Cancer Health Literacy and Cancer Screening Behaviors: A Systematic Review

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암 건강정보문해력과 암 조기진단행위: 체계적 문헌고찰

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Abstract The purpose of this paper is to systematically evaluate the relationship between cancer health literacy and cancer screening behaviors using global data. Following the preferred reporting items for systematic reviews and meta-analyses review guidelines, full-text articles published on PubMed, CINAHL, Embase, and Cochrane Library were reviewed until 31 January 2021. The reference lists of all selected studies have been also included. The cancer health literacy and cancer-screening behaviors of the participants aged ≥18 years were assessed. Seventeen studies that met the inclusion criteria were included. The cancer screening behaviors included mammograms, clinical breast cancer examination, Papanicolaou test, colonoscopy, and PSA screening. Eleven studies revealed a statistically meaningful relationship between the cancer health literacy and cancer screening behaviors. Further research should focus on developing effective interventions and guidelines on cancer health knowledge. The research scope of all areas of cancer health literacy and cancer screening behaviors should be extended to improve the cancer screening rates and public health.

Key Words : Health literacy, Numeracy, Cancer Screening, Behavior, Systematic review

요 약 글로벌 데이터를 사용하여 암 건강정보문해력과 암 조기진단 행위 사이의 관계를 체계적으로 평가하고자 하였다. PRISMA 리뷰 가이드라인에 따라 2021년 1월31일까지 PubMed, CINAHL, Embase, Cochrane Library 4개의 웹 데이터베이스에 발표된 원문을 검색하였으며, 참고문헌 목록을 통해 추가로 검색하였다. 18세 이상의 참여자, 암 건강정보문해력과 암 조기진단 행위를 포함하여 측정하였다. 포함 기준에 충족되는 17건의 원문은 암 건강정보문해력을 측정했고 암 조기진단 행위에는 유방 촬영술, 임상 유방암 검진, Papanicolaou 검사, 대장 내시경 검사, PSA 검진 등이 포함되었다. 그중에 11건의 원문에서 암 건강정보문해력과 암 조기진단 행위 사이는 통계적으로 높은 긍정적인 상관관계를 확인하였다. 이러한 결과를 바탕으로 추후 연구에서는 암 건강 지식에 대한 효과적인 중재프로그램과 가이드라인을 개발하는 것에 초점을 맞추어야 한다. 연구결과를 근거로 암 조기진단율 과 공중 보건 향상을 위해서 암 건강정보문해력과 암 조기진단 행위에 관한 모든 영역으로 연구 범위를 확대하여야 한다.

주제어 : 건강정보문해력, 수리력, 암 조기진단, 행위, 체계적 문헌고찰

1. INTRODUCTION

1.1 Background

Cancer is one of the most common causes of death worldwide, with 9.6 million deaths annually [1]. Prostate, breast, lung, and colorectal cancers were the most common cancers in 2020 [2]. Effective ways to prevent cancer include quitting smoking, limiting alcohol use, maintaining a healthy diet, and exercise [1]. Regular screening is also a valuable measure for finding cancer early. Screening can discover cancer before symptoms appear or worsen, which reduces the mortality rate of cancer [2]. The factors that affect the cancer screening behaviors (CSBs) are socioeconomic status, insurance status, ethnicity, race, age, knowledge about screening, and health literacy (HL) [3]. HL is one of the most important factors affecting cancer screening [4].

The general HL is defined as "the cognitive and social skill that determines the motivation and ability of individuals to gain access to, understand, and use information in ways that promote and maintain good health" [5]. The most common measurement of assessing HL used in studies are the Rapid Estimate of Adult Literacy in Medicine (REALM) and the Test of Functional Health Literacy in Adults (TOFHLA) [6,7]. Because of increasing cancer, general health literacy cannot represent the cancer patients' health literacy. Cancer health literacy (CHL) has become a major focus.

CHL is defined as an individual's capacity to seek out, comprehend, evaluate, and use basic information and services required to make appropriate decisions regarding cancer prevention, diagnosis, and treatment [8]. The many kinds of CHL measurements include Breast Cancer Literacy Assessment Tool (B-CLAT), Cervical Cancer Literacy Assessment Tool (C-CLAT), and The Assessment of Health Literacy in Cancer Screening (AHL-C) [9-11].

There is evidence showed that there is a link between HL and CSBs. Original study had proved that HL is a factor promoting CSBs [4]. Some researchers have reported a significant association between CHL and CSBs. A study of which subjects were African immigrant women aged 21–65 years old showed that high CHL were associated with Pap testing in bivariate models. In another study, 560 Korean American women as subject, and do a research on several CHL dimensions and Papanicolaou (Pap) test. This research still showed that familiarity and navigational health literacy were associated with Pap test [12,13]. Based on the above messages, we need more evidence to strengthen the relationship between CHL and CSBs in order to reduce the risk of cancer.

1.2 Purpose

This review aims to reinforce the evidence and relationship between CHL and CSBs. And systematically summarize the relation between CHL and CSBs.

2. THE REVIEW

2.1 Design

A systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [14].

2.2 Subjects

All kinds of research design articles on CHL and CSBs were considered as subjects. Seventeen studies were included based on the inclusion criteria.

2.3 Inclusion and exclusion criteria

2.3.1 Inclusion criteria

The articles included in this study were written in English and published in peer-reviewed

journals until 2021. The inclusion criteria for the randomized controlled trials (RCTs) and non-randomized studies (NRSs) followed the PICO (Participant, Intervention, Comparison, Outcome) framework:

P: Any participant, irrespective of sex, age, area, race, and health condition, would be considered.

I: Cancer health literacy interventions implemented on the participants, such as face to face health education, telephone consultation, peer education, and cueing screening activities.

C: General care or different interventions.

O: Cancer screening outcomes.

The inclusion criteria for the descriptive or correlational study and qualitative research were based on the PEO (Population/problems, Exposure, Outcomes/themes) framework as follows:

P: Any participant with no limitation.

E: Aspects of cancer health literacy regarding cancer screening.

O: Practices, beliefs, and awareness related to cancer screening as a measure or experience of the participants.

2.3.2 Exclusion criteria

· Health literacy not measured by a cancer health literacy measurement.

· Article was not full text.

· Article was not in English.

2.4 Search method

The keywords of 'health literacy' OR 'health numeracy' OR 'literacy' OR 'numeracy' AND 'cancer screening' complying with the Medical Subject Headings and review of keywords were used to identify the related studies published in PubMed, CINAHL, Embase, and Cochrane Library databases until 28 January 2021 (Appendix S1 shows the search strategy). The reference lists of all selected studies were also used to assess the eligibility of additional studies.

2.5 Data collection

One reviewer (G.L.R.) reviewed all studies based on titles and abstracts according to the inclusion criteria. The full-text articles potentially included in this review were then screened. Finally, the results were rechecked and decided by another researcher (K.H.L.).

2.6 Search outcome

Figure 1 shows the data collection process. Nine hundred and twenty studies were obtained using the search strategy from the four databases. After deleting the duplicates, 570 articles remained. Two hundred and nine studies were chosen bytitle and abstract, and 172 studies were selected by full-text screening. Full-text articles that did not meet the inclusion criteria were deleted, and 13 articles were included. Finally, four articles were added through the reference list, giving a total of 17 studies were included in this review.

2.7 Quality appraisal

Two reviewers (G.L.R. and K.H.L.) independently used the judging tool from the Joanna Briggs Institute (JBI) [15] to check the risk of bias for all studies included in this review. A 'yes' answer scored one point, and the other answer scored zero points. Any article that received more scores was considered to be of higher quality. A score $\geq 2/3$, $1/3 < \text{score} < 2/3$, and $\leq 1/3$ of the total score represented high, middle, and low quality, respectively.

3. RESULTS

Among the 17 articles, there was one randomized controlled trial (RCT), three non-randomized studies (NRSs) (Table 1), and 13 surveys (Table2).

Identification

PubMed
N = 322

Embase
N = 269

CINAHL
N = 74

Cochrance
Library
N = 255

Screening

Total = 920

Removed duplicates:
N = 350

Title or/and Abstract
screened: *N* = 570

Not selected:
N = 361
(inclusion criteria not met)

Eligibility

Full text found:
N = 209

Not selected: *N* = 37
- Article in press (*N* = 1)
- Editorial briefing (*N* = 1)
- Pilot study (*N* = 3)
- Conference abstract (*N* = 9)
- Clinical trial (*N* = 23)

Full screened:
N = 172

Included

Additional records
identified through
another source: *N* = 4

Full-text articles did
not meet the inclusion
criteria: *N* = 159
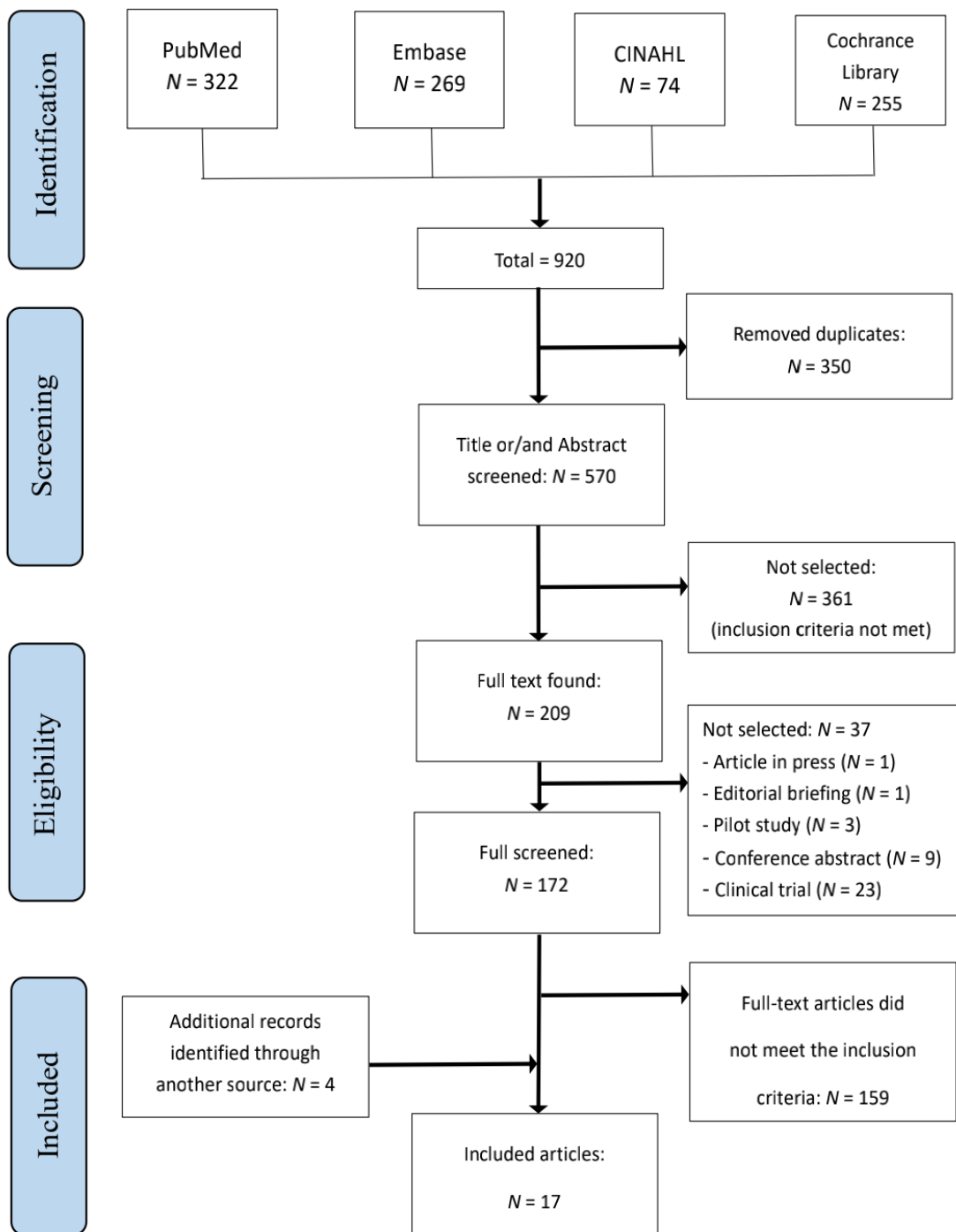
Included articles:
N = 17

Fig. 1. PRISMA flow diagram of study included in this review

3.1 Results of quality appraisal

The articles selected in this review were judged using the JBI appraisal tools; all of them were of high quality (Table 3). The RCT study received eight points [19], the three NRSs had six points, seven points, and eight points [16-18]. Four surveys received six points [21,24,27,28], five surveys received seven points [12,20,22,25,26], and four surveys received eight points [13,23,29,30]. Appendix S2 provides details of the quality appraisal.

3.2 Interventions and outcomes of RCT and NRSs

In the RCT, an intervention of education and shared experience was used. CHL was scaled by four parts: Pap test knowledge, beliefs, self-efficacy, and confidence. Pap test screening ratio as a result index showed that this intervention, which was carried out on community health workers, was an effective way of increasing the CSBs [16].

In the three NRSs, the outcome variables of one measured CHL by an Assessment of Health Literacy in Cancer, outcome variables were mammograms (MAMM) and Pap tests. All CSB changes showed statistically significant differences [17]. One study used an e-learning module on colon cancer literacy as an intervention. The CHL was assessed by a colon cancer-literacy quiz assessment, and the CSBs was defined as colonoscopy. The result showed a statistically significant change [18]. The final NRS intervention was home-based cancer literacy education. CHL was scaled by the Cancer Literacy Measure-Breast Cancer-Navajo and MAMM as the outcome variable, and this intervention still had a positive effect on the CSBs [19].

Table 1. Interventions and outcomes of the RCT and NRSs

Author	Year	Design	Sample size	Participant characteristics	Intervention	Control	CHL measurement	Cancer screening investigated	Results
Emerson, A. M. et al. [16]	2019	Pre-post randomized wait list-control	133	– Kansas women ≥18 years old	Lessons addressed cervical health literacy		Pap test knowledge, beliefs, self-efficacy, and confidence for screening	Pap tests	Post:82.00% Baseline: 72.20%, $p < .05$
Han, H. R. et al. [17]	2017	Cluster randomized controlled trial	560	– Korean American woman – Aged 21 to 65 – No MAMM or Pap test	Community health worker –led health literacy intervention: 16 hours over 3 days	Community health worker education: 5 hours in 1 day	AHL–C	– MAMM – Pap test	– MAMM OR=18.50 – Pap tests OR=13.30 – MAMM and Pap test OR=17.40
Hassinger, J. P. et al. [18]	2010	Pre-post randomized controlled trial	73	– Adult patients – Accompanying adult family members	An e-learning module about colon cancer literacy		Colon cancer literacy quiz assessment	Colonoscopy	OR=0.62, $p > .05$
Sinicrope, P. S. et al. [19]	2020	Pilot randomized controlled trial	25	– Navajo women≥40 years old – No MAMM – No prior breast cancer diagnosis	Home– based cancer literacy interventions	Breast health and cancer screening education home visit	Cancer Literacy Measure–Breast Cancer–Navajo (CLM–BC–N)	MAMM	Control group: 66.70% Intervention group: 50.00%, $p > .05$

Abbreviations: RCT, randomized controlled trial; NRSs:non-randomized studies, Mammography(MAMM), Papanicolaou test (Pap test)

Table 2. Summary of surveys

Author	Year	Design	Sample size	Participant characteristics	CHL measurement	Cancer screening investigated	Results
An, S. et al. [20]	2020	Survey questionnaire	233	− ≥20 years old − First generation of immigrants − Korean American women	5−items measurement	Annual check	β=0.21, SE=0.17, p< .05
Boogar, I. R. et al. [21]	2018	Retrospective cross sectional	366	− Aged 20 to 55 − 133 males, 233 females	ACCL	Colorectal cancer screening and/or colonoscopy	R=−0.11, p< .05
Choi, Y. J. et al. [22]	2020	Cross−sectional survey	230	− ≥18 years old − Korean American woman	5−item measurement	Annual check	t=2.05, p < .05
Cudjoe, J. et al. [12]	2020	Cross−sectional	167	− African immigrant women − Aged 21 to 65 − Had no history of hysterectomy	AHL−C	Pap test	OR (95% CI)=0.55 (0.10,3.16), p> .05
Han, H. R. et al. [13]	2019	Cross−sectional	560	− Korean American women − Aged 21 to 65 − No MAMM and/or Pap test	AHL−C	Pap test	OR (95% CI)=1.10 (1.04,1.16), p< .01
Kim, K. et al. [23]	2018	Cross−sectional, correlational	560	− Korean American women − Aged 21 to 65 − No breast and/or cervical cancer screening	AHL−C	Pap test	Indirect effect: path coefficient=0.13, p< .05
Lee H. Y. et al. [24]	2015	Cross−sectional	164	− Hmong American women − Aged 21 to 65	12−items cancer literacy questionnaire	Pap test	OR=0.87, p> .05
Lee H. Y. et al. [25]	2016	Cross−sectional	585	− Korean adults − Aged 20 to 83	12−items cancer literacy questionnaire	− Prostate−specific antigen test − Breast ultrasound − Faecal occult blood test − Gastrography − Sigmoidoscopy/ colonoscopy	Direct effect: path coefficient=0.08, p< .05
Mazor, K. M. et al. [26]	2014	Survey questionnaire	527	Women aged 40 to 65	CMLT−Listening and Reading	Pap test	CMLT−Listening scores : − Top quartile: OR=2.00 − Third quartile: OR=1.59 − Second quartile: OR=1.36 CMLT−Reading scores: − Top quartile: OR=1.61 − Third quartile: OR=1.66 − Second quartile: OR=1.61
Morris N. S. et al. [27]	2013	Survey questionnaire	1013	− Adult − Aged 40 to 70	CMLT−Listening and Reading	Colorectal Cancer Screening	Low health literacy did CCS: 73.30% High health literacy did CCS: 77.30%, p> .05
Pendlimari, R. et al. [28]	2012	Survey questionnaire	61	− Adult − No colon cancer or inflammatory bowel disease	ACCL	Colonoscopy	Limited literacy: n=24 Adequate literacy: n=14 Univariate p< .05 Multivariate p< .05
Roman, L. et al. [29]	2014	Exploratory analysis	514	− Women aged 21to 70 − Black, Latina, and Arab	BCLAT CCLAT	−CBE − MAMM − Pap test	CBE: − Black: OR=0.70, p< .05 − Latina: OR=1.06, p> .05 − Arab: OR=1.03, p> .05 MAMM: − Black: OR=0.66, p< .05 − Latina: OR=0.85, p> .05 − Arab: OR=1.09, p> .05 Pap test: − Black: OR=0.50, p< .05 − Latina: OR=1.48, p> .05 − Arab: OR=0.90, p> .05
Talley, C. H. et al. [30]	2017	Survey questionnaire	278	Women: Blacks 130; Latina 68; Arab Americans 80	BCLAT	− CBE − MAMM	SEM of CBE: γ=.05, p> .05 SEM of MAMM: γ=.07, p> .05

Abbreviations: Mammography (MAMM), Papanicolaou test (Pap test), Clinical breast exam (CBE), Structural equation model (SEM)

3.3 Measurements and outcomes of surveys

In the 13 survey studies, the CHL was measured using five-item questionnaire developed from the cancer screening guidelines and breast cancer risk factors [20], Assessment of Colon Cancer Literacy [21,28], five items from the American Cancer Society's cancer screening guidelines [22], Assessment of Health Literacy-Cancer [12,13,23], 12-item cancer literacy scale made from cancer risk beliefs [24,25], the Cancer Message Literacy Test (CMLT)-Listening and CMLT-Reading [26,27], Breast Cancer Literacy Assessment Tool, and the Cervical Cancer Literacy Assessment Tool [29,30].

The CSBs were checked as an annual check [20,22]. The American Association of Retired Persons suggested a Pap smear, colon cancer screening, MAMM, PSA screening, and bone density scan as the annual check items. Hence, in the previous studies, colorectal cancer screening, colonoscopy [21,25,27,28], Pap test [12,13,23,24,26,29], prostate-specific antigen test, breast ultrasound, fecal occult blood test, gastrography, sigmoidoscopy [25], clinical breast exam (CBE), and MAMM [29,30] were assessed.

Among these articles, 10 studies showed positive relationship between CHL and CSBs [13,16,17,20-23,25,26,28]. Six studies showed no association between them [12,18,19,24,27,30]. One study reported that only a part of the CSBs had association with CHL [29].

4 DISCUSSION

Various statistic analysis methods were used in original studies such as logistic regression [20], correlation [21], t test [22,28], $x2$ test [16,19,27], structural equation modeling [23,25,30], and odds ratios (OR) [12,13,17,18,24,26,29]. Based on the statistically significant OR value, the lowest value is 0.50, and the highest value is 18.50. Study pointed that CHL scores usually bring with it a up in CSBs [13], and both causality and correlation showed positive relationship between CHL and CSBs.

Emerson et al. [16] performed an educational program regarding cervical HL and Pap test as outcome. The results showed that this intervention is an effective method for improving Pap test. Han et al. [17] conducted a HL skills training intervention, MAMM and Pap test were measured. After training, both MAMM and Pap tests increased significantly. Hassinger et al. [18] designed a colon cancer literacy module applied to participation, but it had no effect after the intervention. Syncope et al. [19] tested a home-based cancer literacy intervention, which the result was scaled as MAMM. That study showed that the MAMM test rate had not increased meaningfully. von Wagner C [31] developed a framework suggesting that knowledge can mediate the HL and health behaviors. Only two of the four intervention studies demonstrated a statistically significant relationship between CHL and CSBs. Nevertheless, the effectiveness cannot be ignored. Hence, the prior study had the same result as this review [32].

Different authors measured CHL in a variety of ways. Boogar et al. [21] and Pendlimari et al. [28]

Table 3. Quality appraisal result

Study	Study design	Score	Appraisal tools
Sinicrope, P. S. et al. [19]	RCT	8	JBI checklist for RCT
Emerson, A. M. et al. [16]	NRSs	6	JBI checklist for NRSs
Han, H. R. et al. [17]	NRSs	7	
Hassinger, J. P. et al. [18]	NRSs	8	
An, S. et al. [20]	Survey	7	JBI checklist for analytical survey
Boogar, I. R. et al. [21]	Survey	6	
Choi, Y. J. et al. [22]	Survey	7	
Cudjoe, J. et al. [12]	Survey	7	
Han, H. R. et al. [13]	Survey	8	
Kim, K. et al. [23]	Survey	8	
Lee H. Y. et al. [24]	Survey	6	
Lee H. Y. et al. [25]	Survey	7	
Mazor, K. M. et al. [26]	Survey	7	
Morris N. S. et al. [27]	Survey	6	
Pendlimari, R. et al. [28]	Survey	6	
Roman, L. et al. [29]	Survey	8	
Talley, C. H. et al. [30]	Survey	8	

used the Assessment of Colon Cancer Literacy (ACCL) in their research. Cudjoe et al. [12], Han et al. [13], and Kim et al. [23] scaled the CHL by an Assessment of Health Literacy-Cancer (AHL-C). Lee H. Y. et al. [24,25] used a 12-items cancer literacy questionnaire on cancer risk beliefs. In contrast, Mazor, K. M. et al. [26] and Morris N. S. et al. [27] scaled CHL using the Cancer Message Literacy Test (CMLT)-Listening and Reading. Roman, L. et al. [29] and Talley, C. H. et al. [30] assessed CHL using the Breast Cancer Literacy Assessment Tool (Breast-CLAT). Roman, L. et al. [29] also used the Cervical Cancer Literacy Assessment Tool (CCLAT). An, S. et al. [20] used a five-item tool made from the cancer screening guidelines and breast cancer risk factors, Choi, Y. J. et al. [22] measured CHL by a five-item questionnaire made from the American Cancer Society's cancer screening guidelines.

For cancer prevention, HL is indispensable, and a suitable concept is necessary. Health literacy is a multiple concepts with several dimensions. Following the attribute of HL, an important characteristic is dynamic. This is different from the patient's status and individual's condition [33]. On the other hand, a CHL measurement is more reliable and representative than the general HL measurement [28]. So, in this review, HL in all articles were scaled by CHL questionnaire. Despite this, these scales were different in studies. This may explain the different CHL results and research results among these articles.

HL is a vital health area for people to prevent disease and improve quality of life. It is useful for both healthy people and patients. Particular attention should be paid to cancer consumer. An earlier study suggested that HL might affect CSBs, which results in different health beliefs that lead to different cancer screening outcomes [34]. The results of the present review suggest that CHL has a positive association with CSBs.

The outcome variable in this review was CSBs, which is varied. For example, the most common CSBs are Pap test, colorectal cancer screening, and breast cancer screening. Different CSBs have different screening rates. The National Cancer Institute 2020 annual report showed that the lung cancer-screening rate was low. The colorectal screening rate was 62.4%. The breast cancer-screening rate was 35.4% of uninsured women, and the prostate cancer-screening rate was 16.7% [35]. The difference in screening rates may also be a factor affecting the results.

The participants in this review have different age ranges, which is a factor leading to different HL levels and CSBs, as shown in other study [36]. With age, the health belief has essentially improved, even age is not a decisive factor that affects CHL and CSBs, but its importance cannot be ignored. After all, there is a higher risk of cancer in older people.

Articles selected in this review assessed people of different ethnicities, including immigrants. Immigrants have a low HL and low cancer-screening rate, as do different ethnic groups [37]. For immigrants, English is their second language, and it is not easy to understand the health information provided. In addition, the questionnaires were English version. Although they were translated into native language for subjects, there is still some cultural ambiguity. Hence, there is an inducement factor resulting in different research outcomes. This may indicate that immigrants have more urgent need for health knowledge.

This review used three kinds of research designs: randomized controlled trials, non-randomized studies, and surveys. The researchers showed that an RCT study has a higher level of scientific evidence [38]. Hence, it is an effective method to confirm whether an intervention is helpful to patients for their health. Among the articles in this review, one RCT and three NRS, only two studies were statistically significant.

Therefore, it is difficult to confirm that the CHL has an association with CSBs. On the other hand, the contribution of the survey research on discipline cannot be denied. The articles included in this review has heterogeneity, which is an undeniable factor affecting the result.

5 CONCLUSIONS

This review highlights the evidence of the CHL and CSBs in published articles. A relation between CHL and CSBs was noted. Hence, the characteristics and effects of CHL and CSBs need to be understood as a medical guide for patients' preventive health behavior. Considering a person as integral and dynamic, it is necessary to develop a representative CHL scale to increase the credibility of these studies as a complementary and alternative measurement for all patients. The literature used for this topic research has some limitations, and there was obvious heterogeneity in the published randomized controlled trials in the related literature. Therefore, the results of this study should be treated with caution. More data integration will be needed to confirm the effectiveness of the same intervention. This study focused on CHL which is less researched in the original studies or the review studies. HL is a new concept developed for a short time. So far, most studies put the barycenter on general HL not on CHL, but cancer has been a troublesome health problem. So, this review attempts to seek out connection between CHL and CSBs so that the hidden danger of cancer can be reduced. To ensure a comprehensive and accurate assessment of CHL, an universality CHL questionnaire is needed and more researches on the CHL scales development can be considered. The attributes of subjects are important factors affecting CHL, such as age, race, and area. So, more researches on different subjects and more RCT articles

should be reviewed to verify the evidence of CHL and CSBs. In future clinical work, more cancer-related interventions can be considered for patients. Some Multi-faceted intervention methods or in-depth comprehensive interventions in a single field are still needed. There are some limitations in this review, no meta-analysis was performed, which may reduce the credibility of data analysis. All articles were in English. Hence, the representativeness of the articles is limited and does not represent the current state of global data. Hence, the scope of interventional research should be expanded to form a comprehensive evidence system. Moreover, without a unified measurement, it is difficult to explain the level of CHL objectively. Therefore, more research will be needed in this field.

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Appendix S 1. Research strategy

Health Literacy related terms	Cancer Screening related terms		
	"…"	AND	"…"
health literacy*	colon*		cancer screening
health numeracy*	rectum*		cancer early detection
literacy*	lung		screening, cancer
numeracy*	breast		cancer screening test*
	cervi*		screening test*, cancer
	liver		test*, cancer screening
	prostate		early diagnosis of cancer
	skin		cancer early diagnosis
	ovari*		early detection of cancer
			ultrasound
	breast MRI, CA−125 test*, breast self exam*, clinical breast exam*, mammogra*, PSA test*, Pap test*, human papillomavirus test*, skin exam*, transvaginal ultrasound, virtual colonoscopy, colonoscopy, sigmoidoscopy, stool test*, high sensitivity fecal occult blood test*, stool DNA test*, low dose helical computed tomography, alpha fetoprotein blood test*		

Appendix S 2. Risk of bias of included studies using JBI
JBI critical appraisal checklist for RCTs (n =1)

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	score
Sinicrope, P. S. et al.,2020	N	N	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	8

Note

Y: yes; N: no; U: unclear; NA: not applicable

Q1. Was true randomization used for assignment of participants to treatment groups?
Q2. Was allocation to treatment groups concealed?
Q3. Were treatment groups similar at the baseline?
Q4. Were participants blind to treatment assignment?
Q5. Were those delivering treatment blind to treatment assignment?
Q6. Were outcomes assessors blind to treatment assignment?
Q7. Were treatment groups treated identically other than the intervention of interest?
Q8. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?
Q9. Were participants analyzed in the groups to which they were randomized?
Q10. Were outcomes measured in the same way for treatment groups?
Q11. Were outcomes measured in a reliable way?
Q12. Was appropriate statistical analysis used?
Q13. Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?

JBI critical appraisal checklist for NRSs (n = 3)

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	score	Note
Emerson, A. M. et al.,2019	Y	Y	N	N	Y	N	Y	Y	Y	6	Y: yes; N: no; U: unclear; NA: not applicable
Han, H. R. et al.,2017	Y	N	N	Y	Y	Y	Y	Y	Y	7	Q1. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is 2. no confusion about which variable comes first)?
Hassinger, J. P. et al.,2010	Y	Y	Y	N	Y	Y	Y	Y	Y	8	Q2. Were the participants included in any comparisons similar?
											Q3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?
											Q4. Was there a control group?
											Q5. Were there multiple measurements of the outcome both pre and post the intervention/exposure?
											Q6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?
											Q7. Were the outcomes of participants included in any comparisons measured in the same way?
											Q8. Were outcomes measured in a reliable way?
											Q9.Was appropriate statistical analysis used?

JBI critical appraisal checklist foranalytical surveys (n = 13)

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Score	Note
An, S. et al.,2020	Y	Y	Y	N	Y	Y	Y	Y	7	Y: yes; N: no; U: unclear; NA: not applicable
Boogar, I. R. et al.,2018	Y	U	Y	Y	Y	N	Y	Y	6	Q1. Were the criteria for inclusion in the sample clearly defined?
Choi, Y. J. et al.,2020	Y	Y	Y	N	Y	Y	Y	Y	7	Q2. Were the study subjects and the setting described in detail?
Cudjoe, J. et al.,2020	Y	U	Y	Y	Y	Y	Y	Y	7	Q3. Was the exposure measured in a valid and reliable way?
Han, H. R. et al.2019	Y	Y	Y	Y	Y	Y	Y	Y	8	Q4. Were objective, standard criteria used for measurement of the condition?
Kim, K. et al.,2018	Y	Y	Y	Y	Y	Y	Y	Y	8	Q5. Were confounding factors identified?
Lee H. Y. et al.,2015	Y	U	Y	N	Y	Y	Y	Y	6	Q6. Were strategies to deal with confounding factors stated?
Lee H. Y. et al.,2016	Y	Y	Y	N	Y	Y	Y	Y	7	Q7. Were the outcomes measured in a valid and reliable way?
Mazor, K. M. et al.,2014	Y	Y	Y	N	Y	Y	Y	Y	7	Q8. Was appropriate statistical analysis used?
Morris N. S. et al.,2013	Y	Y	Y	N	Y	N	Y	Y	6	
Pendlimari, R. et al.,2012	U	U	Y	Y	Y	Y	Y	Y	6	
Roman, L. et al.,2014	Y	Y	Y	Y	Y	Y	Y	Y	8	
Talley, C. H. et al.,2017	Y	Y	Y	Y	Y	Y	Y	Y	8	