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The Relationship Between Health Literacy, Cancer Prevention Beliefs, and Cancer Prevention Behaviors

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Abstract

While cancer prevention behaviors have been clearly defined, many people do not engage in these risk-reduction behaviors. Factors such as cancer prevention beliefs and limited health literacy may undermine cancer prevention behavior recommendations. This study explored the relationships between cancer prevention beliefs, health literacy, and cancer prevention behaviors. Data were analyzed from the 2013 Health Information National Trends Survey ($n = 1675$). Regression analyses for four cancer prevention belief (*prevention is not possible*, *cancer is fatal*, *there are too many recommendations for prevention*, *everything causes cancer*) statements were modeled, including health literacy and sociodemographic variables as predictors. In addition, separate regression analyses predicted four cancer prevention behaviors (fruit and vegetable consumption, physical activity, cigarette smoking) from cancer prevention beliefs, health literacy, and sociodemographic variables. Participants with low health literacy were more likely to hold fatalistic cancer prevention beliefs than those with higher health literacy. Cancer prevention beliefs were related to less fruit and vegetable consumption, fewer days of physical activity, and with being a nonsmoker after controlling for sociodemographic variables. Health literacy was not a significant predictor of cancer prevention behaviors. Given the relationship between health literacy and cancer prevention beliefs, research is needed to ascertain how to empower patients with low health literacy to have a more realistic understanding of cancer.

Keywords Cancer · Cancer prevention behaviors · Cigarette smoking · Diet · Fatalism · Fruits and vegetables · Health literacy · Physical activity

Cancer is the second leading cause of death in the USA [22]; however, incidence rates of many cancers can be significantly reduced through engagement in healthy lifestyle behaviors [2, 13]. Physical inactivity, poor diet, and tobacco use are implicated in approximately 30% of all cancer-related deaths [2]. Yet, 20% of adults engage in tobacco use, 34% are inactive, and 76% and 87% have low fruit and vegetables intake, respectively [14, 21]. Some cancer prevention beliefs may undermine lifestyle behavior recommendations that reduce risk and prognosis.

Cancer fatalism, specifically, the belief that cancer development and prognosis is beyond human control, is a barrier to cancer screening [18]. In adults, higher fatalistic beliefs are related to lower value being placed on cancer prevention behaviors, reduced motivation for engaging in cancer prevention behaviors, and perceptions of lack of control [15, 16]—all of these attitudes are related to a decreased likelihood for engagement in cancer prevention behaviors. Higher fatalistic beliefs are also directly related to lower engagement in cancer prevention behaviors, including exercising weekly, avoiding smoking, and consuming fruits and vegetables [16]. Cancer information overload, the feeling of being overwhelmed by the amount of cancer-related information provided, is another factor that undermines cancer prevention behaviors [9]. Some studies subsumed this factor in their operationalization of cancer fatalism [15, 16].

Health literacy (HL), the ability to obtain, understand, process, and apply health information to health decision-making [20], is also directly linked to engagement in cancer prevention behaviors. Specifically, low levels of HL are related to tobacco use, physical inactivity, and low fruit and vegetables consumption [5, 23]. Low HL is also related to cancer misconceptions, less information-seeking, and less perceived

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control over cancer risks [6, 10]. Cancer-related HL, specifically, is negatively related to cancer fatalistic beliefs [10, 15].

Further, the sociodemographic characteristics of adults with higher cancer fatalistic beliefs and cancer information overload (i.e., low income, low education, or racial ethnic minorities) [7, 9, 10, 16] corresponds to those at highest risk for cancer mortality [1, 22, 24] and low HL [10, 18]. Given these adults' multiple risks for cancer including cancer-related lifestyle behaviors, and that cancer fatalism [16], cancer information overload, and HL [5, 9, 23] are independently related to reduced engagement in cancer prevention behaviors, an understanding of the relationships between these variables are essential for the design of informed, effective cancer prevention interventions.

The Current Study

The relationship between perceptions of cancer prevention beliefs and (1) HL and (2) cancer prevention behaviors have been explored separately. Yet, the characteristics of adults at risk for negative cancer prevention beliefs, lower HL, and lower cancer prevention behaviors overlap, suggesting that the three variables may be related in a meaningful way. This study expanded on previous research by examining (1) the relationship between functional HL and cancer prevention beliefs specifically and (2) the extent to which HL and cancer prevention beliefs were related to cancer prevention behaviors. We hypothesized that individuals with higher HL would be more likely to disagree with cancer fatalism and cancer information overload beliefs than those with lower and medium HL, and these relationships would be sustained after including sociodemographic variables in the model. Additionally, we proposed that individuals with higher HL and who disagree with cancer fatalism and cancer information overload beliefs would have more cancer prevention behaviors than those with lower and medium HL and who agree with cancer fatalism and cancer information overload beliefs, after controlling for sociodemographic variables.

Methods

Study Population and Design

We used the 2013 US Health Information National Trends Survey (HINTS), a population-based survey administered by the National Cancer Institute ($n = 3185$). HINTS employs a complex probability sampling design to collect data from non-institutionalized persons 18 years and older. African Americans and Hispanics are oversampled to ensure sufficient representation of these groups for analyses. HINTS was a mail survey that utilized a two-stage approach to randomly select residential addresses, and one adult respondent from each chosen household was selected using the Next Birthday Method. Participants were given the option of completing the survey in English or Spanish. Survey data were collected between September and December 2013. Only participants who answered all four HL questions were included in the analyses ($n = 1675$). The survey is available at http://hints.cancer.gov/instrument.aspx. The current study was exempt from institutional review board approval as it is a secondary analysis of a publicly available, de-identified dataset.

Measures

Socio-Demographic Variables

Sex, age, race/ethnicity, education, and income were included in the analyses. Responses to race and ethnicity questions were combined to create a single variable with four categories (non-Hispanic white, Hispanic, non-Hispanic black, and other). Education was categorized into low (< high school, high school graduate), medium (some college), and high (college graduate and post-baccalaureate degree), and household income was grouped into < $20,000, $20,000–$49,999, $50,000–$74,999, and ≥ $75,000.

Health Literacy

HL was measured using an adapted, self-administered version of the Newest Vital Sign (NVS)—a validated measure of functional HL [25]. The original NVS has six questions referencing a nutrition label; however, two questions were omitted from the HINTS survey as they required skip logic procedures which would only be possible in an interviewer or computer-assisted administration format (see footnote a in Table 1 for included questions). NVS responses were categorized into lower (score < 3), medium (score = 3), and higher (score = 4) HL.

Cancer Prevention Beliefs

Participants indicated agreement on a 4-point Likert scale to four statements about cancer prevention (see Table 1 for questions). Responses were dichotomized into agree (strongly agree/agree) and disagree (strongly disagree/disagree) as done in prior studies [16].

Cancer Prevention Behaviors

Participants self-reported daily fruits (including 100% fruit juice) and vegetables (including 100% vegetable juice) intake using the following response choices: none, ½ cup or less, ½ cup to 1 cup, 1 to 2 cups, 2 to 3 cups, 3 to 4 cups, and 4 or more cups. Fruits and vegetables were each treated as

Table 1 Socio-demographic characteristics and frequency of beliefs and behaviors of the sample

	Unweighted frequency (weighted %)
Sex	
Male	679 (54)
Female	877 (46)
Missing	119
Age	
18–34 years	248 (14.8)
35–49 years	418 (25)
50–64 years	604 (36.1)
65–74 years	255 (15.2)
75+ years	130 (7.8)
Missing	20
Race/ethnicity	
White	954 (62.3)
Hispanic	248 (13.5)
Black	206 (7.6)
Other	124 (7.2)
Missing	143
Education	
Low	389 (26.2)
Medium	530 (36.9)
High	741 (36.9)
Missing	15
Income ($)	
< 20,000	302 (14.7)
20,000–49,999	457 (28.6)
50,000–74,999	290 (17.6)
≥ 75,000	578 (39)
Missing	48
Health literacy[a]	
Low	389 (19.8)
Medium	448 (27.8)
High	838 (52.4)
There is not much you can do to lower your chances of getting cancer (prevention is not possible)[b]	
Disagree	1207 (74.6)
Agree	453 (25.4)
When I think about cancer I automatically think about death (cancer is fatal)[b]	
Disagree	753 (43.5)
Agree	900 (56.5)
There are so many different recommendations about preventing cancer, it is hard to know which one to follow (too many recommendations)[b]	
Disagree	457 (27)
Agree	1203 (73)
It seems like everything causes cancer (everything causes cancer)[b]	
Disagree	648 (34)
Agree	1013 (66)
Cancer prevention behaviors	
Fruits (daily)	
0—none	108 (5.6)
1—½ cup or less	306 (20)
2—½ cup to 1 cup	411 (24.2)
3—1 to 2 cups	481 (30.8)
4—2 to 3 cups	217 (12.1)
5—3 to 4 cups	98 (5.3)
6—4 or more cups	36 (2)
Missing	18
Vegetables (daily)	
0—none	61 (3.2)
1—½ cup or less	246 (16.8)
2—½ cup to 1 cup	399 (23.9)
3—1 to 2 cups	533 (31.7)
4—2 to 3 cups	250 (14.4)
5—3 to 4 cups	111 (7)
6—4 or more cups	57 (3)
Missing	18
Physical activity (days per week)	
0 days	373 (19.1)
1 day	168 (9.9)
2 days	179 (10.36)
3 days	303 (18.6)
4 days	188 (12.7)
5 days	199 (13.6)
6 days	98 (5.5)
7 days	147 (10.2)
Missing	20
Cigarette smoking	
Non-smoking	1424 (81.4)
Smoker	237 (18.6)
Missing	14

Only participants who completed all of the health literacy questions were included in data analysis

[a] Health literacy was scored: low < 3 correct, medium = 3 correct, high = 4 correct. Specific items included the following: (1) if you eat the entire container, how many calories will you eat?; (2) if you are allowed to eat 60 g of carbohydrates as a snack, how much ice cream could you have?; (3) you usually have 42 g of saturated fat each day, which includes one serving of ice cream. If you stop eating ice cream, how many grams of saturated fat would you be consuming each day?; and (4) if you usually eat 2500 cal in a day, what percentage of your daily value of calories will you be eating if you eat one serving?

[b] Cancer prevention belief statements were assessed on a 4-point Likert scale ranging from Strongly Agree to Strongly Disagree; dichotomized into agree (strongly agree/agree) and disagree (strongly disagree/disagree

continuous variables because the overlap in answer choices did not allow for categorization based on CDC's five servings of fruits and vegetables per day recommendations. Physical activity was assessed with "In a typical week, how many days do you do any physical activity or exercise of at least moderate intensity" and was treated as a continuous variable. Smoking cigarettes responses were dichotomized into smokers (every day, some days) and non-smokers (not at all).

Data Analysis

Analyses were conducted using the procsurveylogistic and procsurveyreg commands in SAS 9.4. These procedures allowed for weighting data to reflect national demographic characteristics and included both the jackknife replicate weights and the final sample weights. In keeping with prior research [15, 16] using the HINTS cancer belief items, each belief was treated as a separate outcome variable. A regression with HL as the predictor was first estimated; then, a multivariate regression including both HL and sociodemographic variables was estimated for each belief. Several steps were necessary to determine if HL and cancer prevention beliefs were related to cancer prevention behaviors. First, sociodemographic variables were entered in models to predict each cancer prevention behavior and only variables with $p < 0.25$ were retained for further analyses. Next, cancer prevention behavior models were estimated including sociodemographic characteristics and each of the four beliefs separately to determine each belief's association with each health behavior (i.e., 4 behaviors × 4 fatalistic beliefs = 16 models). Next, cancer prevention behaviors models were estimated including sociodemographic characteristics and HL (i.e., 4 behaviors × HL = 4 models). Last, "final" regression models including sociodemographic characteristics, HL, and all four beliefs (i.e., 1 final model per behavior = 4 models) were estimated.

Results

Sociodemographic characteristics are presented in Table 1. The total sample included 1675 participants, of which approximately 54% of participants were male, 72% were white, 37% had at least a college degree, and 39% had a household income ≥ $75,000 dollars. The largest age group was 50–64 years old (~36%).

Approximately 52% of participants had higher HL, whereas 20% had lower HL. Cancer prevention beliefs varied within the sample but were significantly correlated ($p < 0.001$). Approximately 25% of participants responded that *prevention is not possible*, 57% believed that *cancer is fatal*, 73% felt that *there are too many recommendations*, and 66% held beliefs that *everything causes cancer*. Health behaviors also varied; approximately 50% and 44% ate one cup or less of fruits and vegetables daily, respectively. Participants exercised an average of 3.09 days per week, and 81% of participants were nonsmokers.

Cancer Prevention Beliefs and HL

Results are presented in Table 2. Participants with low education (vs. high education) and lower HL (vs. higher HL) had greater odds of endorsing *prevention is not possible*. Similarly, participants with lower HL (vs. higher HL) were more likely to endorse *cancer is fatal*. Sociodemographic characteristics and HL were not predictive of *there are too many recommendations*. However, women, younger participants, participants with low and medium levels of education (vs. high education), and participants with higher HL (vs. medium HL) were more likely to endorse *everything causes cancer*.

Cancer Fatalism, HL, and Cancer Prevention Behaviors

The adjusted estimates for the final models are presented in Table 3. Regarding fruits, participants who believed that *prevention is not possible* and that *there are too many recommendations* reported eating less fruits than participants who did not endorse these beliefs. These findings remained significant after controlling for sociodemographic variables and after including HL and all cancer prevention beliefs in a single regression model. Participants who believed that *everything causes cancer* and *cancer is fatal* reported eating less vegetables than those who did not endorse these beliefs. However, these findings were no longer significant when HL and all cancer prevention belief statements were included in the same model. Participants who believed that *everything causes cancer* were less likely to engage in physical activity; however, these findings were not significant after HL and all cancer prevention belief statements were included in the model. HL and cancer prevention beliefs were not significant in the individual models predicting smoking behavior. However, in the final model, participants who believed *everything causes cancer* had lower odds of being nonsmokers than those who did not endorse this belief. HL was not predictive of any cancer prevention behaviors after controlling for sociodemographic variables.

Discussion

The purpose of this study was to determine (1) the relationship between HL and cancer prevention beliefs and (2) the relationship between cancer prevention beliefs, HL, and cancer prevention behaviors. Our first hypothesis was confirmed for two of the four cancer prevention belief statements (*prevention is not possible* and *cancer is fatal*), such that participants

Table 2 Logistic regression models of relationship between health literacy, sociodemographic characteristics, and cancer prevention beliefs

	There is not much you can do to lower your chances of getting cancer[a] OR (95% CI)	When I think about cancer I automatically think about death[a] OR (95% CI)	There are so many different recommendations about preventing cancer, it is hard to know which one to follow[a] OR (95% CI)	It seems like everything causes cancer [a] OR (95% CI)
Model 1				
Health literacy				
Low	3.25*** (2.11, 5.00)	1.99** (1.31, 3.02)	1.01 (0.64, 1.60)	0.71 (0.46, 1.10)
Medium	1.13 (0.77, 1.66)	1.37 (0.93, 2.03)	0.76 (0.52, 1.12)	0.65** (0.47, 0.88)
High	Reference	Reference	Reference	Reference
Model 2				
Female	1.07 (0.73, 1.57)	0.87 (0.61, 1.24)	1.38 (0.92, 2.08)	1.59* (1.10, 2.30)
Age[b]	0.99 (0.84, 1.16)	0.90 (0.77, 1.07)	1.04 (0.90, 1.20)	0.81** (0.70, 0.95)
Race				
Hispanic	0.91 (0.48, 1.70)	1.25 (0.75, 2.07)	0.81 (0.47, 1.41)	1.01 (0.62, 1.66)
Black	1.38 (0.75, 2.51)	1.15 (0.69, 1.93)	1.09 (0.62, 1.89)	0.55 (0.30, 1.03)
Other	1.61 (0.73, 3.56)	0.93 (0.51, 1.71)	0.94 (0.47, 1.89)	0.99 (0.48, 2.04)
White	Reference	Reference	Reference	Reference
Income ($)				
< 20,000	1.12 (0.54, 2.31)	1.45 (0.81, 2.61)	1.58 (0.87, 2.86)	0.71 (0.41, 1.23)
20,000–49,999	1.28 (0.74, 2.20)	0.91 (0.57, 1.45)	1.09 (0.64, 1.85)	1.07 (0.67, 1.72)
50,000–74,999	1.24 (0.68, 2.25)	1.04 (0.65, 1.67)	1.23 (0.65, 2.32)	.83 (0.49, 1.42)
≥ 75,000	Reference	Reference	Reference	Reference
Education				
Low	2.44** (1.48, 4.03)	1.04 (0.66, 1.64)	1.14 (0.67, 1.94)	2.31*** (1.54, 3.45)
Medium	1.23 (0.66, 2.27)	1.11 (0.77, 1.58)	1.21 (0.80, 1.83)	1.84** (1.19, 2.83)
High	Reference	Reference	Reference	Reference
Health literacy				
Low	2.28** (1.23, 4.23)	1.77* (1.04, 3.02)	0.85 (0.47, 1.56)	0.68 (0.39, 1.19)
Medium	1.03 (0.68, 1.56)	1.43 (0.93, 2.21)	0.71 (0.46, 1.08)	0.64* (0.45, 0.91)
High	Reference	Reference	Reference	Reference

CI confidence intervals, *OR* odds ratio

*Odds ratio significantly different from one at $p < 0.05$, **odds ratio significantly different from one at $p < 0.01$, ***odds ratio significantly different from one at $p < 0.001$

[a] Four-point Likert scale ranging from strongly agree to strongly disagree (dichotomized into agree/disagree)

[b] OR interpreted in 15-year increments

with lower HL were more likely to endorse fatalistic views about cancer than those with higher HL. However, this hypothesis was not confirmed when looking at beliefs that *everything causes cancer* and *there are too many recommendations*. Note that the two statements that did not support our hypothesis reflect cancer information overload [9] and negative experiences with cancer information-seeking [3].

Our second hypothesis was partially confirmed, specifically, cancer prevention beliefs were related to less engagement in cancer prevention behaviors and these results were consistent with Nierdeppe & Levy [16]. Contrary to what was predicted, HL was unrelated to cancer prevention behaviors even without controlling for sociodemographic characteristics.

Approximately 25% of the sample endorsed the perspective that *prevention is not possible* and this was more common among individuals with lower HL and education. Indeed, HL and education were strong independent predictors of this sentiment. As the US has the lowest level of social mobility by education across industrialized nations [12], it is likely that our results are in part due to entrenched multigenerational effects of low education and education-related health disparities. Specifically, given limited social mobility, there may be a social cohort effect of individuals with low education that contributes to fatalistic thinking in a manner that is independent of low HL. For example, individuals with low education are more likely to have poorer health prognosis and limited

Table 3 |Results of multivariate regression models of relationship between health literacy, cancer prevention beliefs, and cancer prevention behaviors

	Fruits B (95% CI)	Vegetables B (95% CI)	Physical activity B (95% CI)	Non-Smoking OR (95% CI)
Health literacy				
Low	0.28 (− 0.04, 0.60)	0.02 (− 0.33, 0.37)	0.31 (− 0.40, 1.02)	0.70 (0.28, 1.73)
Medium	− 0.06 (− 0.32, 0.20)	− 0.01 (− 0.28, 0.26)	0.09 (− 0.30, 0.48)	0.64 (0.32, 1.31)
High	Reference	Reference	Reference	Reference
Cancer prevention beliefs[a]				
There is not much you can do to lower your chances of getting cancer	− 0.26* (− 0.50, − 0.02)	− 0.05 (− 0.34, 0.23)	− 0.40 (− 0.92, 0.12)	0.79 (0.41, 1.52)
When I think about cancer I automatically think about death	− 0.02 (− 0.22, 0.18)	− 0.16[b] (− 0.34, 0.03)	− 0.10 (− 0.46, 0.25)	1.01 (0.63, 1.61)
There are so many different recommendations about preventing cancer, it is hard to know which one to follow	− 0.27* (− 0.52, − 0.02)	− 0.05 (− 0.30, 0.19)	< − 0.01 (− 0.41, 0.41)	1.40 (0.72, 2.73)
It seems like everything causes cancer	0.01 (− 0.24, 0.25)	− 0.21[b] (− 0.45, 0.03)	− 0.29[b] (− 0.69, 0.10)	0.57* (0.34, 0.95)

Note. Cells contain beta (fruits, vegetables, physical activity models) and odds ratio (non-smoking) estimates. Estimates are adjusted for sociodemographic confounders that were correlated with prevention behavior in bivariate models at $p < 0.25$. Sociodemographic confounders: fruits = sex, race, education, income; physical activity/vegetables = sex, age, race, education, income; non-smoking = sex, age, education, income

CI confidence intervals, *OR* odds ratio

*Variables were statistically significant at $p < 0.05$

[a] Four-point Likert scale ranging from strongly agree to strongly disagree (dichotomized into agree/disagree)

[b] Variables that were statistically significant with the behavior ($p < 0.05$) in "independent" models but became nonsignificant when health literacy and all four beliefs were included

access to resources [1], and thus embedded in an environment with higher cancer morbidity across generations which shape their fatalistic thinking. Future research to understand these observations and ascertain implications for successful interventions to decrease cancer fatalism is warranted.

Approximately 57% of participants reported that *cancer is fatal*. This shows that there is room for growth as 67% of individuals diagnosed with cancer survive, with some cancers (e.g., skin cancer) rarely leading to death [8]. Participants' endorsement of this item may be a result of the misinformation available to the public through unreliable sources [3] and catastrophizing of cancer seen in television and other media outlets [19]. These results may also reflect the disproportionate prevalence of cancer deaths in communities at risk for disparities [1, 24]. For example, individuals in low-literacy communities are more likely to be diagnosed at advance stages of the disease and have less access to resources for prevention and treatment [4]. Therefore, only those who succumb to cancer are identified as having cancer and those living with cancer may not be identified, thus promoting a frame of reference where the belief of high fatality from cancer is valid. As predicted, participants with lower HL were more likely to endorse *cancer is fatal*. Though information-seeking as well as distinguishing good from bad sources of information may be problematic in individuals with lower HL [10], it is imperative that future research explore the extent to which these individuals' beliefs are shaped by their personal and community experiences with cancer prognosis and morbidity.

Approximately 73% of participants endorsed the perspective that *there are too many recommendations*. The high endorsement of this item is alarming but should be interpreted with caution. This item and the high endorsement of *everything causes cancer* suggest that individuals may likely be overwhelmed with the information presented to them regarding cancer prevention [3]. These beliefs should be explored further as it is unclear if individuals' responses indicate their resignation about getting cancer or if they are responding to the amount of information about cancer prevention. Nonetheless, the high rate of feeling that there are *too many recommendations* and that *everything causes cancer* suggests that health providers and prevention scientist need to try to avoid overwhelming their target audience. The measurement issue with this belief is noteworthy. Specifically, as written, the belief contains two parts (there are so many different recommendations about preventing cancer, it is hard to know which one to follow) that could be interpreted independently, thus potentially confusing the respondent and influencing the endorsement of the item across demographic groups [9, 19].

Approximately 66% of the sample agreed or strongly agreed that *everything causes cancer*. Participants with low and medium education were more likely to endorse this item than those with high education. However, contrary to our

hypothesis, participants with higher HL were more likely to endorse this item than those with medium or lower HL. It is possible that participants with higher HL are more exposed to various sources of health information in a manner that ultimately serves as a disadvantage, for example, exposure to a high volume of information on cancer that is presented in a manner that may be overwhelming to decipher without medical training. HL and education are highly correlated [10, 23] and the contradictory direction of the results for the two variables warrants further research.

Endorsing *everything causes cancer* was related to lower vegetables consumption and physical activity and higher smoking. The combination of high endorsement of *everything causes cancer* and its significant negative relationship to cancer prevention behaviors highlight the potential major role cancer prevention beliefs can have on lifestyle behaviors. Prevention intervention scientists should explore whether providing more tailored cancer prevention education, potentially targeting one or only a few behaviors at a time, would result in higher cancer prevention behaviors overall.

Though HL was not a significant predictor for cancer prevention behaviors after controlling for sociodemographic characteristics, it is worthy of further exploration. Specifically, there may be an indirect path via cancer prevention beliefs in its association with behaviors. Research on guidelines to help patients access credible information and accurately interpret accessed information could help ascertain the possible mediating effect of HL on the relationship between cancer prevention beliefs and behaviors. In addition, it is important to note that HINTS only included questions related to functional HL. Communicative/interactive, critical, and media HL may be more related to cancer prevention behaviors as they are action-oriented aspects of HL [11, 17]. Further, it is likely that results will be different if the focus of the behaviors were on meeting recommendations as this requires more in-depth knowledge of what is needed for good health rather than engaging in the behavior overall. Future research should explore these relationships and evaluate interventions that empower patients who harbor negative cancer prevention beliefs.

Several limitations of this study warrant discussion. The cancer prevention belief items were single-item measures. Additionally, the third question had two parts and was potentially confusing especially for individuals with low HL and/or education [9]. Future studies should include a more comprehensive measure of cancer prevention beliefs that is validated for use with individuals who have limited education and HL. Another limitation is that cancer prevention behaviors were self-reported, thus the potential for recall and social desirability bias. While not previously studied, it is possible that recall and social desirability biases could be associated with HL. Additionally, the response options for the diet and physical activity behaviors hindered assessment of meeting recommendations, a more salient outcome metric. The HINTS sample is highly useful for its oversampling of the black and Latino communities and use of Spanish language: it however does not include an adequate sample of other racial and ethnic minority groups. Lastly, this study was limited to one aspect of HL, functional HL. Other aspects of HL, especially literacy to critically evaluate media information, may have stronger associations with cancer prevention beliefs and behaviors.

Study Implications

Cancer prevention belief is related to cancer prevention behaviors. Thus, future research should explore the potential benefits of clinicians addressing patients' cancer prevention beliefs prior to suggesting cancer prevention-related lifestyle changes. Additionally, HL is related to cancer prevention beliefs. Given that HL is the ability to access, process, understand, and utilize health information, all aspects of interacting with health information should be considered when addressing cancer prevention beliefs. The high percentage of participants who endorsed items related to being overwhelmed by information on cancer prevention suggests the need for new methods on communicating new technologies and discoveries about cancer prevention to the general public as well as better understanding of what information individuals use to form their beliefs.

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