

Cancer perceptions: implications from the 2007 Health Information National Trends Survey

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Abstract

Introduction Research has demonstrated associations between sociodemographic characteristics and illness perceptions; however, the impact of cancer exposure through personal or family diagnoses is not well-studied. The purposes of this study were to examine different cancer beliefs and disparities in cancer beliefs across groups of individuals with distinct cancer histories and to identify whether cancer history predicts a set of cancer beliefs.

Methods Using Leventhal's Common Sense Model and data from the 2007 Health Information National Trends Survey ($N=7,172$), we constructed multivariable logistic regression models to evaluate the effect of different stimuli, including cancer experience on cancer perceptions (e.g., prevention, causation, outcome, worry).

Results Findings indicated significant associations between cancer history and cancer perceptions. Individuals with family and personal cancer histories were more likely than individuals without any cancer history to worry about getting cancer ($OR=3.55$, 95 % $CI=2.53-4.99$), agree they will develop cancer in the future ($OR=8.81$, 95 % $CI=6.12-12.67$) and disagree that cancer is most often caused by a person's behavior or lifestyle ($OR=1.24$, 95 % $CI=1.01-1.52$).

Conclusions Cancer history affects perceptions throughout the cancer continuum. Additionally, cancer history may influence coping behaviors and outcomes. Cancer education and survivorship programs should assess important variables such as cancer history to more effectively tailor services and monitor evolving needs throughout cancer care. **IMPLICATIONS FOR CANCER SURVIVORS:** Integrating cancer history information into patient education programs tailored to an individual's needs may better empower survivors and their family members to effectively promote informed decision-making about screening and preventive health behaviors, manage cancer worry, and enhance quality of life.

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Abbreviations

ACS American Cancer Society
CSM Common Sense Model
HINTS Health Information National Trends Survey

Introduction

Mortality rates for most cancers are declining. Furthermore, from 1990 to 2005, overall cancer mortality declined by 19.2 % in men and 11.4 % in women [1]. Enhanced

treatments, coupled with earlier detection, have created a growing group of cancer survivors and family members, making it important to understand how their experiences influence thoughts and perceptions about cancer [2].

Evidence indicates that perceptions affect how people receive and interpret health-related messages [3]. Leventhal's Common Sense Model of illness representations (CSM) suggests that how people think about an illness can affect their decisions concerning the illness [4, 5]. The CSM is multifaceted and considers the roles of several external and internal stimuli in illness representation [6]. One of its core dimensions describes the function of cognitive factors in shaping an individual's illness representations. Five domains are encompassed by cognition: (1) identity (cancer-related symptoms), (2) cause, (3) timeline, (4) consequences (quality-of-life impact), and (5) controllability (preventable or curable) [7].

A meta-analysis examined 45 studies employing the CSM [8]. Findings illuminated the relationship among illness cognitions, coping behaviors, and health outcomes. Fatalistic beliefs associated with cognitive domains predicted poor health behaviors and subsequent health outcomes. For example, perceiving a disease as having unpleasant consequences was associated with maladaptive coping. The meta-analysis identified two studies that used the CSM to analyze illness representations in cancer. More recently, several studies examining associations between participant characteristics and cancer representations have suggested that notable disparities in cancer beliefs may be attributable to differences in education, gender, ethnicity, and age [9–15].

These results highlight the concentration of previous research on associations between demographic characteristics and cancer perceptions. Although these relationships should not be discounted, the CSM suggests other characteristics, such as cancer history, affect perceptions of cancer susceptibility. One study evaluating associations between cancer history and cancer beliefs in 108 retirement community residents reported differences in beliefs concerning "vulnerability to cancer" among groups of cancer survivors, individuals with vicarious cancer experiences, and those with no cancer history [16]. This study illustrates the importance of cancer history in framing cancer perceptions. However, the sample only represents a small subset of the US adult population.

The current study expands upon previous research by incorporating concepts from the CSM framework to study a large, nationally representative sample of adults to determine differences across 11 cancer beliefs, spanning prevention, causation, outcome, and worry, among four groups of individuals with varied cancer history. We focus on two primary objectives: (1) to examine the prevalence and disparity in cancer beliefs across groups with distinct cancer histories and (2) to identify whether, when adjusted for sociodemographic characteristics, cancer history predicts a

set of cancer beliefs. On the basis of this rationale, we hypothesized that (1) individuals with different cancer histories will report different beliefs; and (2) individuals with few cancer experiences will report less cancer worry than individuals with more experience, while individuals with more cancer experiences will more strongly endorse prevention strategies than individuals with less experience.

Additionally, to further refine our understanding of how personal and family history of cancer might affect risk perceptions, we applied an adaptation of the Risk Perception Attitude (RPA) framework to interpret cancer perception profiles [17]. The RPA describes the relationship between an individual's perceived risk and efficacy beliefs using four attitudinal categories: responsive (high risk, high efficacy), avoidant (high risk, low efficacy), proactive (low risk, high efficacy), and indifferent (low risk, low efficacy). Instead of the dichotomous representation of perceived risk used in the original framework (high/low), our adaptation extends the model to include risk perceptions across the four cancer history groups, allowing eight distinct groups stratified across the risk gradient (Fig. 1).

Materials and methods

This study analyzed data from the third iteration of the National Cancer Institute's Health Information National Trends Survey (HINTS-2007), a biennial survey collecting information concerning use of cancer-related information. HINTS-2007 recruited adult Americans from January through May 2008, using a dual-frame sampling design integrating telephone and mail survey methods. This generated a sample of 7,674 adult Americans, ages 18–97. Response rates for the random-digit dial (RDD) and postal address frames were 24.20 and 30.99 %, respectively. A weighting scheme was applied to represent all American adults. The HINTS-2007 Final Report contains a complete description of survey methods [18].

		Perceived Risk			
		No History	Family History	Personal History	Family & Personal
Perceived Efficacy	Low	Indifferent			Avoidant
	High	Proactive			Responsive

Fig. 1 Adapted risk perception attitude framework

Measures

Independent variables—cancer history

From participants' responses to cancer history questions, we generated four distinct cancer history groups: individuals with (1) no history, (2) only family history, (3) only personal history, and (4) both personal and family history. Individuals not responding to cancer history questions were recorded as missing and discounted from analyses ($n=502$), leaving 7,172 individuals.

Dependent variables—cancer beliefs

We selected 11 variables capturing perceptions of cancer prevention, causation, outcome, and worry. Eight were measured using a 4-point scale of agreement, ranging from “strongly agree” to “strongly disagree” and dichotomized to allow comparisons between those who agreed (strongly/somewhat) and disagreed (strongly/somewhat). We used similar methods to dichotomize three additional variables. We assessed “How often do you worry about getting cancer” by comparing responses of “all the time/often” versus “sometimes/rarely.” For “How many people do you think survive at least 5 years?” we compared responses of “<25 %/about 25 %/about 50 %” versus “about 75 %/nearly all.” Responses to “How likely do you think you will develop cancer?” were dichotomized as “very low/somewhat low/moderate” versus “somewhat high/very high.”

Statistical analysis

Analyses were conducted using STATA-11.0 [19]. Previous studies have developed scales from variables similar to the 11 items captured in HINTS-2007 [20]. Initially, we examined the internal consistency of the 11 cancer belief variables to assess whether scale construction was appropriate. Due to insufficient internal reliability (Cronbach's $\alpha=0.52$), we rejected scale construction from the 11 items. However, we were able to conceptualize the individual variables into four domains related to different aspects of cancer, including causation, outcomes, prevention, and worry.

We used descriptive analyses to measure the prevalence of agreement across variables. Chi-square analyses were conducted to examine differences across groups. Cancer belief variables with significant chi-square values ($p<0.05$) were selected for logistic regression models.

For all regression analyses, we accounted for oversampling and survey weighting techniques using composite replicate weights and jackknife standard errors. We explored associations between demographic characteristics and cancer beliefs using multivariate logistic regression. To control for potential confounding, demographic characteristics significantly associated with at least half of the cancer belief

variables ($p<0.25$) were included in final multivariate logistic regression models [21].

We examined cancer belief variables in regression models adjusted for demographic variables previously identified as potential confounders. Cancer history was the primary independent variable. Four demographic variables (i.e., age, education, relationship status, household income) were included in the adjusted models. The Holm sequentially rejective Bonferroni method was applied to adjust for multiple testing [22]. Additional stratified analyses were conducted to examine potential differences by mode of survey administration.

Results

Respondent demographics

Overall, a majority of respondents were non-Hispanic White, female, and married or living as married, with a mean age of 54.12 years ($SD=16.84$ years, see Table 1). Over one third reported having obtained at least a bachelor's degree; while 32.5 % reported an annual household income greater than \$75,000. Almost three-quarters reported a family history of any cancer diagnosis, while 13.6 % reported a personal cancer history.

Prevalence of cancer beliefs across cancer histories

Respondents reported discordant cancer beliefs. Overall, four of the eight variables measuring agreement versus disagreement revealed strong division among respondent opinions (Table 2). “People can tell they have cancer before being diagnosed,” and “Everything causes cancer,” had responses distributed most equally. Percentage agreement among the remaining four statements ranged from 25.4 to 94.9 %. Most respondents strongly endorsed that “Getting checked regularly...helps find cancer when it's easy to treat,” and that “Cancer, when detected early, can be cured.”

Three additional statements did not capture responses in agree/disagree format. Prevalence rates for these statements indicate the proportion of individuals endorsing these beliefs. For example, 35.8 % of respondents believed greater than 75 % of individuals diagnosed with cancer survive at least 5 years. Additionally, 10.4 % of respondents expressed frequent worry about getting cancer, while 59.8 % indicated feeling a moderate-to-high likelihood of developing cancer in the future.

Supportive of the first hypothesis, individuals with different cancer histories reported different cancer beliefs. Chi-square values were significant ($p<0.05$) for eight of the 11 variables measured. Individuals across all cancer history groups agreed “There are too many recommendations about cancer to know which to follow” (74.1 %, $p=0.95$). Given

Table 1 Distribution of demographic characteristics

<i>N</i> =7,172	<i>n</i> (%)
Mean age (SD)=54.12 (16.84)	
Gender	
Male	2,780 (38.8)
Female	4,390 (61.2)
Race/ethnicity	
Non-Hispanic White	5,336 (76.0)
Non-Hispanic Black/African-American	669 (9.5)
Asian	197 (2.8)
Hispanic	604 (8.6)
Other	215 (3.1)
Education	
Less than high school diploma/equivalent	652 (9.1)
High school diploma	1,756 (24.6)
Some college/technical training	2,149 (30.1)
College graduate	2,586 (36.2)
Relationship status	
Married	4,062 (59.6)
Divorced	870 (12.2)
Widowed	816 (11.4)
Separated	160 (2.3)
Single, never married	1,036 (14.5)
Household Income	
<\$20,000	1,097 (17.8)
\$20,000 to <\$35,000	1,037 (16.8)
\$35,000 to <\$50,000	851 (13.8)
\$50,000 to <\$75,000	1,180 (19.1)
\$75,000 or greater	2,007 (32.5)
Cancer history	
No history	1,685 (23.5)
Family history	4,511 (62.9)
Personal history	232 (3.2)
Family and personal history	744 (10.4)

the consistent distribution of responses across groups, this variable was excluded from further analyses.

The prevalence of “responsive” individuals among those with the highest perceived risk (individuals with a family and personal cancer history) ranged from 19.5 to 95.9 %. The strongest efficacy beliefs in this group were reported among perceptions of prevention. However, the majority of these individuals also reported poor efficacy beliefs concerning the causality of behavioral or lifestyle factors.

Associations between demographic variables and cancer beliefs

Consistent with previous findings, education was strongly associated with cancer beliefs [9, 10]. Individuals with

education beyond high school were more likely to disagree that cancer prevention was not possible (OR=1.68, $p<0.01$) and more likely to believe that greater than 75 % of individuals with cancer survive at least 5 years (OR=1.41, $p<0.01$). Our results support previous findings that low education levels are associated with fatalistic beliefs. Additional findings indicate women were more likely to worry frequently about getting cancer (OR=1.48, $p<0.01$) than men and more likely to disagree that cancer is most often caused by a person’s behavior or lifestyle (OR=1.50, $p<0.01$). In addition to determining relationships between demographics and cancer beliefs, regression results were used to select variables for adjusted regression models. Age, education, relationship status, and household income were associated ($p<0.25$) with at least half (5/10) of the cancer belief variables and were included in final models to control for potential confounding.

Associations between cancer history and cancer beliefs

Cancer history was strongly associated with perceptions related to cancer worry and cancer outcome. Consistent with our second hypothesis, individuals with more cancer experiences were susceptible to increased worry concerning cancer and future diagnoses (trend $p<0.01$). Individuals with family and/or personal cancer history were more likely to worry frequently about developing cancer (OR=1.40–3.55, $p<0.01$; see Table 3), while individuals with any cancer history were more likely to think they will develop cancer (OR=2.86–8.81, $p<0.01$). In contrast, individuals with more cancer history were less likely to express beliefs supporting cancer as a death sentence. Individuals with any personal cancer history were more likely to believe greater than 75 % of individuals diagnosed with cancer will survive at least 5 years (OR=1.61–1.82, $p<0.01$), and individuals with any personal cancer history were more likely to disassociate cancer with death (OR=1.41–1.84, $p<0.01$).

Counter to the associations observed between cancer history and perceptions of cancer worry and outcome, results indicated conflicting or absent associations between cancer history and perceptions within the cancer causation and prevention domains. In support of adopting risk prevention strategies, individuals with any cancer history were more likely to disagree, “There’s not much you can do to lower your risk for cancer” (OR=1.25–1.30, $p<0.05$). However, in contrast, individuals with family and personal cancer history were more likely to disagree that cancer is most often caused by a person’s behavior or lifestyle (OR=1.24, $p<0.05$). Cancer history was not a predictor for beliefs about someone being able to know he/she has cancer prior to diagnosis. Approximately 85 % of individuals surveyed agreed that cancer can be

Table 2 Cancer perceptions in groups of individuals with different cancer histories

	Overall [N (Col%)]	No history	Family history	Personal history	Family and personal	χ^2 (<i>p</i>)
“How often do you worry about getting cancer?”	7,128	1,675	4,491	228	734	89.0 (<0.01)
Never, rarely, or sometimes	6,384 (89.6)	1,547 (92.4) I	4,055 (90.3)	191 (83.8)	591 (80.5) A	
All the time or often	744 (10.4)	128 (7.6) P	436 (9.7)	37 (16.2)	143 (19.5) R	
“How likely do you think it is that you will develop cancer in the future?”	6,888	1,613	4,350	214	711	305.1 (<0.01)
Low	2,770 (40.2)	922 (57.2) I	1,615 (37.1)	72 (33.6)	161 (22.6) A	
Moderate–high	4,118 (59.8)	691 (42.8) P	2,735 (62.9)	142 (66.4)	550 (77.4) R	
“When I think of cancer, I automatically think of death.”	7,115	1,666	4,481	230	738	59.0 (<0.01)
Agree	4,185 (58.8)	990 (59.4) I	2,732 (61.0)	101 (43.9)	362 (49.0) A	
Disagree	2,930 (41.2)	676 (40.6) P	1,749 (39.0)	129 (56.1)	376 (51.0) R	
“Overall, how many people who develop cancer do you think survive \geq 5 years?”	6,846	1,589	4,338	217	702	53.9 (<0.01)
Less than 25 %—about 50 %	4,395 (64.2)	1,062 (66.8) I	2,841 (65.5)	112 (51.6)	380 (54.1) A	
About 75 %—nearly all	2,451 (35.8)	527 (33.2) P	1,497 (34.5)	105 (48.4)	322 (45.9) R	
“There’s not much you can do to lower your chances of getting cancer.”	7,085	1,659	4,470	222	734	24.0 (<0.01)
Agree	1,796 (25.4)	496 (29.9) I	1,078 (24.1)	52 (23.4)	170 (23.2) A	
Disagree	5,289 (74.6)	1,163 (70.1) P	3,392 (75.9)	170 (76.6)	564 (76.8) R	
“It seems like everything causes cancer.”	7,061	1,647	4,453	227	734	31.1 (<0.01)
Agree	3,625 (51.3)	804 (48.8) I	2,387 (53.6)	91 (40.1)	343 (46.7) A	
Disagree	3,436 (48.7)	843 (51.2) P	2,066 (46.4)	136 (59.9)	391 (53.3) R	
“Cancer is most often caused by a person’s behavior or lifestyle.”	7,091	1,661	4,469	230	731	6.1 (0.10)
Agree	3,418 (48.2)	831 (50.0) P	2,154 (48.2)	104 (45.2)	329 (45.0) R	
Disagree	3,673 (51.8)	830 (50.0) I	2,315 (51.8)	126 (54.8)	402 (55.0) A	
“People can tell they might have cancer before being diagnosed.”	6,938	1,628	4,363	224	723	5.9 (0.11)
Agree	3,571 (51.5)	804 (49.4) P	2,290 (52.5)	107 (47.8)	370 (51.2) R	
Disagree	3,367 (48.5)	824 (50.6) I	2,073 (47.5)	117 (52.2)	3,533 (48.8) A	
“Getting checked regularly for cancer helps find cancer when it’s easy to treat.”	7,116	1,666	4,481	230	739	8.3 (0.04)
Agree	6,758 (94.9)	1,563 (93.8) P	4,271 (95.3)	215 (93.5)	709 (95.9) R	
Disagree	358 (5.1)	103 (6.2) I	210 (4.7)	15 (6.5)	30 (4.1) A	
“Cancer is an illness that when detected early can typically be cured.”	7,078	1,660	4,457	225	736	23.9 (<0.01)
Agree	6,072 (85.8)	1,433 (86.3) P	3,771 (84.6)	210 (93.3)	658 (89.4) R	
Disagree	1,006 (14.2)	227 (13.7) I	686 (15.4)	15 (6.7)	78 (10.6) A	
“There are so many recommendations, it’s hard to know which ones to follow.”	7,072	1,654	4,463	230	725	0.3 (0.95)
Agree	5,243 (74.1)	1,230 (74.4) I	3,310 (74.2)	167 (72.6)	536 (73.9) A	
Disagree	1,829 (25.9)	424 (25.6) P	1,153 (25.8)	63 (27.4)	189 (26.1) R	

Risk Perception Attitude framework notation: *A* Avoidant, *I* Indifferent, *P* Proactive, *R* Responsive

more easily cured if detected early. In this circumstance, response variation was not predicted by differences in cancer history.

Stratified analyses indicated similar trends across RDD and mailed survey groups. With one exception, all relationships were in the same direction and of similar magnitude in each group. The primary difference between RDD and mailed responses was observed in the magnitude of the odds ratio of the likelihood of cancer diagnosis in the future within individuals with personal and family cancer history (mail-OR=8.37, RDD-OR=4.97; $p < 0.01$).

Discussion

To our knowledge, this study is the first to evaluate associations between cancer history and cancer beliefs in a nationally representative sample of American adults. Results revealed three principal findings. Concern about one’s inability to control cancer incidence and outcome appears prevalent among this sample. Additionally, the association between cancer history and cancer perceptions was stronger across perceptions within the worry and outcome domains compared to perceptions related to causation and prevention.

Table 3 Comparing agreement across groups using logistic regression models

Reference group=group 1—no history of cancer	Domain	Overall ^a OR (95 %CI)	Stratified by survey mode ^a	
			Mail (n=3,582) OR (95 %CI)	RDD (n=4,092) OR (95 %CI)
“How often do you worry about getting cancer?”	Worry			
Group 2—Only family history of cancer		1.40 (1.01–1.95)	1.18 (0.78–1.78)	1.90 (0.96–3.79)
Group 3—Only personal history of cancer		2.94 ^b (1.67–5.17)	2.33 (1.09–4.98)	4.22 (1.64–10.84)
Group 4—Family and personal history of cancer		3.55 ^b (2.53–4.99)	3.23 (2.01–5.20)	4.53 (2.22–9.29)
“How likely do you think it is that you will develop cancer in the future?”	Worry			
Group 2—Only family history of cancer		2.86 ^b (2.14–3.83)	2.51 (1.69–3.74)	2.04 (1.51–2.76)
Group 3—Only personal history of cancer		4.56 ^b (3.11–6.70)	3.76 (2.20–6.42)	3.71 (2.31–5.96)
Group 4—Family and personal history of cancer		8.81 ^b (6.12–12.67)	8.37 (5.23–13.42)	4.97 (3.51–7.03)
“When I think of cancer, I automatically think of death.”	Outcome			
Group 2—Only family history of cancer		0.89 (0.73–1.10)	0.89 (0.69–1.15)	0.89 (0.68–1.18)
Group 3—Only personal history of cancer		1.84 ^b (1.24–2.72)	2.16 (1.15–4.05)	1.65 (1.01–2.71)
Group 4—Family and personal history of cancer		1.41 ^b (1.10–1.81)	1.32 (0.92–1.89)	1.46 (1.04–2.04)
“Overall, how many people who develop cancer do you think survive at least 5 years?”	Outcome			
Group 2—Only family history of cancer		1.01 (0.85–1.19)	0.93 (0.74–1.18)	1.07 (0.84–1.36)
Group 3—Only personal history of cancer		1.82 ^b (1.27–2.61)	1.63 (0.98–2.72)	2.06 (1.28–3.33)
Group 4—Family and personal history of cancer		1.61 ^b (1.28–2.02)	1.67 (1.17–2.38)	1.59 (1.13–2.22)
“There’s not much you can do to lower your chances of getting cancer.”	Causation			
Group 2—Only family history of cancer		1.25 (1.05–1.51)	1.17 (0.91–1.50)	1.33 (0.97–1.82)
Group 3—Only personal history of cancer		1.46 (0.89–2.40)	1.33 (0.66–2.69)	1.61 (0.92–2.83)
Group 4—Family and personal history of cancer		1.30 (1.00–1.68)	1.34 (0.86–2.09)	1.26 (0.86–1.84)
“It seems like everything causes cancer.”	Causation			
Group 2—Only family history of cancer		0.79 (0.65–0.97)	0.80 (0.63–1.02)	0.78 (0.58–1.06)
Group 3—Only personal history of cancer		1.30 (0.88–1.92)	1.26 (0.68–2.32)	1.30 (0.73–2.32)
Group 4—Family and personal history of cancer		0.98 (0.77–1.26)	0.92 (0.65–1.29)	1.00 (0.67–1.50)
“Cancer is most often caused by a person’s behavior or lifestyle.”	Causation			
Group 2—Only family history of cancer		1.06 (0.90–1.24)	1.04 (0.84–1.29)	1.08 (0.87–1.36)
Group 3—Only personal history of cancer		1.25 (0.88–1.78)	1.02 (0.57–1.83)	1.43 (0.92–2.21)
Group 4—Family and personal history of cancer		1.24 (1.01–1.52)	1.32 (0.98–1.78)	1.18 (0.88–1.60)
“Getting checked regularly for cancer helps find cancer when it’s easy to treat.”	Prevention			
Group 2—Only family history of cancer		0.73 (0.52–1.03)	0.84 (0.52–1.34)	0.64 (0.39–1.06)
Group 3—Only personal history of cancer		1.12 (0.60–2.11)	0.67 (0.17–2.67)	1.37 (0.58–3.27)
Group 4—Family and personal history of cancer		0.63 (0.35–1.14)	0.72 (0.31–1.67)	0.56 (0.24–1.30)
“Cancer is an illness that when detected early can typically be cured.”	Prevention			
Group 2—Only family history of cancer		1.13 (0.84–1.51)	1.12 (0.82–1.54)	1.14 (0.71–1.84)
Group 3—Only personal history of cancer		0.64 (0.34–1.21)	0.48 (0.19–1.23)	0.79 (0.38–1.63)
Group 4—Family and personal history of cancer		0.74 (0.51–1.09)	0.63 (0.38–1.03)	0.87 (0.49–1.53)
“People can tell they might have cancer before being diagnosed.”	Prevention			
Group 2—Only family history of cancer		0.88 (0.72–1.06)	0.86 (0.66–1.11)	0.90 (0.70–1.14)
Group 3—Only personal history of cancer		1.06 (0.72–1.57)	0.96 (0.53–1.73)	1.14 (0.71–1.83)
Group 4—Family and personal history of cancer		0.90 (0.67–1.22)	0.87 (0.57–1.32)	0.95 (0.64–1.40)

^a Adjusted for age, education, household income, and relationship status^b Statistically significant *p* value under sequentially rejective Bonferroni adjustment

Furthermore, the relationship between cancer history and perceptions related to cancer worry indicated a strong trend of increasing worry with increasing cancer experiences. Lastly, results confirm previous findings that education predicts cancer beliefs. It is interesting to examine these findings in the context of three more comprehensive concepts: health literacy, disease-specific knowledge, and cancer-specific anxiety.

Health literacy

Our findings suggest that health literacy may affect one's ability to understand how to prevent and monitor carcinogenesis. Health literacy is a multidimensional concept mediated by social and individual factors (e.g., education, culture, language) [23]. Low health literacy among adults has been linked to limited understanding of cancer screening guidelines, as well as poor adherence and health outcomes [24].

Consistent with previous findings, education was associated with cancer perceptions [9, 10]. Specifically, those with low education levels were more likely to endorse fatalistic cancer beliefs. Despite the availability of information through internet and other media sources, individuals with low education remain more likely to disagree that "Getting checked regularly for cancer helps find cancer when it's easy to treat." Additionally, individuals with little education were more likely to agree that "There's not much you can do to lower your chances of getting cancer," and "Everything causes cancer." Although data from this study cannot directly address this concern, due to the diminished incentive and sense of control these beliefs represent, fatalistic beliefs about cancer prevention may inhibit individuals from appropriately following screening and other risk reduction guidelines. As mounting evidence confirms the negative role that educational deficits play in forming fatalistic cancer beliefs, cancer education and counseling programs must continue to target increased support to less-educated individuals.

Several factors may account for the difficulties low-health-literacy individuals experience in comprehending health messages [25–28]. Our results support increased efforts to accommodate low-literacy individuals by providing cancer education programs tailored to literacy levels and informational preferences [29]. Additionally, it is important to design educational interventions to not only supply basic knowledge but also to enhance understanding regarding how this information influences treatment, monitoring, and risk for recurrence.

Cancer-specific knowledge

In this sample, analysis of prevalence rates across all respondents revealed a pervasive fraction of beliefs dismissing behavior's role in cancer causation. Further analyses indicated that small differences were predicted by cancer

history. Indicative of "avoidant" beliefs, individuals with family and personal cancer history were likely to dispute behavioral and lifestyle influences in cancer etiology [30]. Wallston's Health Locus of Control model defines how individuals view internal and external contributions to their health status as a continuum [31]. At one extreme, individuals view internal factors (e.g., one's behaviors) as the most significant contributors to illness and recovery. At the opposite end of the continuum, individuals believe external causes (e.g., environment, fate) play a central role in determining health status. Wallston proposes that individuals who believe their own behavior controls their health are more likely to practice behaviors conducive to improving health.

Individuals with previous cancer may be at increased risk for developing additional primary cancers [32]. Recent statistics indicate up to 10 % of new cancer diagnoses occur in cancer survivors [33]. Therefore, it is imperative that individuals with a cancer history embrace the significance of practicing risk-reducing behaviors and use this information to limit additional primary cancer progression [34].

Cancer management occurs in stages, beginning with prevention and early detection and extending through treatment and survivorship. The stages are appropriately characterized as a continuum; and, to this effect, once a patient reaches survivorship, focus shifts from primary prevention to secondary and tertiary prevention [35]. Considering the additional cancer risk for survivors, successful transition back to the prevention phase of the continuum is critical. Healthcare providers can facilitate this by maintaining open communication with cancer survivors about risk reduction and preventive behaviors.

Previous work in diabetes care may provide context to guide supportive efforts. Diabetes care has provided two methods by which providers can increase patient adherence and involvement in care: practical and communicative support [36]. Guidelines encourage practitioners to provide patients with goal-driven planning and follow-up structure that promote better adherence and outcomes. Communicative support complements practical support with responsive listening and communication and may engender teamwork and trust necessary to build an effective patient-provider partnership. Implementing the supportive strategies outlined for diabetes care settings may facilitate similar improvements in adherence and involvement in care for cancer patients.

Cancer-specific anxiety

The ACS has set "Challenge Goals" for 2015 [37]. One is to produce "a measurable improvement in quality-of-life for all cancer survivors beginning at diagnosis." Providing effective and timely medical management is important. However, cancer patients report additional concerns (e.g., psychological,

emotional, spiritual) that are equally critical components to successfully enhancing quality-of-life.

In this sample, individuals with family and personal cancer history reported increased worry about developing cancer. Previous research indicates that high levels of worry and anxiety are inversely related to self-efficacy and may impair quality of life [38, 39]. Additionally, elevated levels of worry increase avoidance and impinge upon healthy decision making [40]. Thus, our approach of integrating the CSM and RPA may provide a more nuanced picture of how messages may be framed to reduce anxiety, reduce avoidance, and increase perceived efficacy for cancer prevention.

One theory, proposed by Leventhal, details the influence of anxiety arousal in patient decision making, explaining that the impact of arousal follows a normal distribution [41]. The optimal level of arousal occurs in the curve's middle, whereas unfavorable levels appear in the upper and lower tails. An individual's position on the curve is primarily determined by the interaction between two opposing health threat-processing mechanisms. The first can be characterized as rational and abstract, the other as emotional and impulsive. Optimally, there exists a delicate balance between the opposing mechanisms. However, as stress and anxiety increase, the emotional component begins to overwhelm the rational.

Leventhal found that, with high levels of arousal anxiety, the controlling emotional element promoted choices with immediate benefits, ignoring the decision's long-term consequences. In our sample, significant increases in cancer worry reported by individuals with additional cancer experiences may inhibit optimal information processing and decision making. Previous research has shown that psychological interventions targeting cognitions, emotions, and behaviors can produce several positive changes [42–44]. Through improvements in self-efficacy and level of anxiety, individuals can restore the optimal balance between health threat processing mechanisms and facilitate effective decision making. Thus, in support of the "Challenge Goals", psychological interventions (e.g., peer support programs, comprehensive illness self-management, group/individual counseling) should be incorporated into cancer treatment plans to increase self-efficacy and reframe worry and anxiety in cancer survivors [45].

Study limitations

This study has limitations related to design properties of HINTS-2007. Its cross-sectional design does not allow inferences to be drawn regarding causal relationships between cancer histories and cancer beliefs. Additionally, while there have been multiple iterations of HINTS, which allows evaluation of national trends over time, the same

cannot be accomplished at the individual level. Further, the response rates were low, which could reveal a potential source of bias. In conducting this study, it is unknown whether or not significant differences exist between responder and nonresponder characteristics (e.g., cancer beliefs, sociodemographics) due to a lack of information describing nonresponders. Therefore, questions remain concerning how well this random sample represents the national population. Finally, due to the number of outcome variables analyzed, multiple comparisons may introduce an increased risk of type I error. However, we implemented a sequentially rejective Bonferroni method to reduce the potential for global type I error.

Implications for cancer education and assistance programs

Coping with cancer is not "one-size-fits-all." Needs are unique to the individual and vary throughout the cancer continuum. Subsequently, cancer education and counseling programs should be tailored and amended to the changing needs of the individual. The CSM and RPA explain that many factors affect how individuals receive and interpret information about their health; thus, interventions should go beyond traditional medical management to treat the whole patient. Providing literacy-appropriate education programs leveraging information preferences might help patients better comprehend health information [46]. Subsequently, patients may be able to more effectively collaborate with providers during goal-oriented treatment decisions. Additionally, cancer history plays a significant role in forming cancer representations. Therefore, it is important to integrate information concerning cancer history when designing assistance programs. Tailoring programs to individual needs may better empower survivors and others (e.g., family members) to effectively self-manage cancer worry, promote informed decision making and enhance quality of life.

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