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Does cancer literacy predict cancer screening intention or uptake? A systematic review

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ABSTRACT

Objective: To examine the association between cancer literacy (CL) and cancer screening behaviors, including screening intention and uptake.
Methods: A comprehensive search was conducted across three databases up to October 2024 (CRD42024500935). Studies were included if they (i) had an observational design, (ii) measured CL using validated or *ad hoc* tools, and (iii) quantified its association with cancer screening intention and/or uptake. Quality was assessed using the Newcastle-Ottawa Scale. Findings were narratively synthesized by cancer type for each outcome.
Results: Six cross-sectional studies met the inclusion criteria: one focused on screening intention, four on screening uptake, and one on both outcomes. Data were available for breast, cervical, colorectal, prostate, and skin cancer. Study quality was heterogeneous, with most studies rated as fair quality and affected by methodological limitations, including reliance on self-reported data, imprecise outcome definitions and measurements, and heterogeneous target populations. While higher levels of CL were linked to increased screening intentions in both included studies, findings on screening uptake were inconsistent across and within cancer types, with significant associations more commonly observed in adjusted analyses. Although a few studies suggested that awareness of the importance of preventive measures may influence screening adherence, the overall results remained inconclusive across all cancer types.
Conclusions: This review suggests a positive association between higher CL and cancer screening intentions, although the evidence is limited. The role of CL in screening uptake remains uncertain, indicating that additional factors may influence adherence. Given the limited evidence, methodological variability, and study limitations, further research employing more robust and standardized approaches is essential to better understand the role of CL in cancer-related behaviors.
Practical Implications: Improving CL may have a role in shaping cancer screening behaviors, particularly in promoting screening intention. More rigorous research is needed to clarify the role of CL in screening behaviors.

1. Introduction

Cancer screening is a cornerstone of preventive healthcare, aimed at detecting precancerous conditions or early-stage cancers in asymptomatic individuals [1]. By enabling timely diagnosis and intervention, participating in cancer screening programs significantly improves health outcomes [1]. Across many countries, various organized oncological screening programs have been designed and implemented, targeting cancers such as cervical, breast, and colorectal [2,3]. These programs have consistently demonstrated their effectiveness in significantly reducing mortality [2–4]. Thanks to their success and advances in treatment, the 5-year survival rates approach 100 % for individuals diagnosed with early-stage breast or colorectal cancer, compared to much lower survival rates of 31 % and 16 %, respectively, for advanced stages [5–7]. However, the benefits of these programs rely on population adherence, which remains suboptimal and varies significantly both

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between and within countries [8].

Individuals' willingness to participate in screening programs is influenced by various factors at different levels. At the group level, factors such as educational interventions, communication strategies, access to screening services, and social support play a significant role [9–11]. At the individual level, factors include age, gender, perceived benefits and barriers, knowledge and awareness, personal attitudes, and cultural or religious beliefs [9,10]. Lately, health literacy (HL) has been identified as a crucial determinant for making informed decisions about health, including adopting preventive behaviors [12,13]. However, as HL primarily measures basic literacy skills in a health context, it may not fully capture the specific knowledge required for understanding a particular condition, such as cancer [11]. To address this limitation, the concept of cancer literacy (CL) has been introduced, encompassing the knowledge a layperson needs to understand the information and guidance provided by the healthcare system for preventing, diagnosing, and treating cancer [11].

While the influence of HL on cancer screening adherence has already been studied [14], a comprehensive assessment of the association between CL and screening behaviors remains lacking. Furthermore, the available studies [15–20] show considerable heterogeneity in how both CL and screening outcomes are measured, contributing to the fragmentation and inconsistency of the results. Therefore, this systematic review aims to consolidate the evidence on the relationship between CL and cancer screening behaviors, addressing both screening intention and uptake. The findings may enhance our understanding of CL as a potential predictor of preventive behavior and inform more targeted strategies to improve cancer screening adherence.

2. Methods

This study was performed according to the Cochrane Handbook for Systematic Reviews and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement [21,22]. The review protocol was registered at PROSPERO (identifier CRD42024500935). Since primary data collection was not performed, informed consent was not required, and the protocol was not submitted for institutional review board approval.

2.1. Search strategy and study selection

Two reviewers searched the bibliographic databases PubMed, Web of Science and Scopus using the following search terms: ("cancer" AND "literacy") OR ("cancer literacy") OR ("cancer health literacy") AND ("screening"). The string was adapted to fit the search criteria of each database (Supplementary Table 1). The search was conducted among records published from database inception to 29th October 2024. No language or date restriction was applied. After the removal of duplicate records, two reviewers independently screened the title and abstract of all records retrieved. Studies that did not meet the inclusion criteria were excluded, and two researchers examined the full texts of potentially relevant articles. Disagreements were resolved through discussion with a third reviewer and reasons for exclusion were recorded. In addition, the reference lists of included studies were searched to identify other potential articles for inclusion.

2.2. Inclusion and exclusion criteria

We included original articles with the following characteristics: i) reported in English or Italian, based on our co-author language abilities; ii) had an observational design (i.e., cross-sectional, cohort, case-control); iii) investigated CL using either validated or *ad hoc* tools; and iv) provided raw data, unadjusted or adjusted estimates of the association between CL and cancer screening behavior (i.e., cancer screening intention and/or uptake), in any population. Any cancer screening program and statistical analysis were considered eligible. As for CL, we adopted the definition by Diviani *et al.*: "the knowledge a layperson needs to possess to understand the information and advice the health system has to offer with regard to preventing, diagnosing and treating cancer" [11]. Only studies explicitly referring to the term "cancer literacy" were included. Articles in which data or estimates of the associations of interest were not described or retrievable were excluded. Abstracts, commentaries, letters to the editor, and reviews were also excluded.

2.3. Data collection and quality assessment

For each record included, two reviewers independently extracted the following information using a standardized data abstraction form: first author, year of publication, country, study design, main characteristics of the target population (age, gender, ethnicity, recruitment process, and number of participants), type of cancer screening program (e.g., screening for breast cancer, colorectal cancer, etc.), screening test (e.g., mammography, Papanicolaou - Pap - test, etc.), type of outcome investigated (cancer screening intention and/or uptake), outcome measurement and coding (e.g., dichotomous or continuous), CL evaluation measurement tool (e.g., validated or *ad hoc*) and coding (e.g., dichotomous or continuous), screening time interval, statistical analysis, main findings, and adjustment factors (if applicable). The sample size was categorized as low (<100 participants), moderate (101–1000 participants), large (1001–10,000 participants) and very large (>10,000 participants). Quality assessment of the articles included was carried out by two independent authors, using an adapted version for cross-sectional studies of the Newcastle-Ottawa scale [23]. Articles were considered of high quality when the total score was ≥ 7, of fair quality if the score was ≥ 5 and < 7, and of poor quality if the score was lower than 5 (Supplementary Table 2). Discrepancies were resolved by consensus or discussion with a third reviewer.

2.4. Data synthesis

Two main outcomes were distinguished: cancer screening intention and uptake. Then, for each outcome, articles were grouped according to the investigated cancer. Due to the limited number of studies included, a meta-analysis was not feasible for either cancer screening intention or uptake. Instead, a narrative synthesis approach was used to investigate the studies' characteristics, methods and results.

3. Results

A total of 3982 records were identified through database searches (Fig. 1). After removing duplicates and screening titles and abstracts, 31 articles were assessed for eligibility. Of these, 25 were excluded at the full-text analysis stage, with reasons provided, leaving six articles included in the systematic review.

All included studies employed a cross-sectional design. Of these, one focused solely on cancer screening intention, four examined only cancer screening uptake, and one addressed both outcomes separately.

3.1. Characteristics of the studies included in the systematic review

3.1.1. Studies investigating only cancer screening intention

One study [15], conducted in Japan in 2022, investigated a sample of over 2000 healthy individuals aged 20–70 years (Table 1). The authors did not specify the test, the type of screening hypothesized and the frequency to assess the population's screening intentions. The study was judged to be of fair quality due to limitations in the sample investigated, including insufficient representativeness and a lack of justification for the sample size (Supplementary Table 2).

3.1.2. Studies investigating only cancer screening uptake

All four studies [16–19] investigating only screening uptake were

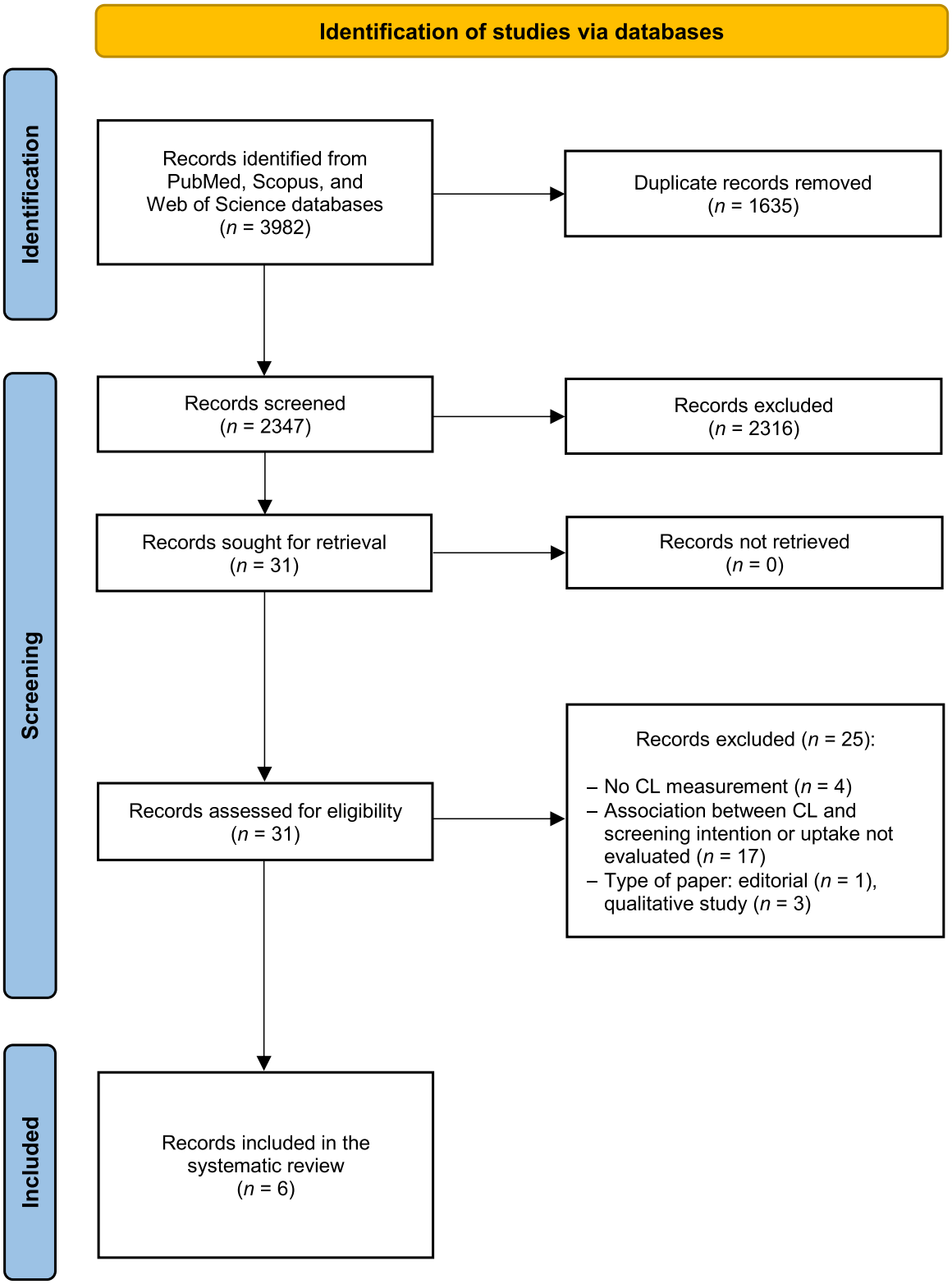

Fig. 1. PRISMA flow diagram of the review process. CL: cancer literacy.

published between 2016 and 2021 (Table 1). Of these, two [16,17] were conducted in Asia, specifically in Nepal [16] and South Korea [17], and two in the United States [18,19]. The sample size was categorized as medium in all cases. Two studies [18,19] targeted American Indian women, focusing on adherence to cervical and breast cancer screening, respectively, while the remaining two studies [16,17] recruited adults from the general population and investigated multiple screening programs simultaneously. Cancer screening tests were specified in three studies only [17–19]. Overall, two studies [17,19] focused on breast cancer screening, using either ultrasound [17] or clinical examination and mammography [18], whereas screening for colorectal cancer was assessed through fecal occult blood testing (FOBT), gastrography, or sigmoidoscopy/colonoscopy [17]. Prostate cancer screening was evaluated through the prostate-specific antigen (PSA) test [17], while Pap

Table 1
Characteristics of the studies included in the systematic review.

First author, year	Country	Study design	Target population	Screening type	Screening test	Time interval	Screening behaviour	Quality
Studies investigating screening intention only								
Minamitani, 2022	Japan	CS	Healthy individuals aged 20–70 years (N = 2454)	NR	NR	NR	NA	5
Studies investigating screening uptake only								
Koirala, 2021	Nepal	CS	Adults with median age of 42.0 (screened participants) and 33.0 (not screened participants), 63.8 % female (N = 180)	Breast, cervical, prostate, throat	NR	In the entire life	SR	7
Lee, 2016	South Korea	CS	Community-dwelling adults aged 20–83 years, 51.3 % female (N = 585)	Breast (N = 328) Colorectal Prostate (N = 335)	Breast ultrasound FOBT (N = 528), gastrography (N = 552), sigmoidoscopy or colonoscopy (N = 530) PSA	In the entire life	SR	6
Lee, 2021	United States	CS	American Indian women aged ≥ 18 years*	Cervical (N = 286)	Pap test	In the entire life	SR	5
Roh, 2018	United States	CS	American Indian women aged ≥ 18 years*	Breast (N = 286)	Clinical breast exam, mammography	In the entire life	SR	5
Studies investigating both screening intention and screening uptake								
Diviani, 2014	Switzerland	CS	Ticino residents aged 15–96 years, 53.8 % female (N = 639)	Breast Cervical Colorectal Prostate Skin	Mammography Pap test FOBT, colonoscopy or endoscopy, rectal exam PSA test Skin exam	In the entire life	SR	6

CS: Cross-sectional. FOBT: Fecal occult blood test. N: Number. NA: Not applicable. NR: Not reported. Pap test: Papanicolaou test. PSA: Prostate-specific antigen. SR: Self-reported.
* Data derived from the same sample population.

test was used for cervical cancer screening adherence [18]. In all studies, participants self-reported screening uptake over their lifetime. All studies except one [17–19] were judged to be of fair quality, with major deficits in sample representativeness and the comparability of participants and non-participants (Supplementary Table 2).

3.1.3. Studies investigating both cancer screening intention and uptake

A single study [20], conducted in Switzerland with a moderate sample size of individuals aged 15–96 years, investigated both screening behaviors (Table 1). The authors assessed screening intention or uptake for five types of cancer (i.e., breast, cervical, colorectal, prostate, and skin) using mammography, Pap test, FOBT/colonoscopy/endoscopy or rectal exam, PSA test, and skin examination, respectively. Screening uptake was self-reported over the participants' lifetime. The study was evaluated as being of fair quality. Main limitations included a lack of representativeness, insufficient justification for the sample size, and a lack of comparability between participants and non-participants (Supplementary Table 2).

3.2. Main findings

3.2.1. Association between CL and cancer screening intention

One study [20] investigated cancer screening intention using a validated continuous scale to measure CL levels, while the other [15] used an *ad hoc* tool, coding CL as a categorical variable (Table 2, Supplementary table 3). In both studies, screening intention was assessed

Table 2
Association between cancer literacy (CL) and screening intention.

First author, year	CL		Screening intention		Statistical analysis	Main findings		Adjustment factors
	Measurement and coding	Score/ levels	Measurement	Coding		Unadjusted analysis	Adjusted analysis	
Currently recommended								
Diviani, 2014	Cancer Literacy Scale, continuous	0–10	One question on the intention to undergo cancer screening	Continuous (7-point Likert scale)	Hierarchical regression analysis	/	Significant association between higher CL and positive attitude towards screening (B=0.044, $p < 0.001$)	Gender, age, education level, cancer history, being a caregiver, functional health literacy
Not specified								
Minamitani, 2022	Ad hoc questionnaire, Japanese Cancer Intelligence Quotient literacy (JCIQ-L), categorical	Four categories: - Very difficult - Fairly difficult - Fairly easy - Very easy	One question on the intention to undergo cancer screening	Continuous (5-point Likert scale)	Multiple regression analysis	/	Significant association between higher CL and positive attitude towards screening (B=0.00–0.04, $p < 0.05$)	Gender, age, income level, employment status, JCIQ knowledge

FOBT: fecal occult blood test.

with a single question, but the focus differed: one study [20] targeted intentions for currently recommended screenings, while the other [15] addressed generic cancer screening intentions without specifying the screening program. Both studies conducted adjusted analyses, accounting for sociodemographic and cancer-related factors. In both cases, a significant association emerged between higher CL levels and a positive attitude toward cancer screening.

3.2.2. Association between CL and cancer screening uptake

3.2.2.1. Breast cancer. Two of the three studies exploring the association between CL and breast cancer screening uptake measured CL levels using validated scales and treated CL as a continuous variable [17,20] (Table 3). In the third study, breast cancer CL was assessed using an *ad hoc* questionnaire that separately considered awareness and knowledge [19] (Supplementary table 3). In the first two studies, screening uptake was assessed with a single question: participants were asked whether they had ever undergone a mammogram [20] or a breast ultrasound [17] at least once in their lifetime, with dichotomous response options (i.e., yes or no). In the third study [19], two separate questions investigated whether participants had ever undergone a clinical breast examination or a mammogram. The findings across studies were inconclusive. Diviani *et al.* [20] reported a significant association between CL and screening uptake in analyses adjusted for sociodemographic factors, HL, and cancer history. Conversely, Lee *et al.* [17] found no significant influence of CL on screening adherence in their unadjusted analyses. Roh's study [19] reported mixed results coming from hierarchical regressions: significant associations were found between clinical breast examination and awareness of breast examination, as well as between mammography and awareness of mammography. However, no significant associations were observed when knowledge of breast cancer was considered in relation to either clinical breast examination or mammography uptake. In this study [19], the analyses were adjusted primarily for sociodemographic factors and motivational aspects.

3.2.2.2. Cervical cancer. Two studies investigated cervical cancer screening uptake, each using different methods to assess CL (Table 3). One study [20] used a validated scale to measure CL levels, while the other [18] developed an *ad hoc* questionnaire with awareness of the Pap test assessed with one question, and 13 additional questions evaluating knowledge about cervical cancer (Supplementary table 3). In both studies [18,20], participants were asked a single question about whether they had ever undergone screening with a Pap test. In the first study [20], CL was found to significantly influence screening adherence in an analysis adjusted for sociodemographic factors, cancer history, and HL. Similarly, in the second study [18], greater awareness of the Pap test was identified as a predictor of screening adherence in adjusted analyses. However, the association became non-significant when knowledge about cervical cancer was used as the exposure. The adjustment factors in this study included sociodemographic characteristics, motivational aspects, and health status.

3.2.2.3. Colorectal cancer. Both studies [17,20] investigating colorectal cancer screening used validated scales to measure CL and assessed screening uptake (Table 3, Supplementary table 3). One study [20] asked participants in a single question whether they had ever undergone FOBT, endoscopy, colonoscopy, or rectal examination, while the other [17] asked separately about FOBT, gastrography, or sigmoidoscopy/-colonoscopy. Only Diviani *et al.* [20] performed an analysis adjusted for sociodemographic factors, cancer history, and HL, finding a significant association between CL and cancer screening uptake. In contrast, the unadjusted analyses by Lee *et al.* [17] consistently showed no significant associations.

3.2.2.4. Recommended cancer screening. Two studies [16,17] investigated the association between CL and adherence to recommended cancer screenings, using two different but validated continuous scales to measure CL levels (Table 3, Supplementary table 3). Screening adherence was assessed using one categorical question in one study [16] and five categorical questions in the other [17]. The first study examined adherence to screenings for breast, cervical, prostate, and throat cancers [16], while the second focused on breast, colon, and prostate cancers [17]. Both studies reported a significant association between CL and screening adherence. The first study [16] employed a multivariable regression model, adjusting for sociodemographic factors. In contrast, Lee *et al.* [17] conducted a path analysis, demonstrating that CL directly influences screening behaviors after adjusting for both sociodemographic and behavioral factors.

3.2.2.5. Prostate cancer. Two studies [17,20] investigated the association between CL and adherence to prostate cancer screening using validated scales to measure CL levels (Table 3, Supplementary table 3). Both studies assessed whether participants had ever undergone PSA blood testing, categorizing responses as yes or no. The findings were consistent: CL levels did not predict screening uptake in either study. However, only one study [20] conducted analyses adjusted for sociodemographic factors, HL, and cancer history.

3.2.2.6. Skin cancer. Only one study [20] focused on skin cancer screening using a validated and continuous CL scale (Table 3, Supplementary table 3). After asking participants whether they had ever undergone a skin examination, the authors identified a significant association between CL levels and skin cancer screening in analyses adjusted for sociodemographic factors, HL, and cancer history.

4. Discussion and conclusion

4.1. Discussion

This review found inconclusive evidence regarding the association between CL and cancer screening behaviors. There is extremely limited research that measures CL as a factor influencing individuals' willingness to undergo screening procedures, making the findings difficult to generalize. However, results were encouraging, showing a positive association with CL in both studies. Conversely, whether CL can predict screening uptake remains an unresolved question. Indeed, in our review the evidence on the relationship between CL and screening adherence was highly heterogeneous, varying not only by cancer type but also within studies evaluating the same type of cancer, even though it is worth noting that a positive association was more likely to be observed when adjusted analyses were employed. For breast and cervical cancer, our findings suggest that awareness of the importance of preventive measures is more relevant in predicting screening adherence than knowledge of the disease itself. This is in line with the notion that CL is linked to general awareness of preventive interventions as it encompasses not only the ability to access and understand health information, but also the motivation and competencies required to critically appraise and apply this information effectively [24]. For colorectal cancer, while findings remain inconclusive, adjusted analyses revealed a positive association between CL and screening uptake. Unfortunately, given that the authors considered multiple screening procedures simultaneously, it was not possible to determine which specific relationship(s) between CL and individual screening tests contributed to this finding. This lack of information is relevant because colorectal cancer screening programs often require individuals to either self-submit fecal samples or undergo more complex diagnostic procedures, requirements that may introduce additional barriers to participation that differ depending on the screening test [14]. Therefore, it is essential for future studies to better investigate these aspects to understand how such barriers relate to CL and influence colorectal cancer screening adherence. As for the other

Table 3
Association between cancer literacy (CL) and screening uptake.

First author, year	CL		Screening uptake		Statistical analysis	Main findings		Adjustment factors
	Measurement and coding	**Score/ levels**	**Measurement**	**Coding**		**Unadjusted analysis**	**Adjusted analysis**	
Breast								
Diviani, 2014	Cancer literacy scale, continuous	0–10	One question on whether they had ever had a mammography	Two categories: -Yes -No	Multivariable logistic regression		Significant association between higher CL and screening uptake (B=0.033, $p < 0.05$)	Gender, age, education level, cancer history, caregiver, functional HL
Lee, 2016	12-item cancer literacy scale, continuous	0–12	One question on whether they had ever had a breast ultrasound	Two categories: -Yes -No	ANOVA	Non-significant association between higher CL and screening uptake ($p = 0.17$)	/	/
Roh, 2018	Ad hoc questionnaire, breast cancer literacy (two questions on awareness of clinical breast exam or mammography, 10 questions on knowledge of breast cancer)	Awareness: 0–1, dichotomous Knowledge: 0–10, continuous	One question on whether they had ever had a clinical breast exam One question on whether they had ever had a mammography	Two categories: -Yes -No	Hierarchical logistic regression	/	Significant association between higher awareness of clinical breast exam and clinical breast exam uptake (OR=18.74; CI=4.49–78.26; $p < 0.001$). Non-significant association between higher breast cancer knowledge and screening uptake (OR=1.20; CI=0.97–1.49; $p \geq 0.05$) Significant association between higher awareness of mammography and mammography uptake (OR=25.78; CI=3.43–194.09; $p < 0.001$). Non-significant association between higher breast cancer knowledge and mammography uptake (OR=1.06; CI=0.88–1.29; $p \geq 0.05$)	Age, marital status, employment, education, benefits, barriers, motivation
Cervix								
Diviani, 2014	Cancer literacy scale, continuous	0–10	One question on whether they had ever had a Pap test	Two categories: -Yes -No	Multivariable logistic regression		Significant association between higher CL and screening uptake (B=0.035, $p < 0.001$)	Gender, age, education level, cancer history, caregiver, functional HL
Lee, 2021	Cervical cancer literacy (one question on awareness of Pap test, 13 questions on knowledge of cervical cancer)	Awareness: 0–1, dichotomous Knowledge: 0–13, continuous	One question on whether they had ever had a Pap test One question on whether they had ever had a Pap test	Two categories: -Yes -No	Hierarchical logistic regression	/	Significant association between higher awareness and screening uptake (OR=63.5, $p < 0.001$); non-significant association between higher knowledge and screening uptake (OR=0.99, $p \geq 0.05$)	Age, marital status, education, income, health status, BMI, benefits, barriers, motivation
Colorectal								
Diviani, 2014	Cancer literacy scale, continuous	0–10	One question on whether they had ever had a colonoscopy or endoscopy, a FOBT, a rectal exam	Two categories: -Yes -No	Multivariable logistic regression		Significant association between higher CL and screening uptake (B=0.076, $p < 0.001$)	Gender, age, education level, cancer history, caregiver, functional HL
Lee, 2016	12-item cancer literacy scale, continuous	0–12	One question on whether they had ever had a FOBT	Two categories: -Yes -No	ANOVA	Non-significant association between higher CL and screening uptake ($p = 0.903$)	/	/

(*continued on next page*)

Table 3 (*continued*)

First author, year	CL		Screening uptake		Statistical analysis	Main findings		Adjustment factors
	Measurement and coding	**Score/ levels**	**Measurement**	**Coding**		**Unadjusted analysis**	**Adjusted analysis**	
			One question on whether they had ever had a gastrography			Non-significant association between higher CL and screening uptake (p = 0.575)		
			One question on whether they had ever had a sigmoidoscopy or colonoscopy			Non-significant association between higher CL and screening uptake (p = 0.962)		
Recommended screening programs								
Koirala, 2021	6-item Cancer Health Literacy Test (CHLT−6), categorical	0–6	One question on adherence to cancer screening (at least one among breast, cervical, prostate, throat)	Two categories: -Yes -No	Multivariable logistic regression	Non-significant association between higher CL and screening adherence (OR = 1.24; CI = 0.95–1.63; p = .109)	Significant association between higher CL and screening uptake (OR=1.42; CI=1.01–2.02; p = 0.045)	Gender, age, marital status, family support
Lee, 2016	12-item cancer literacy scale, continuous	0–12	Five questions on adherence to cancer screening (at least one among breast, colon, prostate)	Two categories: -Yes -No	Path analysis		Significant direct effect of CL on cancer screening behaviours (0.079)	Gender, use of eastern medicine, fatalism, education, income, family support, health status
Prostate								
Diviani, 2014	Cancer literacy scale, continuous	0–10	One question on whether they had ever had a PSA test	Two categories: -Yes -No	Multivariable logistic regression		Non-significant association between higher CL and screening uptake (data not shown)	Gender, age, education level, cancer history, caregiver, functional HL
Lee, 2016	12-item cancer literacy scale, continuous	0–12	One question on whether they had ever had a PSA test	Two categories: -Yes -No	ANOVA	Non-significant association between higher CL and screening uptake (p = 2.204)		
Skin								
Diviani, 2014	Cancer literacy scale, continuous	0–10	One question on whether they had ever had a skin exam	Two categories: -Yes -No	Multivariable logistic regression		Significant association between higher CL and screening uptake (B=0.034, p < 0.001)	Gender, age, education level, cancer history, caregiver, functional HL

ANOVA: Analysis of variance. BMI: body mass index. CI: confidence interval. HL: health literacy. OR: odds ratio. Pap test: Papanicolaou test. PSA: Prostate-specific antigen.

screening, such as those for prostate and skin cancer, the evidence was both insufficient and heterogeneous, making it challenging to draw any conclusion and highlighting the need for further research on the topic.

However, the differences observed between CL and cancer screening intention and uptake align with evidence from other fields, such as vaccine literacy and intention to vaccinate and vaccination status [25], which demonstrate that intention does not always translate into actual behavior [26,27]. In the context of cancer screening, it is evident that adherence is influenced by a multitude of factors beyond CL. For example, in some cultural and religious communities, there are beliefs that negatively impact participation in cancer screening programs [28–31]. A few studies have reported that breast or cervical cancer screening may be perceived as inappropriate or embarrassing when performed by male medical staff [29–31], screening procedures may be viewed with fear or skepticism, or cancer may be approached with fatalism [28], reflecting a broader perspective where suffering is seen as part of a divine plan or fate, rather than something to be avoided [28–30]. Another key aspect to consider in screening adherence is the nature of the healthcare system. It is well known that the overall organization of healthcare delivery, along with the accessibility and proximity of cancer screening services, can significantly affect patient participation [32–34]. Therefore, in light of the persistently suboptimal screening rates observed in recent years [2,35], further research is needed to explore the interplay of cultural, psychological, and systemic factors with CL in order to design effective interventions and strategies.

Future studies should also pay more attention to some methodological aspects. First of all, it should be noted that the studies included in this review were of heterogeneous quality, with only a few assessed as high quality. In our review, most of the studies included that employed validated tools to measure CL, particularly those using the original, non-adapted versions, demonstrated a clearer association with screening uptake [16,17,20]. However, it is worth noting that each study adopted a different instrument, often developed for distinct purposes, which may have contributed to the heterogeneity of findings. For instance, Lee *et al.* [17] used a tool originally developed to assess the prevalence of scientifically unsubstantiated beliefs about cancer risk in the United States population, rather than CL per se. Koirala *et al.* [16] employed the 6-item Cancer Health Literacy Test (CHLT-6), based on an ability-oriented definition of HL that integrates knowledge and skills, capturing basic reading, writing, and numeracy skills. Diviani *et al.* [20] used a

definition that more closely aligns with the theoretical construct of CL as "all the knowledge a layperson needs to possess to understand the information and advice the health system has to offer with regard to preventing, diagnosing and treating cancer." This appears to be reflected in the results, suggesting that tools grounded in a well-defined and comprehensive understanding of CL may be more effective in capturing its influence on preventive behaviors. In contrast, studies relying on *ad hoc* or narrowly defined instruments yielded more heterogeneous findings. This emphasizes the importance of developing and applying standardized, reproducible tools for measuring CL, as the current scarcity of validated instruments leaves room for the proliferation of *ad hoc* measures, which may not accurately reflect the multifaceted nature of the concept. Other critical aspects are related to the method used to assess screening uptake. Given that it was consistently based on self-reported data, inaccuracies in the outcome measurement cannot be excluded. Additionally, none of the studies specified whether the screenings were part of organized programs or opportunistic screenings. This is a distinction that can significantly impact participation rates and overall health outcomes [32,33,36–38]. Furthermore, while most of the screening procedures examined were those recommended by clinical guidelines, all studies considered screening adherence as a one-time event, failing to account for longitudinal or repeated participation, an omission that could lead to an inaccurate estimation of uptake [8,39,40]. Therefore, future research should adopt more objective methods to verify cancer screening adherence, precisely define it, and incorporate the temporal aspect of participation through longitudinal designs. These improvements would facilitate better comparisons across studies, screening tests, and settings [39,41].

Lastly, it is important to note that conducting more research on the association between CL and screening behavior would also help bridge the existing gap in the literature on this topic. Indeed, despite the global emphasis on finding ways to increase cancer screening rates [41,42], including enhancing CL as a strategy to promote higher participation and achieve better health outcomes [13], the majority of the literature investigates its role in cancer patients, demonstrating benefits such as reduced unmet information needs [43], improved collaborative decision-making with physicians [44], higher adherence to follow-up care [45] and enhanced overall quality of life [46,47]. This finding is in contrast with HL, whose relationship with preventive behaviors has been more extensively studied [14]. A possible explanation for this disparity is that HL, being a broader and more established concept, has received greater attention in research. Nevertheless, as healthcare systems move toward tailoring preventive measures to individual risk profiles [48–50], the importance of CL is likely to grow. CL fully captures the disease-specific knowledge and decision-making skills that general HL measures often fail to capture [11]. It is worth noting that many of the included studies adjusted their analyses for a wide range of potential confounders including, in some cases, functional HL, highlighting the complexity of isolating the specific contribution of CL from other related constructs such as general HL, language proficiency, and numeracy. Given that the available research spans three continents, but has largely focused on heterogeneous study populations and has often yielded evidence marked by the previously mentioned shortcomings, there is definitely a need for more robust and high-quality studies.

This review has both strengths and limitations. The primary limitation is the inability to perform a quantitative synthesis of the results due to the limited number of studies and the varied nature of the reported data. Additional limitations are predominantly related to the included primary studies, such as the reliance on self-reported data, which is susceptible to social desirability bias and reporting bias, potentially affecting the accuracy of the findings. Secondly, the heterogeneity of the populations studied presents challenges for generalizability. Thirdly, the cross-sectional design of all the included studies prevents causal inferences from being drawn. Furthermore, not all studies specified the type of cancer screening examined, and those that did were too few in number to enable conclusions specific to screening type. Lastly, half of the included studies used non-validated tools, and even among the validated ones, it is not always clear whether the assessed constructs are cancer-specific or applicable across different cancer types, representing a further limitation in the comparability of findings. Despite these limitations, to the best of our knowledge, this is the first systematic review to investigate the association between CL and screening behaviors, providing a comprehensive overview of the current research. By exploring both screening intention and uptake, this review addresses multiple aspects of the decision-making process. Additionally, the inclusion of studies employing both validated and *ad hoc* measurement tools broadens the scope of evidence considered, while by excluding ambiguous terms such as "literacy" and "literacy on cancer," this review minimizes potential errors in study inclusion, ensuring a clear and focused analysis of CL.

4.2. Conclusions

This review found that higher CL appears to be positively associated with cancer screening intentions, based on evidence from two studies, while it remains unclear whether CL predicts cancer screening uptake, suggesting that other factors may play a role. However, due to the extreme paucity of evidence, the heterogeneity of the methods employed, and the limitations of the studies included, it is crucial to conduct further research to better clarify the role of CL in cancer-related behaviors, possibly using more rigorous and standardized approaches to investigate the associations of interest.

CRediT authorship contribution statement

Paolo Villari: Writing – review & editing, Validation. **Jessica Iera:** Methodology, Investigation, Formal analysis, Data curation. **Antonio Sciurti:** Writing – original draft, Methodology, Investigation, Formal analysis, Data curation. **Carolina Marzuillo:** Writing – review & editing, Validation. **Giuseppe Migliara:** Formal analysis, Data curation, Conceptualization. **Claudia Isonne:** Writing – original draft, Visualization, Supervision, Resources, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Andrea Pistollato:** Writing – original draft, Investigation. **Alessandra Sinopoli:** Writing – original draft, Investigation, Conceptualization. **Valentina Baccolini:** Writing – review & editing, Visualization, Validation, Supervision, Project administration, Methodology, Data curation, Conceptualization.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Registration

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.pec.2025.109346.

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