring interventions to the SES background of women may not enhance their effectiveness. Interventions aiming to reduce the SES screening disparities may achieve more success through addressing underlying mechanisms as opposed to the behavioural barriers themselves.

Keywords Cancer Screening, Women's Health, Bowel Cancer, Breast Cancer, Cervical Cancer, Social determinants of Health

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Background

Compared to those living in high socioeconomic areas, those living in low socioeconomic areas have a 5% higher cancer incidence rate and a 40% higher risk of cancer related death [1]. Despite improvements in cancer control over recent decades, research is urgently needed to understand and reduce socioeconomic disparities in cancer outcomes [2].

Screening for breast, cervical, and bowel cancer is one of the most effective means to reduce the incidence of late-stage disease and improve survival rates [3]. However, participation rates in Australia's three national cancer screening programs—BreastScreen Australia, the National Cervical Screening Program, and the National Bowel Cancer Screening Program—are sub-optimal, ranging from 43.5 to 68.4% [4–6]. Participation rates are even lower for those living in low socioeconomic areas. For example, in the cervical screening program the participation rate is 9% lower in low socioeconomic areas compared to high socioeconomic areas (i.e., most deprived quintile compared to the least deprived quintile) [6].

Socioeconomic status (SES) is typically a composite measure reflected by multiple indicators including education, income, and occupation intended to represent the economic and social standing [7]. In Australia, SES is commonly measured and studied at the area-level (i.e., based on an aggregated profile of all residence within a given geographical-location). Research in cancer screening based on area-level SES provides important insights into the inequity of cancer screening participation but provides little understanding of the individual-level mechanisms that may explain this disparity. This knowledge is vital to inform targeted behaviour change strategies to reduce socioeconomic inequity in screening participation (e.g., Wardle et al., 2016, [8]).

The Social Ecological Model supports the notion that individual psychosocial factors, interact with broader socio-economic and environmental influences to affect health behaviours and outcomes [9]. Psychological factors such as stress, self-efficacy, health literacy, screening beliefs, and perception of barriers often influence cancer screening behaviours [10–14]. For instance, a persons' perceived experience with stressful situations (i.e., perceived stress; [15]), beliefs regarding their ability to cope or perform whilst experiencing adversity (i.e., general self-efficacy; [16]), and ones' knowledge regarding cancer screening (i.e., screening literacy; [17]) are likely to impact an individual's decision to participate in cancer screening programs. These individual factors can also vary according to SES, with people from low SES backgrounds tending to have lower health literacy and higher levels of stress compared to their high SES counterparts [10]. It has also been shown that people with higher SES tend to exhibit higher levels of self-efficacy [11]. It may be that people living with socioeconomic disadvantage experience more stress and may be more prone to certain screening barriers, while also having poorer self-efficacy and understanding of cancer screening. With all these factors together making them less likely to participate in cancer screening. To date, such examinations have yet to be conducted in the Australian context.

Aims

This study aimed to explore the relationship between SES and screening participation and gain a deeper understanding of the factors that drive the SES disparities in cancer screening participation in a sample of Australians eligible for all three national screening programs (i.e., amongst women aged 50–74 years). Specifically, this study aimed to estimate the relationship between area-level and individual-level measures of SES and cancer screening participation, assess if reported reasons for non-participation in cancer screening differs across high and low SES groups, and test if self-efficacy, stress, and screening literacy mediate the relationship between area and individual level measures of SES and cancer screening participation.

Materials and methods

Recruitment and Procedure

Participants were recruited through Facebook advertising as part of a wider survey study assessing cancer screening and health behaviours, conducted between the 19th of May 2022 and 16th of June 2023. Digital and physical flyers containing a QR code and weblink to the online survey were also distributed in local community groups (e.g., sporting clubs and shopping centres). Only women aged 50–74 years, who had access to the internet and were able to read English were included in the present study. The survey was hosted via the Qualtrics survey website [18] and took approximately 10-minutes to complete. Participants were provided with an information sheet and gave consent before answering questions about their health and cancer screening behaviours. After completing the survey, participants were invited to enter a draw to win one of eight $50 grocery vouchers. Data from other sections of the survey are published in a separate study [19]. Ethical approval for this study was granted by the Human Research Ethics Committee at the University of Southern Queensland (ref. H22REA090).

Measures

Cancer screening. Participants were asked to report their current cancer screening status through three questions (with yes/no responses): (a) "*Have you had a mammogram for breast cancer screening in the last 2 years?*", (b) "*Have you had a cervical screening test done in the*

last 5 years?", and (c) "*Have you completed a faecal occult blood test (FOBT) in the last two years?*". Intervals were based on the recommended screening frequency of each program.

Individual level SES. This study used a previously established measure of individual level SES [14, 20] where participants were asked if they had attended university (1=no, 0=yes), their current housing tenure status (1=renting, 0=owning), and whether they owned a car (1=no, 0=one or more cars). These indicators of deprivation were summed to make a composite SES score ranging from 0 to 3 with higher scores indicating lower SES [14]. Consistent with the observations of Lo et al. [14], only a small percentage of people (i.e., 3%) endorsed all three indicators of deprivation (see Table 1), as such people reporting two or three indictors of deprivation were collapsed into one category for the structural equation modelling. To make comparisons of barriers reported between high and low SES individuals, those who reported no indicators of deprivation were categorised as high SES and the remaining categorised as low SES. These lead to the most equal balance between those two categories (see Table 1).

Table 1 *Sample demographics*

Demographic	Percent	(*n*)	Australian Population
Screening Participation[a]			
Breast	77.5%	(652)	50.0%
Cervical	65.0%	(546)	61.0%
Bowel	55.1%	(463)	43.0%
Individual Level SES			
0	40.8%	(270)	-
1	43.2%	(286)	-
2	12.9%	(86)	-
3	3.0%	(20)	-
Area Level SES (IRSD[b])			
1 – Most Disadvantaged	20.8%	(137)	16.8%
2	18.7%	(123)	17.2%
3	23.7%	(156)	20.7%
4	18.8%	(124)	20.5%
5 – Least Disadvantaged	18.1%	(119)	24.8%
Remoteness Level[b, c]			
Major City	53.7%	(354)	72.2%
Inner Regional	32.5%	(214)	17.8%
Outer Regional/Remote	13.7%	(83.21)	10.0%
Born in Australia[c]			
Yes	75.1%	(500)	71.0%
No	24.9%	(166)	29.0%
Aboriginal and Torres Strait Islander Status[d]			
Yes	2.1%	(14)	3.80%
No	97.9%	(651)	96.2%

Note. a=Population participation rates sourced from each screening program's respective monitoring report and is referenced for women aged 50–74 years (4, 5, 22). Due to lack of available data, all other population statistics are in reference to the entire population. b=both Socioeconomic Indexes for Areas (SEFIA; based on the Index of Relative Socioeconomic Disadvantage) and remoteness level are on based postcode and the Australian Bureau of Statistics 2016 geography standards (21). c=Remoteness population statistics sourced from Australian Institute of Health and Welfare (31). d=Population statistics Aboriginal and Torres Strait Islander status population data sourced from the Australian Bureau of Statistics (32)

Area level SES. Area level SES was based on self-reported postcode. Postcodes were converted to *Index of Retaliative Socioeconomic Disadvantage* percentiles based on the Australian Bureau of Statistics 2016 geography standards [21]. Percentiles were then converted to quintiles (1=most disadvantaged to 5=least disadvantaged) to reflect typical SES reporting in screening research [4, 5, 22].

In the current sample, the individual measure of SES showed convergent validity with the MacArthur measure of individual subjective SES, $r=-.42$, $p<.001$ [23]. There was also a small, but significant relationship with the area level measure of SES, $r=-.10$, $p=.007$. These results support the notion that area level and individual levels SES are related yet distinct constructs.

Reasons for non-participation. Participants were asked to identify reasons that prevented them from participating in cancer screening from a nine-item checklist derived from Lo and colleagues allowing participants to check multiple reasons as relevant [14]. For example, *"I'd rather not know if I had [bowel/breast/cervical] cancer."* An open text box was also provided for participants to specify other reasons for non-participation. Survey participants who selected multiple reasons were asked what their main reason for not participating in screening was. Participants main or only reason for non-participation were used in the analysis. See Supplementary File 1 for a description of these reasons and how they were coded.

Perceived Stress. Individual stress levels were measured using the "Short Form Perceived Stress Scale" (PSS) [15]. This is a validated and widely used 4-item scale for which participants are asked to respond to questions (e.g., "*in the last 5 years, how often have you felt that things were going your way?*") on a 5-point scale (0 = "never" to 4 = "very often"). Higher scores indicate higher levels of stress, and internal reliability was $\Omega=0.76$ in this sample.

General Self-Efficacy. Individual levels of self-efficacy were measured using the "General Self-Efficacy Scale" (GSE) [16]. This 10-item scale asks people to rate the degree to which statements are true on a 4-point scale (1 = "not at all true" to 4 = "exactly true", for example "*I can always handle whatever comes my way*"). Higher scores indicate higher levels of general self-efficacy. In this sample, the internal reliability of this measure was high $\Omega=0.90$.

Screening literacy. Five items were used to measure cancer screening literacy, adapted from five misconceptions regarding cancer screening reported by Denberg

[17]. Participants were asked to respond to statements such as "*Screening for cancer is only necessary if you have symptoms or a family history of cancer*", with response options of '*True*', '*False*', and '*I don't know*'. A total score of correct responses (with '*I don't know*' being scored as incorrect) was calculated for each participant. Higher scores indicate higher screening literacy.

Statistical analysis

Data cleaning, plotting, and analysis were all conducted using the R statistical program with the 'dplyr', 'lavaan', 'ggplot', and 'semTools' packages [24–28]. Open-text reasons for non-participation were dual coded using deductive content analysis by four independent researchers. As unique reasons were identified from responses, a new code was formed, and remaining responses were coded into existing codes. The percentage agreement between coders and Kappa interrater reliability statistic were calculated. Disagreements were resolved through discussion. Similar reasons were collapsed together to form broader groups, for example, "I don't like the idea of having the mammography" and "I've had a bad experience with breast cancer screening in the past" were combined into "I don't like getting mammograms" (see Supplementary File 1 for more details on the coding process including the codebook). After all responses were coded, the frequency and percent (i.e., the frequency of each reason divided by the number of participants responding for each screening modality) of each reason were calculated.

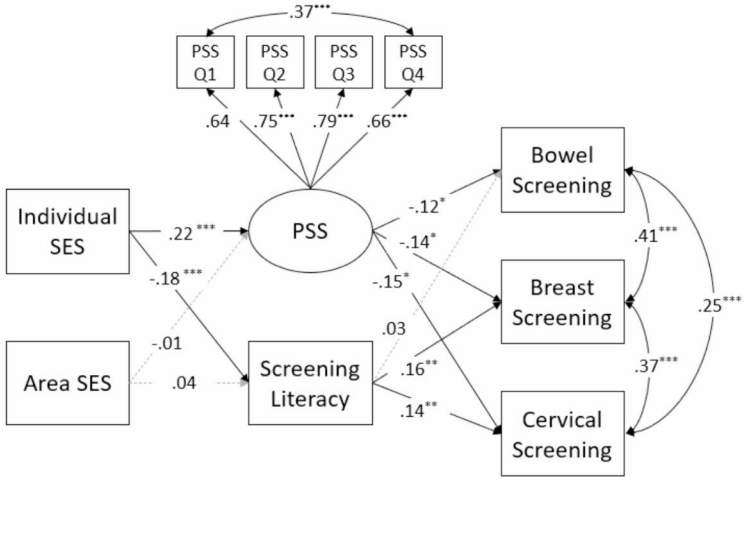
Structural equation modelling (SEM) was used to assess if the relationship between SES (both area level and individual level) and cancer screening participation is mediated by PSS, screening literacy, and/or GSE (see Fig. 1). A full description of the SEM analysis procedure can be found in supplementary file 2. In short, only variables significantly related to at least one cancer screening outcome were included in the model. Model fit was assessed with traditional cut-off statistics: Tucker-Lewis Index (TLI) > 0.95, standardised root mean squared residual (SRMR) < 0.08, and root mean squared error of approximation (RMSEA) < 0.06 [29], . The SEM was estimated using bootstrapped diagonally weighted least squared (DWLS) and 95% bootstrapped percentile confidence intervals were calculated for indirect effects. Reliability of the multiple item factors was estimated using McDonald's omega, with values over 0.70 interpreted as acceptable [30].

Results

In total, 874 women aged 50–74 years consented to participate, with a mean age of 61.97 years (SD = 6.77 years). Full demographic characteristics can be found in Table 1 alongside Australian population statistics for reference. Overall, self-reported screening rates in the present sample were higher than Australian populations rates. The high SES group reported screening participation rates as 60.0% (n = 162) bowel, 78.9% (n = 213) breast, and 72.6% (n = 196) cervical cancer screening participation rate. The low SES group reported 53.8% (n = 211) bowel, 76.5% (n = 300) breast, and 60.5% (n = 237) cervical cancer screening participation rate.

Screening participation and measures of SES

The relationship between area and individual-level measures of SES and cancer screening participation across the three screening programs can be found in Table 2.



Indirect effects	b	95%CI
Individual SES → PSS → Cervical Cancer Screening	-0.05*	[-0.10, -0.01]
Individual SES → Screening Literacy → Cervical Cancer Screening	-0.04*	[-0.08, -0.01]
Individual SES → PSS → Breast Cancer Screening	-0.04*	[-0.09, -0.01]
Individual SES → Screening Literacy → Breast Cancer Screening	-0.04*	[-0.08, -0.01]
Individual SES → PSS → Bowel Cancer Screening	-0.04*	[-0.09, -0.01]
Individual SES → Screening Literacy → Bowel Cancer Screening	-0.01	[-0.04, 0.02]
Area SES → PSS → Cervical Cancer Screening	0.00	[-0.01, 0.01]
Area SES → Screening Literacy → Cervical Cancer Screening	0.00	[-0.00, 0.01]
Area SES → PSS → Breast Cancer Screening	0.00	[-0.01, 0.01]
Area SES → Screening Literacy → Breast Cancer Screening	0.00	[-0.01, 0.01]
Area SES → PSS → Bowel Cancer Screening	0.00	[-0.01, 0.01]
Area SES → Screening Literacy → Bowel Cancer Screening	0.00	[-0.00, 0.00]

Fig. 1 Full structural model

Note: PSS = perceived stress. Dotted lines represent non-significant paths. * $p < .05$, ** $p < .01$, *** $p < .001$. Only standardised effects are reported

Table 2 *Standardised relationships between study variables*

	2	3	4	5	6	7	8
Individual SES (1)	−0.102**	0.209***	−0.169***	−0.190***	−0.143**	−0.114*	−0.191***
Area SES (2)	-	−0.022	0.040	−0.024	0.052	0.068	0.117*
PSS (3)		-	−0.022	−0.778***	−0.128*	−0.144*	−0.163**
Screening Literacy (4)			-	0.008	0.035	0.161**	0.140**
GSE (5)				-	0.001	0.005	0.062
Bowel Screening (6)					-	0.428***	0.288***
Breast Screening (7)						-	0.356***
Cervical Screening (8)							-

Note. Correlations with the PSS and/or GSE variables were calculated using their respective latent factors. GSE = General Self-efficacy, PSS = Perceived Stress Scale, SES = Socioeconomic status. For individual level SES, higher scores indicate lower SES. For area level SES, lower scores indicate lower SES

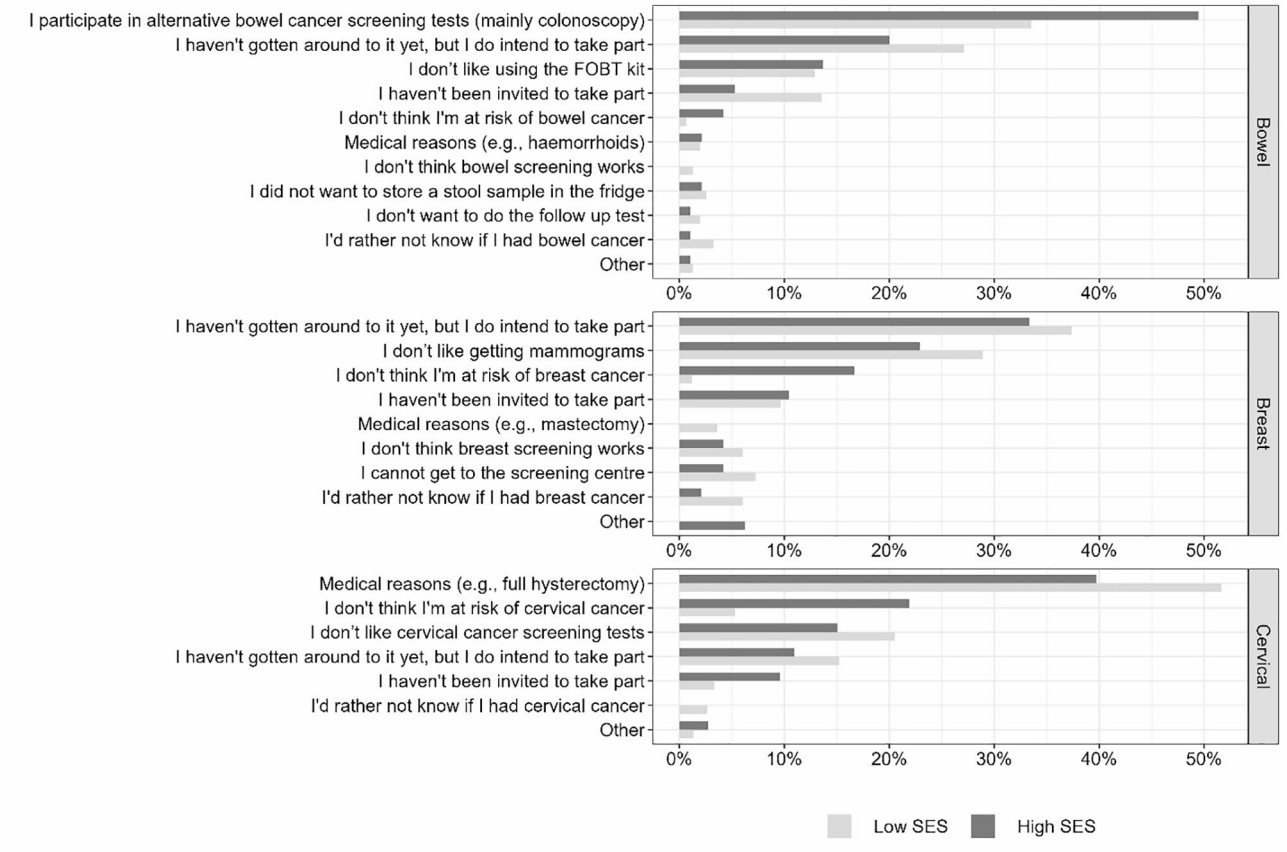


Fig. 2 Reasons for non-participation in bowel, breast, and cervical cancer screening
Note: 1 or more levels of deprivation = low SES. No indicators of deprivation = high SES. Numbers of participants who reported a barrier in each group: 155 (bowel cancer screening – low SES); 95 (bowel– high SES); 83 (breast– low SES); 48 (breast– high SES); 151 (cervical-low SES); and 73 (cervical-high SES)

The only significant relationship between area-level SES and screening participation was with participation in cervical screening, where screening participation decreased with greater levels of deprivation. There were small to moderate negative relationships between individual level SES and screening participation, with screening participation decreasing with more indicators of deprivation. This was evident for all three types of cancer screening.

SEM results

Correlations among the study variables are reported in Table 2. GSE was the only variable to not be significantly correlated with any of the cancer screening variables and was subsequently removed from the analysis.

The structural model showed excellent model fit, χ^2 [26] = 33.322, p = .153, TLI = 0.992, RMSEA = 0.021 90% [CI < 0.001, 0.039], SRMR = 0.025. All parameter estimates, direct effects, and indirect effects are displayed in Fig. 2. Higher deprivation according to the individual

measure of SES was significantly associated with higher levels of perceived stress and lower levels of screening literacy. Higher perceived stress was associated with lower rates of cancer screening for all three programs. Higher screening literacy was associated with higher likelihood of breast and cervical screening participation. As reported in Fig. 1, all indirect effects between area level SES and screening were non-significant. The indirect paths from the individual measure of SES to bowel cancer screening through screening literacy were non-significant. All other indirect paths were significant.

Reasons for non-participation in cancer screening

Figure 2 depicts participants' primary reasons for non-participation in bowel, breast, and cervical cancer screening, grouped by individual-level SES. There was substantial agreement between coders with 80.5% agreement ($K_{Cohen's}=0.707$).

Overall, the profiles of responses were similar across both individual-level SES groups for each screening type. For all three screening types, 'intending to participate but not getting around to it' was a commonly reported reason for non-participation (ranging from 15.2 −37.4% for low SES groups; and 11 −33.3% for high SES groups). For all types of screening, high SES non-screeners tended to report not believing they were at risk of cancer more frequently than the low SES non-screener groups (ranging from 3.7 −30.51% for high SES groups; and 1.45 −8.4% for low SES groups). Participants also frequently reported not liking the screening tests as their primary reason for not participating in cancer screening (ranging from 12.9 −28.9% for low SES groups; and 13.7 −22.9% for high SES groups).

Discussion

Findings suggest individual-level measures of SES may be a more precise and reliable method for assessing the impact of socioeconomic deprivation on cancer screening participation in women. This supports previous evidence that area-level measures of SES may underestimate the magnitude of health inequalities when compared to individual-level measures [33] and may explain the non-significant relationship between area-level SES and participation in breast and bowel cancer screening observed in the present study. Further, as education and income levels can vary widely across individuals within statistical areas, the true discrepancy in screening participation across levels of SES is likely underestimated. Therefore, the need to remedy these discrepancies is likely greater than previously believed.

Stress is an important consideration in understanding why women with lower SES are less likely to screen for bowel, breast, and cervical cancer. Previous research has shown mixed results around relationships between psychological distress and participation in cancer screening, suggesting, for some, it may promote an avoidance of situations that trigger discomfort or fear [34]. From this, it has been suggested that a tailored approach whereby reassuring messaging that screening procedures are generally safe and comfortable people are important for those experiencing higher anxiety or concern. In addition to this, encouraging informed choice may support women with lower SES, who may benefit from clear, supportive messaging that builds both awareness and confidence in participating in cancer screening without feeling pressured [35, 36].

People with lower SES consistently report structural challenges that lead to greater stress such as unemployment, housing instability, and employment conditions (e.g., night-work and longer hours) [37]. These stressors are often associated with a range of poorer health behaviours such as smoking, poor diet, and low physical activity levels [38] and may also act as barriers to accessing cancer screening programs Addressing these structural barriers through providing travel subsidies or screening appointments after hours may be an effective way of facilitating uptake of health behaviours, such as cancer screening. The current findings add to the growing body of literature that highlights the health consequences associated with the stress of living with socioeconomic disadvantage, and they underscore individual-level SES as the more appropriate lens through which to view this. While cancer screening plays a crucial role in early detection and improving survival rates, some research suggests that knowledge of general risk factors for breast cancer in the community may be limited [39] and public health messaging should also encompass other modifiable risk factors, such as maintaining a healthy weight, reducing alcohol consumption, and engaging in regular physical activity, which are known to lower breast cancer risk.

Current findings suggest that screening literacy, but not general self-efficacy may underly SES disparities for cervical and breast cancer screening participation only. One key difference between bowel cancer screening and cervical and breast cancer screening is that cervical and breast screening are conducted by health professionals (e.g., having a mammogram), while bowel cancer screening is conducted by the invitee themselves (e.g., self-collection of samples) [40]. Consequently, those that do not participate in bowel cancer screening report practical barriers, such as difficulty in completing the test or forgetting to complete the test, as key reasons for not participating in bowel cancer screening specifically [35]. This may mean that the role screening literacy has on bowel cancer screening participation is overshadowed by the practical difficulties that are specific to that modality of screening [40]. It should be noted that this study was conducted before the National Cervical Screening Program made

self-sampling (i.e., the sampling is done by the invitee and not by a health care professional) available as a choice to all screening participants. If the uptake of self-collection methods for cervical screening increases, future studies should re-examine the role screening literacy plays in cervical screening.

Not detecting an effect of self-efficacy on screening behaviour contradicted expectations. Self-efficacy is thought to be an influential factor in many health belief models, such as the Health Action Process Approach [41], and previous work has shown an association between self-efficacy and bowel cancer screening participation [42]. It is important to note that previous studies included males in their analyses, however, there is no theoretical explanation to suggest that the null effect self-efficacy in this study was due to the sample being female. A more likely reason for this discrepancy, is that the current study used a measure of general self-efficacy, and previous studies use measures of self-efficacy that are task specific [42].

Women who reported that they did not screen for one or more cancers gave a wide range of reasons and the distribution of these reasons tended to be similar across SES groups for all screening types. Systematic reviews of interventions aiming to increase screening rates have found that multiple interventions should be implemented together to address the multiple barriers to screening [43, 44]. Our findings did not point to many differences in reasons for non-participation in cancer screening among high and low SES women. This, combined with the findings that stress and literacy play a significant role in SES-related disparities in cancer screening, may suggest that these disparities are more likely due to ongoing intrinsic or systemic factors. It may be that tailoring these multi-component interventions to the SES background of women in the population is unlikely to enhance their effectiveness. Therefore, interventions aiming to reduce the SES screening disparities, particularly in the female population, may achieve more success through addressing underlying mechanisms as opposed to the behavioural barriers themselves.

This study is the first to investigate the effects of individual-level SES on cancer screening in Australia, providing a more accurate picture of the factors influencing screening participation among female invitees. Additionally, it is one of the few studies to examine a series of theoretically relevant processes simultaneously across various screening programs, highlighting both similarities and differences that impact screening uptake across different modalities. These factors contribute to providing a rich source of information for the effective design public health interventions.

The current findings highlight factors that primary care practitioners should be cognizant of when providing cancer screening advice to low SES individuals. Socially and economically disadvantaged female patients may have lower levels of screening literacy and higher levels of stress that prevent them from participating in cancer screening and primary care providers can act as a trusted and authoritative source of information having a positive impact on a person's decision to screen for cancer [45]. Healthcare providers can also support the delivery of informed-choice messaging by providing balanced information that respects patient autonomy while promoting the understanding needed to make health decisions. While participation in screening programs is largely supported by evidence demonstrating significant survival benefits, there is some concern around overdiagnosis, particularly in the context of breast screening [36]. Therefore, public health messaging and health practitioners alike should consider the balance between benefits and potential harms and the unique implications for each individual when providing advice.

Further research is needed to better understand and identify other mechanisms responsible for SES screening disparities, and co-design work should be conducted with low SES individuals to develop effective public health interventions. For example, qualitative and longitudinal study methodologies could obtain a deeper, practical understanding of the connection between SES and screening uptake and causal relationships, while co-design work should be conducted with consumers in the target population to address specific barriers and tailor interventions to their unique needs and circumstances.

Study limitations

There are several limitations to the present study that should be taken into consideration when interpreting the findings. Participation in bowel, breast, and cervical cancer screening was measured through retrospective self-report and may be affected by reporting biases. The measure used for screening literacy was developed for this study and caution should be used interpreting the results until it is independently validated. Participation in this study was voluntary and self-selection biases may arise due to recruitment through online advertisement. We did find a bias in a higher rate of screeners in the current sample than would be expected from the population screening rates. Last, findings may not apply to participants outside of the age ranges included in this study. One of the aims of the present study was to assess participation in all three Australian national cancer screening programs. As such, participants were limited to women aged 50–74. Caution should be taken when making conclusions about individuals outside of this range (e.g., women under 50 who have been invited for cervical screening).

Conclusions

Higher individual-level SES, but not area-level SES, predicts small to moderate increases in cancer screening across bowel, breast, and cervical cancer types in women. The distribution of screening barriers did not differ greatly across SES categories. However, low SES women tended to have higher levels of stress and lower levels of screening literacy, and these factors negatively impacted screening participation. Consequently, providing support to low SES individuals to reduce stressors and increase screening literacy may increase their capacity to participate in cancer screening.

Abbreviations

SES	Socioeconomic Status
PSS	Perceived Stress Scale
GSE	General Self–Efficacy Scale
SEM	Structural equation modelling
TLI	Tucker–Lewis Index
SRMR	standardised root mean squared residual
RMSEA	root mean squared error of approximation
DWLS	diagonally weighted least squared

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-024-20901-2.

Supplementary File 1: – Codebook.docx. Title: Codebook for barriers to participation in cancer screening.Description of data: Codebook for open-text responses reporting on barriers to participation in screening for breast, cervical and bowel cancer.

Supplementary File 2: – Structural Equation Modelling.docx. Title: Structural Equation Modelling. Description of data: A full description of the structural equation modelling analysis procedure.

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Author contributions

All authors contributed to the study's conception and design. Data preparation and analysis was conducted by L.M and N.P.All authors contributed to the interpretation of study findings. The first draft of the manuscript was written by L.M and N.P, and edited by B.G., M.I., L.A, and C.N. All authors reviewed and edited subsequent versions of the manuscript. All authors read and approved the final manuscript.

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Data availability

The raw data generated in this study are not publicly available as they contain information that may compromise participant privacy and content; however, de-identified data is available upon reasonable request from the corresponding author.

Declarations

Ethics approval and consent to participate

In accordance with the Declaration of Helsinki, ethical approval for this study was granted by the Human Research Ethics Committee at the University of Southern Queensland (ref. H22REA090). All subjects received an information sheet, and all participants provided informed consent prior to participating in this research.

Consent for Publication

Not applicable.

Competing interests

The authors declare no competing interests.

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