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Raising awareness of lifestyle-related cancer risks: a cross-sectional analysis of the 2019 HINT survey

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Abstract

Lifestyle factors including obesity, processed meat consumption, alcohol use, physical inactivity, and tobacco exposure are well-established cancer risk factors. However, public awareness of these modifiable risks remains underexplored in the United States. Using 2019 Health Information National Trends Survey (HINTS 5, Cycle 3) data, I examined cancer risk beliefs across four groups: Group I: nonsmokers/nondrinkers; Group II: nonsmokers/drinkers; Group III: smokers/nondrinkers; Group IV: smokers/drinkers. I used Taylor Series linearization to compare their perceptions. Smokers who abstained from alcohol perceived the cancer risk of processed meat as less significant (mean = 1.83) than nonsmokers who drank (mean = 1.47, $p = 0.03$). Perceived risk scores ranged from 1 ("a lot") to 2 ("a little"), with lower scores indicating higher perceived risk. The risk of cancer associated with being overweight or obese was generally underestimated. The findings highlight the need for targeted health campaigns to correct misperceptions and encourage cancer-preventive behaviors.

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Introduction

Lifestyle risk factors, including being overweight or obese, consuming processed meat, alcohol use, a lack of physical activity, and exposure to tobacco smoke, have been consistently associated with an increased risk of cancer[1,2]. Despite the established association, awareness of these cancer risk factors has been inadequately assessed among the US population. The Health Information National Trends Survey (HINTS), a nationally representative cross-sectional survey conducted by the National Cancer Institute, provides critical insights into public health awareness. The HINTS 5 Cycle 3 (2019) explored US adults' knowledge of and access to health-related information and behaviors, including tobacco smoking and alcohol consumption[3,4].

As cancer remains one of the leading causes of morbidity and mortality in the United States, increasing public understanding of modifiable risk factors is essential for health behaviors. The previous study revealed that while over 79% of US adults correctly identified alcohol consumption as a cause of liver disease, more than 60% did not recognize that heavy drinking is also a significant cause of cancer[5]. Misunderstanding or underestimating the role of diet, body weight, physical inactivity, and substance use may limit individuals' motivation to engage in preventive behaviors. Certain subgroups, such as smokers or individuals with limited access to healthcare, may be especially vulnerable to inaccurate beliefs about cancer risks.

My study contributes to the literature by examining how beliefs about cancer risk differ across groups defined by smoking and drinking behaviors—an area that remains underexplored. While previous studies have addressed general cancer risk awareness[6,7], few have assessed how combinations of lifestyle behaviors (e.g., smoking with or without alcohol use) relate to risk perceptions. My work adds to the evidence base by using nationally representative data to identify patterns in misperceptions that may hinder public health efforts.

The current study builds upon prior research by examining beliefs about cancer risk factors among different smoking and drinking groups. My research highlights key gaps in awareness and facilitates the development of tailored interventions to promote cancer prevention. The objective of this study is to assess US adults' perceptions of cancer risk associated with lifestyle factors, including processed meat consumption, alcohol use, tobacco smoking, and obesity, and to compare these perceptions across four substance use groups (Group I: nonsmokers/nondrinkers; Group II: nonsmokers/drinkers; Group III: smokers/non-drinkers; Group IV: smokers/drinkers). By identifying specific gaps in awareness among high-risk groups, this study aims to inform targeted cancer prevention messaging and behavioral interventions.

Methods

The HINTS is a nationally representative, cross-sectional survey of civilian, noninstitutionalized US adults aged 18 years and older, conducted by the National Cancer Institute since 2003[3,4,8]. It uses a two-stage probability sampling method, with addresses drawn from the US Postal Service database stratified by high- and low-minority regions, and one adult per household selected via the "next birthday" method[4]. Survey weights were developed to account for stratification, oversampling of high-minority areas, nonresponse, and household composition, enabling nationally generalizable estimates[4]. The instrument covered health knowledge, communication, and tobacco and alcohol use, as well as emerging areas like dietary intake and physical activity[4]. For the current study, the author analyzed HINTS 5 Cycle 3 (2019) and defined the sample on the basis of self-reported smoking and alcohol use. The initial sample included 5,438 respondents. I excluded participants with missing information ($n = 2,449$) on smoking status, alcohol use, or any covariates (sex, age, race/ethnicity, education, income), resulting in a final analytic sample of 2,989 adults[5]. Missingness was primarily caused by item nonresponse; exclusion was necessary to maintain complete-case multivariable modeling and ensure validity. My analysis classified participants into four categories according to

their smoking and drinking behaviors: Group I: nonsmokers/non drinkers (respondents who answered "No" to having smoked 100 cigarettes in their lifetime and reported drinking alcohol 0 days per week in the past 30 days, *n* = 1,517); Group II: nonsmokers/drinkers (respondents who answered "No" to having smoked 100 cigarettes in their lifetime but reported having one or more drinks over the past 30 days, *n* = 1,222); Group III: smokers/nondrinkers (respondents who answered "Yes" to having smoked at least 100 cigarettes in their lifetime and reported drinking alcohol 0 days per week in the past 30 days, *n* = 131); Group IV: smokers/drinkers (respondents who answered "Yes" to having smoked 100 cigarettes in their lifetime and reported drinking at least one alcoholic drink per day in the past 30 days , *n* = 119). Using the HINTS questionnaire, the author assessed the participants' beliefs about cancer risk by asking, "How much do you think each of the following can influence whether or not a person will develop cancer? (A) Being overweight or obese; (B) eating enough fiber; (C) eating too much processed meat; (D) eating fruits and vegetables," with the response options ranging across 1 = "a lot", 2 = "a little", and 3 = "not at all". To account for the complex survey design, the author used the Taylor Series linearization variance estimation method to compare beliefs about cancer risk across substance use groups. Weighted descriptive statistics were conducted to summarize the characteristics of the study population by substance use status: Group I (nonsmokers/nondrinkers); Group II (nonsmokers/drinkers); Group III (smokers/nondrinkers); Group IV (smokers/drinkers). Chi-squared tests were used to examine the associations between substance use status and participants' characteristics, including sex, age group, race/ethnicity, education level, and income. These variables were also treated as covariates in subsequent analyses. Specifically, the study included sex (male vs. female), age group (18–34, 35–49, 50–64, 65–74, and ≥ 75 years), race/ethnicity (Hispanic, non-Hispanic White, non-Hispanic Black, and non-Hispanic Other), education level (less than high school, high school graduate, some college, and college graduate or higher), and income (USD $0–$19,999; $20,000–$49,999; $50,000–$99,999; and ≥ $100,000)[5]. A weighted analysis of variance (ANOVA) was then performed to assess whether beliefs about cancer risk differed significantly across substance use groups, adjusting for the covariates above[5]. The Bonferroni correction method was applied to account for multiple comparisons. All analyses were conducted using SAS survey procedures (version 9.4), with the significance level set at 0.05[5]. Institutional review board (IRB) approval was not needed because the HINTS data used in this study are secondary, de-identified, and publicly available on the National Cancer Institute website (https://hints.cancer.gov). Informed consent was not sought for the present study because HINTS data are publicly available.

Results

Supplementary Table S1 presents details of the study population and demographics[5]. Among Group IV (smokers/drinkers), 64.61% of participants are male, while 62.83% of Group I (nonsmokers/nondrinkers) are female. More than 50% of the participants in Group III (smokers/nondrinkers) are aged 50–64 years, which is higher than in Groups I, II and IV (31.8%, 29.2% and 44.1%, respectively). Over 33% of participants in Group IV are non-Hispanic Black (NH Black). Group III has the highest proportion of participants with less than high school education (20.39%) and an annual income below $20,000 compared with the other three groups.

Table 1 presents the least squares meand of cancer beliefs by substance use status. Group II (nonsmokers/drinkers) believed that consuming too much processed meat had a significant impact on cancer risk (least squares mean = 1.47), whereas Group III (smokers/nondrinkers) perceived this risk to be lower (least squares mean = 1.83), with smaller numbers indicating a greater perceived impact (1 = "a lot" vs. 2 = "a little"). The difference in perceptions between these two groups was statistically significant (difference between the means = −0.36; adjusted confidence interval: −0.70, −0.03; *p*-value = 0.03). However, no significant differences were observed for other cancer-related beliefs across the groups. Overall, the participants generally perceived that being overweight or obese had only a limited impact on cancer development, with average ratings approaching 2 (a little). Supplementary Figure S1 provides a visual summary of the data shown in Table 1.

Discussion

The author found that perceptions of cancer risk from lifestyle factors vary by smoking and drinking behaviors. Smokers, particularly those who do not drink, tend to underestimate the cancer risk associated with processed meat consumption (mean = 1.83) compared with nonsmokers who drink alcohol (mean = 1.47). Although the absolute difference in perceived cancer risk from processed meat consumption between Group II and Group III was 0.36 on a 3-point Likert scale, this discrepancy may still represent a meaningful cognitive gap. Prior research suggests that the formation of accurate risk perceptions plays a critical role in shaping health behaviors[9], and modest differences in perceived risk may influence health behaviors and intentions. Furthermore, this discrepancy suggests that smokers may be less aware of or concerned about dietary cancer risks. One possible explanation is that individuals who consume alcohol but do not smoke may be more receptive to public health messaging or maintain greater general health awareness. Prior studies have shown that moderate alcohol users may be more inclined to engage in other health-related behaviors, and may be linked to other beneficial lifestyle factors[10,11]. In contrast, smokers may be less sensitive to health warnings and less

Table 1. Least squares mean of beliefs about cancer by smoking and drinking status.

	Nonsmokers and nondrinkers, least squares means (SE)	Nonsmokers but alcohol drinkers, least squares means (SE)	Smokers but nondrinkers, least squares means (SE)	Smokers and drinkers, least squares means (SE)
Beliefs about cancer[a]				
Being overweight or obese	1.82 (0.06)	1.76 (0.06)	1.68 (0.14)	1.88 (0.14)
Eating enough fiber	2.08 (0.05)	1.94 (0.06)	2.25 (0.12)	2.19 (0.14)
Eating too much processed meat	1.56 (0.04)	**1.47 (0.05)***	**1.83 (0.13)***	1.63 (0.13)
Eating fruits and vegetables	2.24 (0.05)	2.22 (0.07)	2.37 (0.14)	2.21 (0.15)

[a] "How much do you think that each of the following can influence whether or not a person will develop cancer? (A) Being overweight or obese; (B) eating enough fiber; (C) eating too much processed meat; (D) eating fruits and vegetables", with responses selected from 1 = "a lot"; 2 = "a little"; 3 = "not at all". * Difference in the means between nonsmokers/alcohol drinkers and cigarette smokers/nondrinkers = −0.36; adjusted lower and upper level: −0.70, −0.03; $p = 0.03$.

likely to recognize health risks, as they often underestimate their risk of lung cancer and exhibit other misunderstandings about the dangers of smoking[12]. This may help explain why participants in Group III were less likely to perceive processed meat consumption as a cancer risk, despite being a high-risk group themselves. Another possible explanation is that drinking behaviors may be linked with dietary patterns. Alcohol consumption is frequently accompanied by meat intake, particularly processed meat, in social and cultural contexts. Therefore, drinkers may have been more exposed to public health messaging about the risks of processed meat. This potential dietary confounding might partly explain why nonsmokers who drank perceived processed meat as a stronger cancer risk compared with smokers who did not drink.

Furthermore, across all groups, participants perceived the influence of being overweight or obese on cancer development as limited, with average responses approaching "a little." This indicates a widespread underestimation of these well-established cancer risk factors, suggesting a gap in public awareness. Many individuals underestimate the impact of factors such as overweight, obesity, and processed meat consumption on cancer risk. While processed meats are classified as carcinogenic, public awareness of this association remains limited. Processed meat has been classified as a Group 1 carcinogen by the International Agency for Research on Cancer (IARC)[13]. Carcinogenic compounds, including heterocyclic amines (HCAs) and polycyclic aromatic hydrocarbons (PAHs), are formed during meat processing and high-temperature cooking[14]. Regular consumption of processed meat has been strongly associated with colorectal cancer risk[14]. These established biological mechanisms reinforce the importance of improving public awareness of the cancer risks associated with processed meat intake.

Sociodemographic variables including age, sex, race/ethnicity, education, and income are well-established confounders in studies examining health perceptions and behaviors[15]. These variables may influence both the likelihood of engaging in smoking or drinking behaviors and individuals' interpretation of cancer-related health information. For example, differences in educational achievement, income, and the level of industrialization across countries may be associated with different levels of awareness of modifiable cancer risk factors[16,17]. Similarly, racial and ethnic minority groups may encounter disparities in healthcare access and information exposure, which can shape risk perceptions[18].

These findings have important implications for public health education and intervention efforts. Given that misperceptions about lifestyle-related cancer risks were observed across both smokers and nonsmokers, as well as drinkers and nondrinkers, future health promotion strategies may focus on delivering clear, accessible, and evidence-based information about the association between lifestyle behaviors and cancer. Messaging should be tailored to different subgroups, particularly smokers, who may downplay dietary risks, and use multiple communication channels to reach broader audiences. Enhancing public understanding of how overweight/obesity, diet, and substance use contribute to cancer development might support more informed decision-making and reduce cancer-related health disparities in the long term.

Targeted health campaigns should be designed to address gaps in risk perception, particularly among smokers. For example, integrating cancer risk education into existing tobacco cessation programs may enhance their relevance and impact. Campaigns could use mobile health tools such as text message reminders or app-based interventions that deliver tailored messages and personalized educational content about cancer risk. Additionally, community-based outreach in primary care clinics or public health centers could offer brief educational sessions focused on the risks of smoking and poor dietary habits.

However, the author acknowledges several limitations. First, the difference in perceptions between Groups II and III may be attributed to chance, a small number of valid responses in certain subgroups, or reduced respondent engagement. Such factors may introduce misclassification or affect the observed relationship. Furthermore, whereas Group I (nonsmokers/nondrinkers) would have served as a valuable reference group for comparison, the most significant difference was observed between Groups II and III. Future studies with larger samples and more refined measurement tools are needed to clarify these relationships. Because this study is cross-sectional, the author cannot infer causality. Although the author adjusted for key demographic and socioeconomic covariates, unmeasured confounding and endogeneity may still influence the observed associations. Longitudinal data might be needed to better assess the causal relationships between lifestyle behaviors and cancer risk perceptions. Another important consideration is that low educational achievement and socioeconomic status may have influenced Group III's cancer risk perceptions, as individuals with limited resources often face barriers to accessing health information. Thus, the observed underestimation of processed meat-related cancer risk in Group III may be partially attributable to socioeconomic and educational disparities rather than substance use behaviors alone.

Ethical statements

The study was conducted in accordance with the Declaration of Helsinki. IRB approval was not needed because the HINTS data used in this study are secondary, de-identified, and publicly available. Informed consent was not sought for the present study because HINTS data are publicly availabe on the National Cancer Institute website (https://hints.cancer.gov).

Author contributions

The author confirms sole responsibility for the following: study conceptualization, original draft preparation, formal analysis, methodology and investigation, review and edition, approval of the final manuscript.

Data availability

The HINTS data are secondary, deidentified, and publicly available on the National Cancer Institute website (https://hints.cancer.gov).

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Conflict of interest

The author declares that there is no conflict of interest.

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