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Cancer Awareness and Behavioral Determinants Associated with Cancer Prevention—a Quantitative Study Among Young Adults in Rural Settings

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Abstract

Although college is a crucial time to establish healthy behaviors for cancer prevention, little is known about cancer awareness and behaviors among US college students in less economically developed, rural areas. The purpose of this study was to examine college students' cancer-preventative knowledge and health behaviors. This cross-sectional study was conducted at a large southeastern university in the USA, on a convenience sample of students attending a campus-wide health education class. Data were collected during April and May 2017. Pearson's chi-square tests, independent samples t test, and one-way ANOVA were used. Participants ($n = 1511$) were female (59.1%), non-Hispanic White (69.7%), first-year college students (76.7%), and either 18 (35.9%) or 19 (44.6%) years old. Participants recognized an average of 6.69 (SD = 3.08) out of 11 risk factors on the Cancer Awareness Measure (Cronbach's alpha = 0.874), with a statistically significant difference observed by gender ($t(1471) = -3.348$, $p = 0.001$), but not by race (($F(2,1474) = 1.742$, $p = 0.176$). Chi-square analyses revealed significant associations by gender for exercise ($p < 0.001$), tobacco use ($p < 0.001$), and alcohol use ($p < 0.001$). Significant associations were also found by race/ethnicity for exercise ($p < 0.001$), tobacco use ($p < 0.001$), alcohol use ($p < 0.001$), and fruit and vegetable consumption ($p = 0.035$). Findings indicate a need to educate college students to recognize and modify cancer-related behavioral risk factors, particularly dietary habits. Specifically, health campaigns to reduce gender and racial gaps in cancer-preventative knowledge and behavior among first-year students are recommended.

Keywords College students · Cancer Awareness Measure · Cancer preventive behaviors

Cancer is an enormous burden of disease worldwide. It is estimated that approximately 14.1 million new cancer cases and 8.2 million cancer deaths occurred in 2012 globally [1]. Likewise, cancer constitutes the second leading cause of death in the USA, surpassed merely by heart disease [2]. Nearly one out of every four deaths is due to different types of cancer, which means almost 25% of the US population die from cancer [2–4]. Recent epidemiological reports suggested about 1.7 million new cancer cases and 600,920 cancer deaths in 2017, which translates to about 4630 new cancer diagnoses and 1650 cancer deaths each day in 2017 [1]. Although substantial progress has been made in reducing cancer-related morbidity and mortality in the USA, serious problems associated with cancer prevention remain to be solved.

According to the clinical guidelines by the American Cancer Society (ACS), almost one third of cancer deaths were linked to five behavioral and dietary factors: tobacco use, excessive alcohol consumption, insufficient fruit and vegetable consumption, low physical activity, and obesity/overweightness [5]. Additionally, strong evidence indicated that an individual's lifetime risk of developing cancer can be substantially reduced by maintaining healthy behaviors [2]. Based on extensive scientific research on cancer and dietary habits, ACS recommended consuming healthy foods and drinks to maintain healthy weight and avoid excessive weight gain. More specifically, ACS suggests, for instance, consuming five portions of fruits and vegetables daily, consuming

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whole grains instead of refined grains, and limiting consumption of processed meat and red meat [5].

Although it is crucial to help people establish healthy habits throughout the lifespan, the literature to date has heavily focused on behavioral and dietary cancer prevention among middle-aged or older-aged groups and less in early adulthood [6, 7]. College years are critical for early cancer education and interventions, and many contextual factors need to be considered to effectively reach young adults [8]. However, research investigating cancer awareness and knowledge and cancer-risk behaviors among young adults remains in the nascent stage [9]. Recently, growing numbers of studies have focused on cancer prevention efforts among young adults [10–14]. For example, the Cancer Breakthroughs 2020 program was launched to accelerate the steps in advancing a cancer prevention agenda for young adults [9].

Recent studies found college students to be a vulnerable population due to inadequate cancer awareness and engagement in risky health behaviors in the developing countries of India, Turkey, and Brazil [15–17]. Studies in the UK indicated a significant disparity between college students' perceived cancer susceptibility and actual health risk [18–20]. In other words, college students might not consider their behaviors to carry risk related to cancer. Studies in the USA regarding cancer knowledge and behaviors among college students mainly focused on a few selected cancers, such as colorectal, cervical, and female breast cancers and human papillomavirus (HPV) [10–12, 21, 22]. Furthermore, recent epidemiological reports indicated distinct cancer health disparities by gender and race/ethnicity continue to exist in US adult population [23]. Similarly, ethnic minorities and economically disadvantaged groups still bear a disproportionate burden of cancer among the general population in the USA [24, 25]. However, to the best of our knowledge, cancer awareness and related risky behaviors among college students in less economically developed rural areas in the USA have not been clearly identified.

A new priority goal and key theme set by a panel of experts organized by the CDC's Division of Cancer Prevention and Control is to assess the cancer-related risk factors specific to young adults, including social determinants of health and inequalities [26]. As college students are one sub-population of the young adult population, this study served as a first step to meet the call of assessing young adults' cancer-related awareness and behavior. Specifically, this study sought to answer three research questions related to behavioral or dietary habits predicting cancer prevention knowledge and behavior among college-age young adults: (1) what are the students' perceptions of lifestyle factors related to cancer? (e.g., tobacco use, alcohol consumption, diet, family history of cancer); (2) what are the predicting factors for cancer-preventative behaviors? (i.e., exercise, tobacco use, alcohol use, fruit and vegetable consumption); and (3) are there any sociodemographic differences regarding students' cancer-preventive behaviors?

Methodology

Data Collection

Data were collected as part of a cross-sectional survey examining college students' cancer-related health behaviors, knowledge, and perceptions. The setting was a public, 4-year institution in a southeast US location with a Carnegie classification "doctoral university: higher research activity." The student population of the university is comprised of approximately 26% ethnic minorities. Students ($N = 2242$) enrolled in a freshman-level health course were invited via e-mail to complete an online Qualtrics questionnaire that included with three sets of survey questions aligning with three distinct research projects. Our section focused on cancer risk factor awareness and behaviors associated with cancer prevention. Specifically, questions included sociodemographic characteristics, the Cancer Awareness Measure [CAM] [18], and frequencies of cancer-preventative behaviors [7]. Upon completion of the questionnaire, students had the option of printing a completion report to submit to their course instructor for extra credit. Students electing not to participate were provided an alternative extra credit opportunity. Participant responses were unconnected to identifying information for anonymity. Consent was ascertained with an informed consent statement preceding the questionnaire, after which students clicked the "next" button to provide consent and enter the questionnaire. Study protocol and procedures were approved by the East Carolina University Institutional Review Board.

Survey Instrument

Sociodemographic measures included gender (male, female, other), race/ethnicity (White, not-Hispanic; Black, not-Hispanic; Hispanic; Asian or Pacific Islander; American Indian or Alaskan Native; other), age in years (18, 19, 20, 21, 22, 23, 24, and 25 years or older), and university class status (first-year student, sophomore, junior, senior, other). Students also reported height and weight measurements for BMI calculation. Cancer-preventative behaviors were assessed through four closed questions asking students to identify how frequently they consumed fruits and vegetables, exercised for at least 30 min, consumed alcohol, and used tobacco products, respectively. Response options included "never," "monthly," "once in 15 days," "once a week," "twice a week," "3 times a week," and "four times a week."

Awareness of recognized cancer risk factors was evaluated through a closed question from the CAM: "The following items are some behaviors that might be associated with different types of cancer. How much do you agree that each of these can increase a person's chance of developing cancer?" Eleven known cancer risk factors followed in this order: "smoking

any cigarettes at all," "exposure to second-hand smoke," "drinking more than one unit of alcohol a day," "eating less than five portions of fruit and vegetables a day," "eating red or processed meat once a day or more," "being overweight (BMI over 25)," "getting sunburnt more than once as a child," "being over 70 years old," "having a close family member with cancer," "infection with HPV," and "doing less than 30 minutes of moderate physical activity five times a week." Response options included a 5-point Likert scale ranging from "strongly disagree" to "strongly agree."

Data Analysis

Sociodemographic variables (gender, race/ethnicity, age, class) were descriptively analyzed. Body mass index (BMI) scores were calculated with the formula: weight (kg)/[height(m)^2]. Pearson's chi-square (χ^2) tests were utilized to evaluate relationships between frequency of cancer-preventative behaviors, gender, and race. Responses to the CAM were dichotomized with a score of "1" representing responses of "strongly agree" or "agree" and a score of "0" representing responses of "neither disagree nor agree," "disagree," or "strongly disagree." A CAM scale score was then calculated by summing scores on the 11 items, resulting in scale scores ranging from 0 (no awareness) to 11 (high awareness). Independent samples t test was used to assess differences in overall mean score on the CAM by gender, and a one-way ANOVA was used to assess differences in mean scores by race. Consistent with previous CAM analyses [19, 20], Pearson's chi-square (χ^2) tests were utilized to evaluate relationships between CAM items, gender, and race.

A p value of < 0.05 was considered statistically significant. Analyses were performed using version 24.0 of the Statistical Package of Social Sciences ([SPSS], (IBM), Chicago, IL, USA). A total of 1738 students completed the questionnaire for a response rate of 77.5%. Questionnaires were excluded from analysis due to incompleteness ($n = 186$) and data inconsistencies ($n = 41$), resulting in a final sample of 1511.

Results

Sample

Participants were primarily female (59.1%), non-Hispanic White (69.7%), first-year college students (76.7%), and either 18 (35.9%) or 19 (44.6%) years old. The majority of participants (61.3%) reported height and weight measurements that resulted in a BMI score within the healthy weight range. Regarding cancer-preventative behaviors, participants most frequently reported consuming alcohol weekly (47.8%), consuming fruits and vegetable on three or fewer days a week (50.3%), exercising for at least 30 min on at least 3 days a week (51.7%), and never

using tobacco (70.2%). For data analysis, race/ethnicity categories (hereafter referred to as "race") were collapsed so that "other" included Hispanic, Asian or Pacific Islander, American Indian or Alaskan Native, and other. Table 1 contains further sample information.

Cancer Prevention Behaviors by Gender and Race

As illustrated in Table 2, there was a statistically significant association between gender, and three of the four cancer-preventative behaviors examined (exercise, tobacco use, alcohol use). Males reported higher frequencies for exercise, alcohol use, and tobacco use compared to their female counterparts. There was a statistically significant association between race and all four cancer-preventative behaviors examined (exercise, tobacco use, alcohol use, fruit and vegetable consumption). For exercise (M = 4.20, SD = 1.77), White participants reported the highest frequency (M = 4.33, SD = 1.73) followed by "other" (M = 4.18, SD = 1.64) and Black (M = 3.71; SD = 1.92). For alcohol use (M = 2.39, SD = 1.85), White participants reported the highest frequency (M = 2.64, SD = 1.84) followed by "other" (M = 2.07, SD = 1.83) and Black (M = 1.59, SD = 1.64). For fruit and vegetable consumption (M = 5.0, SD = 1.34), White participants reported the highest frequency (M = 5.06, SD = 1.29), followed by "other" (M = 4.95, SD = 1.45) and Black (M = 4.76, SD = 1.46). For tobacco use (M = 0.92, SD = 1.81), "other" reported the lowest frequency (M = 0.78, SD = 1.71), followed by Black (M = 0.55, SD = 1.39) and White (M = 1.04, SD = 1.90).

Cancer Awareness Measure

The mean number of cancer risks recognized was 6.69 out of 11 (SD = 3.08). CAM scores by gender and race are presented in Table 3. The majority of participants agreed that 9 of the 11 factors were cancer risk factors: smoking (85.5%), second-hand smoke (80.7%), family history (73.9%), being overweight (70.5%), having an HPV infection (68.2%), sun exposure (61.2%), low amounts of exercise (55.0%), consuming alcohol (53.7%), and older age (52.3%). A minority of participants correctly agreed that red and processed meat consumption (34.2%) and low fruit and vegetable intake (30.1%) were cancer risk factors. The CAM scale reliability was high (Cronbach's alpha = 0.874), consistent with previous reports [18–20].

Recognition of Cancer Risk Factors by Gender and Race

A statistically significant difference was found in the mean number of recognized cancer risk factors between male (M = 6.36; SD = 3.27) and female (M = 6.91; SD = 2.93) participants: $t(1471) = -3.348$, $p = 0.001$. Females were statistically significantly more likely to correctly agree that

Table 1 Sociodemographic characteristics and cancer-preventative behaviors of college students (*N* = 1511)

		n[a]	%
Gender	Male	615	40.7
	Female	893	59.1
	Other	4	0.3
Race	White, not-Hispanic	1054	69.7
	Black, not-Hispanic	260	17.2
	Hispanic	103	6.8
	Asian or Pacific Islander	46	3.0
	American Indian or Alaskan Native	7	0.5
	Other	42	2.8
Age (years)	18	543	35.9
	19	675	44.6
	20	138	9.1
	21	64	4.2
	22	29	1.9
	23	21	1.4
	24	11	0.7
	25+	31	2.1
Class	First-year student	1159	76.7
	Sophomore	201	13.3
	Junior	122	8.1
	Senior	22	1.5
	Other	8	0.5
Body mass index (BMI)	Underweight (< 18.5)	60	4.0
	Healthy weight (18.5–24.9)	923	61.3
	Overweight (25.0–29.9)	352	23.4
	Obese (30.0+)	171	11.4
Exercise frequency (at least 30 min)	Never	75	5.0
	Monthly	82	5.4
	Once in 15 days	103	6.8
	Once a week	203	13.5
	Twice a week	265	17.6
	3 times a week	300	19.9
	4 times a week	479	31.8
Alcohol consumption	Never	330	21.9
	Monthly	279	18.5
	Once in 15 days	178	11.8
	Once a week	190	12.6
	Twice a week	307	20.4
	3 times a week	168	11.2
	4 times a week	54	3.6
Tobacco usage	Never	1094	72.7
	Monthly	113	7.5
	Once in 15 days	45	3.0
	Once a week	61	4.1
	Twice a week	53	3.5
	3 times a week	44	2.9
	4 times a week	95	6.3
Fruit and vegetable consumption	Never	21	1.4
	Monthly	26	1.7
	Once in 15 days	48	3.2
	Once a week	101	6.7
	Twice a week	198	13.1
	3 times a week	364	24.2
	4 times a week	749	49.7

[a] Missing data reflect differences in total *n*

smoking, second-hand smoke, family history, being overweight, HPV infection, sun exposure, alcohol consumption, and red/processed meat consumption were cancer risk factors than their male counterparts. Males were statistically significantly more likely to correctly agree that low amounts of exercise and older age were cancer risk factors than females.

No statistically significant difference was found in the mean number of recognized cancer risk factors by race ($F(2,1474) = 1.742$, $p = 0.176$). However, participants who identify as White were statistically significantly more likely to correctly agree that being overweight, low amounts of exercise, and older age were cancer risk factors than their non-White counterparts. Conversely, participants who identify

Table 2 Cancer-preventative behaviors by gender and race ($N = 1511$)

		Gender ($n=1503$[a])					Race ($n=1507$[a])							
		Male ($n = 612$)		Female ($n = 891$)		Significance[b]	White ($n = 1053$)		Black ($n = 258$)		Other ($n = 198$)		Significance[b]	
		n	%	n	%		n	%	n	%	n	%		
Exercise	Never	30	4.9	44	4.9	$\chi^2 (6, 1497) = 58.012$	47	4.5	20	7.8	8	4.0	$\chi^2 (12, 1495) = 36.087$	
	Monthly	23	3.8	58	6.5	$p < 0.001$	52	4.9	22	8.5	8	4.0	$p < 0.001$	
	Once in 15 days	32	5.2	70	7.9		63	6.0	27	10.5	13	6.6		
	Once a week	59	9.6	144	16.2		126	12.0	46	17.8	31	15.7		
	Twice a week	92	15.0	173	19.4		187	17.8	36	14.0	42	21.2		
	3 times a week	119	19.4	181	20.3		213	20.3	44	17.1	43	21.7		
	4 times a week	257	42.0	221	24.8		363	34.5	63	24.4	53	26.8		
Alcohol	Never	131	21.4	199	22.3	$\chi^2 (6, 1496) = 46.187$	186	17.7	87	33.9	57	28.8	$\chi^2 (12, 1494) = 80.812$	
	Monthly	86	14.1	191	21.4	$p < 0.001$	173	16.5	67	26.1	39	19.7	$p < 0.001$	
	Once in 15 days	63	10.3	115	12.9		124	11.8	34	13.2	20	10.1		
	Once a week	79	12.9	111	12.5		147	14.0	22	8.6	21	10.6		
	Twice a week	124	20.3	182	20.4		233	22.2	33	12.8	41	20.7		
	3 times a week	89	14.6	78	8.8		143	13.6	9	3.5	16	8.1		
	4 times a week	39	6.4	15	1.7		45	4.3	5	1.9	4	2.0		
Tobacco	Never	342	55.9	752	84.6	$\chi^2 (6, 1495) = 164.047$	727	69.1	212	82.5	155	79.1	$\chi^2 (12, 1493) = 35.387$	
	Monthly	68	11.1	44	4.9	$p < 0.001$	96	9.1	10	3.9	7	3.6	$p < 0.001$	
	Once in 15 days	24	3.9	19	2.1		33	3.1	8	3.1	4	2.0		
	Once a week	47	7.7	14	1.6		46	4.4	10	3.9	5	2.6		
	Twice a week	29	4.7	24	2.7		36	3.4	7	2.7	10	5.1		
	3 times a week	31	5.1	13	1.5		34	3.2	3	1.2	7	3.6		
	4 times a week	71	11.6	23	2.6		80	7.6	7	2.7	8	4.1		
Fruit and vegetable	Never	13	2.1	8	0.9	$\chi^2 (6, 1497) = 12.103$	9	0.9	6	2.3	6	3.1	$\chi^2 (12, 1495) = 22.185$	
	Monthly	11	1.8	15	1.7	$p = 0.060$	20	1.9	4	1.6	2	1.0	$p = 0.035$	
	Once in 15 days	26	4.2	22	2.5		31	2.9	12	4.7	5	2.6		
	Once a week	47	7.7	54	6.1		64	6.1	24	9.3	13	6.6		
	Twice a week	87	14.2	111	12.5		129	12.3	39	15.1	30	15.3		
	3 times a week	136	22.2	226	25.4		257	24.4	67	26.0	40	20.4		
	4 times a week	292	47.7	455	51.1		543	51.6	106	41.1	100	51.0		

[a] Missing data reflect differences in total n

[b] $p = 0.05$; significant results are in italic

their race as "other" were statistically significantly more likely to agree that family history is a cancer risk factor than their White and Black peers.

Discussion

This study represented one of the largest of its kind exploring college students' cancer awareness and the associations between their perceptions and actual lifestyle and dietary behaviors. According to a recent cancer review report from National Cancer Institute, nearly half of cancer diagnoses are attributed to modifiable factors (tobacco use, lack of exercise, or unhealthy diet) [2]. Therefore, it is essential to be aware of these factors early in life to engage in lifestyle choices that might prevent the onset of cancer later in life. However, to our knowledge, little is known regarding young adults' awareness of risky health behaviors associated with cancer or their behaviors associated with cancer prevention. Our study, in alignment with current CDC goals [26], measured both the cancer awareness and preventive behaviors among college students in a rural, southern US location.

Cancer Risk Factor Awareness

The majority of the students in this study correctly identified select cancer risk factors (e.g., smoking, second-hand smoke, family health, and being overweight) listed in the CAM [20].

Table 3 Cancer Awareness Measure frequency by gender and race (N = 1511)

	Gender (n = 1505)[a]					Race (n = 1509)[a]						
	Male (n = 613)		Female (n = 892)		Significance[b]	White (n = 1053)		Black (n = 258)		Other (n = 198)		Significance[b]
	n	%	n	%		n	%	n	%	n	%	
Smoking	499	81.4	787	88.2	χ^2 (1, 1504) = 13.61 $p < 0.001$	913	86.7	216	83.7	161	81.3	χ^2 (2, 1507) = 4.687 $p = 0.096$
Second-hand smoke	461	75.3	752	84.5	χ^2 (1, 1501) = 19.61 $p < 0.001$	847	80.5	213	82.9	156	79.2	χ^2 (2, 1504) = 1.097 $p = 0.578$
Family history	416	67.9	694	77.8	χ^2 (1, 1503) = 18.136 $p < 0.001$	792	75.2	171	66.5	151	76.3	χ^2 (2, 1506) = 8.732 $p = 0.013$
Overweight	409	67.1	646	72.7	χ^2 (1, 1497) = 5.262 $p = 0.022$	766	73.0	155	60.1	138	71.1	χ^2 (2, 1500) = 16.551 $p < 0.001$
HPV infection	385	62.9	638	71.8	χ^2 (1, 1499) = 13.347 $p < 0.001$	722	68.8	164	63.6	140	71.4	χ^2 (2, 1502) = 3.650 $p = 0.161$
Sun exposure	360	58.7	556	62.7	χ^2 (1, 1499) = 2.386 $p = 0.122$	650	61.8	157	61.3	113	57.7	χ^2 (2, 1502) = 1.192 $p = 0.551$
Low exercise	348	56.9	477	53.5	χ^2 (1, 1501) = 1.713 $p = 0.191$	602	57.3	126	48.8	100	50.8	χ^2 (2, 1504) = 12.574 $p = 0.002$
Alcohol	280	45.9	523	58.9	χ^2 (1, 1497) = 24.55 $p < 0.001$	552	52.6	144	56.7	110	55.6	χ^2 (2, 1500) = 1.726 $p = 0.422$
Older age	328	53.7	457	51.3	χ^2 (1, 1501) = .831 $p = 0.362$	578	54.9	110	42.6	100	51.3	χ^2 (2, 1504) = 7.593 $p = 0.022$
Red meat consumption	197	32.1	346	35.5	χ^2 (1, 1502) = 1.832 $p = 0.176$	343	32.6	100	38.8	73	36.9	χ^2 (2, 1505) = 4.150 $p = 0.126$
Low fruit/vegetable intake	190	30.9	260	29.2	χ^2 (1, 1502) = 0.549 $p = 0.459$	308	29.3	83	32.2	63	31.8	χ^2 (2, 1505) = 1.118 $p = 0.572$

[a] Missing data reflect differences in total n

[b] $p = 0.05$; significant results are in italic

However, only about one in three participants in the current sample identified consumption of red and processed meat (34.2%) and low fruit and vegetable intake (30.1%) as cancer risk factors, compared to approximately one in two participants in a previous study reporting CAM [27]. Although literature is extensive on dietary factors and cancer risk, particularly indicating the dietary recommendations, these factors were not adequately recognized by college students [4–7]. Future health education/promotion programs should emphasize the link between diet and cancer and provide more evidence-based interventions to lower red/processed meat consumption and increase fruit/vegetables intake among young adults. Potential educational topics include carcinogenicity of red/processed meat and the protective benefits of a plant-based diet. In addition to promoting cancer awareness and knowledge, institutions of higher education should enhance policies and procedures to assist with the control of alcohol consumption and tobacco use, increase the access to on-campus or near-campus healthy food choices, and improve the availability of affordable fresh fruit and vegetables in campus-dining facilities among low-income students.

Significant differences were observed in the mean number of recognized cancer risk factors between male and female participants in this study. Specifically, females were more likely to correctly agree that smoking, second-hand smoke, family history, being overweight, and HPV inflection are cancer risk factors than their male counterparts. These findings align with previous reports that women were more likely to recognize disease-related symptoms and use healthcare services than their male counterparts [12, 23, 27]. Similarly, other studies found women to be more likely to initiate family health history discussions with family, peers, and physicians, due to awareness of symptoms or awareness of a close family member's (e.g., spouse, parents, and siblings) disease diagnosis [22]. Therefore, health education specialists should pay particular attention to the role female students might play in future theory-driven educational campaigns to promote cancer-preventative knowledge and behaviors among college-age young adults.

Cancer Prevention Behaviors

With regard to the cancer prevention behavior items measured in this study (exercise, alcohol use, tobacco use, fruit and vegetable intake), a large proportion of students in our sample did not meet current recommendations of the American Cancer Society (ACS) [5]. For instance, ACS recommended that individuals should maintain at least 150 min of moderate activity or 75 min of vigorous exercise each week, which, preferably, should be spread throughout the week [5]. Our study showed that only 45.1% of female students and 61.4% of male students reported exercising three or four times a week. Likewise, more than one in three (35.5%) female

students reported exercising once a week or less, while less than one in four (23.5%) male students reported this low exercise frequency. When controlling for race, students in the current study who identified as Black (44.6%) reported exercising once a week or less more often than students who identified as "other" (30.3%) and White (27.4%).

Regarding diet, approximately half of college students in the current sample reported consuming fruit and vegetables three times a week or less, and approximately 16% of male participants and 11% of female participants reported fruit and vegetable intake of once a week or less. These findings are consistent with previous reports that college students do not meet recommended fruit and vegetable intake guidelines [13]. The *2015–2020 Dietary Guidelines for Americans* recommended daily intake of at least 2½ cups of vegetables and 2 cups of fruit [5], yet less than a quarter of US adults meet these recommendations [13]. According to the most recent National College Health Assessment [14], less than 5% of US college students participating in the survey reported meeting daily fruit and vegetable intake recommendations. Not surprisingly, improving fruit and vegetable consumption among US college students is a priority of the American College Health Association, with a *Healthy Campus 2020* objective to increase the proportion of college students who meet daily guidelines for fruit and vegetable consumption [14]. Nutrition-related health programming is needed for and wanted by the US college populations to help close the gap between college student and other US adult fruit and vegetable intake. In particular, peer influence, such as health coaches or ambassadors who can make positive impact on behavioral changes and involving student leaders in the variety of student organizations across the campuses, could possibly bring positive outcomes for cancer prevention.

Regarding alcohol and tobacco use, statistically significant differences were observed by gender and race. The proportion of male students who reported some level of tobacco usage (44.1%) was nearly three times greater than that of female students (15.4%). For alcohol, while male and female reports of some level of alcohol consumption were similar, males were more likely to report consuming alcohol three or four times a week while females were more likely to report drinking alcohol only monthly. When controlling for race, students in the current sample who identified as Black were more likely to report no alcohol consumption (33.9%) than students who identified as "other" (28.8%) and White (17.7%). Likewise, nearly one in five students who identified as White reported consuming alcohol three or four times a week compared to one in ten who identified as "other" and only one in 20 who identified as Black. Additionally, although nearly 90% of participants reported being younger than 21 years old, more than three fourths reported drinking alcohol. Similar trends were observed for tobacco usage: Students who identified as White were more likely to report some level of tobacco use

(approximately one in three) than students who identified as Black (approximately one in six) and "other" (approximately one in five).

Prior research indicated racial disparities may exist in cancer-preventive behaviors [27], and our study suggests this may be accurate. A statistically significant difference was found by race/ethnicity on all four of the behaviors examined. Specifically, we found that among our sample, White participants reported engagement in cancer-preventive behaviors of exercising and consuming fruit and vegetables more frequently than Black, Hispanic, Asian, and American Indian/Alaskan Native participants. Conversely, White participants, and male participants, reported the highest frequency for the risky behaviors of tobacco use and alcohol consumption. This finding was aligned with one study conducted among prostate cancer survivors that found White men consumed more alcohol than men from other racial/ethnic groups [23].

Practical Implications

Findings from this study were consistent with prior reports that many college students did not exercise enough, maintain healthy dietary habits, or avoid tobacco. Currently, interventions aimed at changing cancer prevention behavior, such as increasing fruit and vegetable consumption and controlling alcohol consumption among college students, primarily target individual-level variables. However, environmental contexts of college campuses such as convenience, cost, and proximity of fruit and vegetables or alcohol also need to be considered. A greater emphasis is needed at all levels of influence to address the gap between students' cancer awareness and cancer-preventive behaviors in future educational campaigns designed for university populations. Future research should explore the use of social media and other relevant communication platforms that are preferred communication methods of today's university student to market programming and reach potentially marginalized groups. In addition, further investigations should also look at factors such as reinforcing college/university policies and enhancing environmental factors that might be associated the current cancer prevention behaviors among college students.

Limitations

Several limitations should be noted when considering this study's results. First, this study was cross-sectional and restricted to students enrolled in a semester-long health promotion class at a single university, which limited the generalizability of the findings. Second, the cancer prevention behavior data collected in this study were obtained through participant self-report, so there was no control for over- or under-reporting of health information. Third, this research focused specifically on first- and second-year undergraduate college students, limiting the generalizability of results to third- and fourth-year students and young adults who are not college students. In future studies, it would be advantageous to analyze different age groups, such as graduate students or young adults outside of university settings. Fourth, since the majority of the current sample identified as White, conclusions drawn by race/ethnicity are constrained. However, the racial make-up of the sample did mimic that of the general population for the state in which the university was located. Despite these limitations, this study represents one of the largest to date investigating cancer prevention perceptions among young adults and one of the first to be conducted in a rural, southern US setting.

Conclusions

Findings from this study highlighted gender and racial gaps in young adults' cancer-preventative knowledge and behaviors among the current sample of college students. Future research should confirm these possible health disparities and assess underlying mechanisms contributing to these disparities to inform university- and evidence-based health campaigns to improve cancer prevention knowledge and decrease risky health behavior among all college students. The racial and gender disparities observed in the current study may reflect the need for culturally sensitive programming tailored to university students across multiple levels (i.e., individual, interpersonal, organization, community, and policy) to close the gaps for cancer-preventative knowledge and behaviors.

Compliance with Ethical Standards

Study protocol and procedures were approved by the East Carolina University Institutional Review Board.

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