

## Determinants of Unhealthy Behaviors among Adult Cancer Survivors

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### Abstract

**Objective:** To evaluate the impact of time since cancer diagnosis, access to health care, and demographics in the prevalence of cancer six unhealthy behaviors (lack of exercise, overweight, inadequate sleep, less life satisfaction, current smoking and alcohol use) among cancer survivors.

**Methods:** Maryland Behavioral Risk Factor Surveillance System (BRFSS) participants, who reported in 2009 a previous history of cancer, were included in this study. With the exception of non-melanoma skin cancers all cancer sites were included. Logistic regression assessed time since cancer diagnosis, access to health care and demographics as predictors of unhealthy behaviors.

**Results:** Unhealthy behaviors were differentially predicted. Time since cancer diagnosis was not significant for any unhealthy behaviors after multivariate adjustment. Access to health care has significant impact on sleep and life satisfaction. Female gender was significant for weight gain. Current smoking, alcohol use, and lack of exercise were affected by place of residence. Most striking were large and statistically significant high ORs for current smoking in all local Maryland jurisdictions compared to Montgomery County.

**Conclusion:** Contrary to our hypothesis, cancer survivors did not participate more in healthy behaviors with increasing time since cancer diagnosis. We expected health care access to play a critical role in advising cancer survivors to adopt healthy behaviors. However, this was true for only two of the six unhealthy behaviors. This study increases awareness about Maryland adult cancer survivors, and may motivate a renewed prevention mindset for physicians towards their cancer survivor patients as well as patients with cancer.

### Introduction

With advances in early detection and treatments for cancers, an increasing number of patients will be long term cancer survivors. In the United States, there are almost 13.7 million cancer survivors and this number is estimated to reach to 18 million by 2022 [1]. Majority of long term

cancer survivors are those diagnosed with breast, prostate, colorectal and gynecologic cancers [2].

Cancer survivors usually face challenges when it comes to their physical and mental health. It is even more challenging for cancer survivors to maintain a healthy lifestyle. A growing number of cancer survivors will pose challenges as well as financial burden for health care systems seeking to meet these patient's long term health care needs. Many factors play a part in the longevity of these patients, some of which require a change in lifestyle and incorporation of healthy behaviors into their routines.

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Promoting healthy lifestyle behaviors among cancer survivor patients is critical and at the same time challenging to their wellbeing and quality of life. Several studies in the literature have supported healthy lifestyle behaviors to promote health and quality of life in cancer survivors from breast, colorectal and other forms of cancer [3, 4, 5].

After diagnosis of cancer, a sense of awareness and concern regarding current health status begins to develop in adult patients [6]. Initially, patients tend to be overwhelmed with treatment protocols, sudden lifestyle changes and adverse effects that result from the disease as well as cancer treatment. With time many patients adapt to their new status as a cancer survivor. They begin to restore or modify behaviors towards a healthy lifestyle that ultimately enhances longevity, which is why these individuals are an important target population for health promotion efforts [6]. An example of modification in behaviors was seen in Blanchard et al., 2003 study of adult cancer survivors. In this study 46% of smokers quit smoking and 47% improved their dietary habits after a cancer diagnosis [7].

Access to health care improves survivorship. Grant and Economou write in "The Evolving Paradigm of Adult Cancer," that health care access was one of ten recommendations for improving the health care and quality of life for cancer survivors [8]. Others have emphasized in addition, the need for health care providers to optimize/promote healthy behaviors among long term cancer survivors as well as in the general adult population [4, 9]. This approach of education and promotion of healthy behaviors is very crucial for cancer survivors, who are at increased risk for developing osteoporosis, diabetes, secondary tumors and cardiovascular disease due to their practice of unhealthy behaviors [3, 10, 11, 12].

Radiation therapy and chemotherapy also exert a toll on the overall health in these individuals. Side effects from these therapies include a reduction in bone density, cardiovascular toxicity, fatigue, infertility, pain, sexual dysfunction and problems

with attention and memory [13]. Therefore, it is very important to help promote healthy behaviors among these patients in order to lessen the burden of early and late onset side effects of cancer treatment.

Cancer survivor's unhealthy behaviors include lack of physical activity, inadequate sleep, weight gain, smoking, alcohol use and life satisfaction. These behaviors have a detrimental effect on the overall health when adopted or constantly practiced by these individuals [3]. Physical activity may reduce the risk of other diseases and promote additional health behaviors that contribute to enhanced survivorship in colon, prostate, uterine, breast, and cervical cancer [14, 15]. Physical activity may reduce risk of death by about 90% in breast cancer survivors [15].

A study conducted by Jean-Pierre et al., 2015 concluded that self-reported memory problems were higher among adult cancer survivors that suffered from insomnia and cardiovascular disease compared to other adults [16]. A study examining weight gain in breast cancer survivors, concluded that weight gain had an adverse impact on cancer survival, treatment and also created a distress in body image among these individuals [17]. From these studies one can deduce the significance of proper sleep hygiene and adequate weight control in maintaining a healthy life style.

An analysis on smoking in colorectal cancer survivors revealed that individuals that smoked after treatment had a higher risk of death compared to individuals that were former smokers [18]. Rock *et al.*, 2013 and Tabuchi *et al.*, 2015 results on the effect of alcohol consumption in cancer survivors disclosed that consuming alcohol increased the risk of the development of new primary cancers in individuals with a prior history of cancer [19,20]. Tabuchi *et al.*, 2015 also found that cancer survivors that had a history of drinking alcohol or smoking had significantly higher like hood of developing subsequent primary esophageal and lung cancer compared to survivors that had never consumed alcohol or smoked [20].

**Table 1:** Overall Frequencies from sample of 819 Maryland adult cancer survivors, Behavioral Risk Factor Surveillance Survey, 2008

Variable	Overall Frequency
Time since Cancer Diagnosis 0-2 years	148 (18.1%)
Access to Health care (none)	36 (4.4%)
Last Physical Exam > 1 year	119 (4.5%)
No Physical Activity	571 (69.7%)
Overweight	506 (61.8%)
Inadequate Sleep	486 (59.3%)
Less life satisfaction	443 (54.1%)
Current Smoking	89 (10.9%)
Alcohol use	434 (53.0%)

A study on life satisfaction in adult cancer survivors concluded that physicians should concentrate on arranging long term follow up visits in order to detect effects of cancer survival which are associated with life satisfaction. Adequate support should be provided to these patients and risk factors such as psychological distress and deficiency in posttraumatic growth both of which have a negative association with life satisfaction should be identified [21].

This study evaluates the relationship of time since cancer diagnosis, access to health care and demographics to the prevalence of unhealthy behaviors in Maryland adult cancer survivors. The aim of the study is to shed light on this notable correlations in order to increase public health awareness and promote policy changes in order to target the needs of individuals that are in dire need of health care. Having health insurance gives an individual greater access to health care options which increases the possibility of visiting a physician on a frequent basis for medical management. A study conducted on young adult cancer survivors revealed that limited or no health insurance was a barrier to engaging in survivorship care among these individuals [22].

Less utilization of health care services due to no health insurance with no recent physical exam, and shorter interval since cancer diagnosis were hypothesized to predict prevalence of six

unhealthy behaviors among cancer survivors. Current health insurance and time since last physician visit were assessed as separate entities in this study due to their importance mentioned in prior studies. Milam *et al.*, 2015, study on cancer related follow up care in Hispanic and non-Hispanics revealed that Hispanics and older childhood cancer survivors were more likely to lack previous follow-up care because health insurance was strongly associated with both previous follow-up care and the intent to seek care [23].

Place of residence and other demographic characteristics like race, sex, and age were controlled for as covariates of lack of physical activity, overweight, inadequate sleep, less life satisfaction, current smoking and alcohol use [24]. Place of residence has a great impact on the prevalence of unhealthy behaviors because Maryland like any other state in the US or around the world, is composed of different counties which made up of people of various socio economic backgrounds. According to county health rankings in 2015 in Maryland, Montgomery County had the best health outcomes rank and its population consisted of 8% adult smokers, 13% uninsured individuals, and 19% obese adults. On the other hand Baltimore Cities population was reported as the worst county and consisted of 24% adult smokers, 14% uninsured individuals, and 34% of obese adults[25].

## Method

This study was deemed exempt by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board. Data from the Center for Disease Control's 2009 Maryland Behavioral Risk Factor Surveillance System survey (BRFSS) was analyzed (Table 1). The BRFSS is the largest, annual telephone health survey used to track risk behaviors and conditions relating to adult health in the United States (US). The BRFSS is a population-based random digit dial, stratified sampling survey of individuals aged 18 years and older [26]. Community dwelling Maryland residents reporting a cancer diagnosis were identified by self-report.

**Table 2:** Demographic factors by time since cancer diagnosis, access to health care and times since last physical exam, Maryland adult cancer survivors, Behavioral Risk Factor Surveillance Survey, 2008.

Variable	N	Time since Cancer Diagnosis 0-2 years	P value	Access to Health care (none)	P value	Last Physical Exam > 1 year	P value
<b>Race</b>			0.764		<b>&lt;0.001</b>		<b>0.042</b>
White	726	130 (17.9%)		25(3.4%)		112 (15.4%)	
Nonwhite	93	18 (19.4%)		11 (11.8%)		7 (7.5%)	
<b>Sex</b>			<b>0.015</b>		0.732		0.207
Females	501	75 (15.0%)		23(4.6%)		79 (15.8%)	
Males	318	73 (17.5%)		13 (4.1%)		40 (9.6%)	
<b>Region</b>			0.154		0.270		0.519
Baltimore City	44	5 (11.3%)		4 (9.1%)		4 (9.1%)	
Baltimore Suburbs	202	37 (18.3%)		9 (4.5%)		26 (12.9%)	
Montgomery County	100	15 (15.0%)		1 (1.0%)		19 (19.0%)	
Prince Georges County	49	7 (14.6%)		2 (4.1%)		8 (16.3%)	
Rural MD	424	84 (19.8%)		20 (4.7%)		62 (14.6%)	
<b>Age (years)</b>			0.057		<b>&lt;0.001</b>		<b>0.004</b>
18-39	31	7 (22.6%)		5 (16.1%)		8 (25.8%)	
40-64	326	71 (21.1%)		25 (7.4%)		61 (18.2%)	
65 and older	452	70 (15.5%)		6 (1.1%)		50 (11.1%)	

Health care variables included: current health insurance (yes/no), time since last physician visit ( $\leq 1$  year/  $>1$  year) and time since cancer diagnosis (0-2 years, 3-4 years or more than 5 years). The questionnaire asked individuals if they were cancer survivors, and when respondents replied 'yes,' they were asked about the type of cancer and further queried regarding cancer treatment and care [12, 24]. Information regarding race (white/nonwhite), sex (male/female), Maryland region (Montgomery County, Prince George's County, Baltimore City, Baltimore suburbs, and the remainder, rural Maryland), and age (18-39/40-64/65+) was collected[24].

Individuals reported their last cancer as breast, colon, rectum, gastrointestinal, lung/bronchus, female reproductive organs, prostate, melanoma, testicular, urinary, bone marrow, lymph, head and neck, and other skin cell carcinomas (N=1,168). Ninety-two percent of these respondents had complete demographic, health care access, and survival time information (N=1,076). Two hundred fifty seven individuals reporting other skin cell carcinoma as their last cancer were excluded,

leaving 819 study subjects, who were survivors of a major cancer. Since this is a fraction of all subjects interviewed ( $819/9,481= 8.6\%$ ), unweighted analyses are presented. Montgomery County was chosen as the reference group in the analysis because its percentage of residents with health insurance, last physical exam and cancer survivors fell in the middle compared to other counties in Maryland.

Report from cancer survivors from the BRFSS survey included physical activity in past month (any/none), overweight (body mass index (BMI)  $<25/ \geq 25$ , calculated from reported weight and height), days in the past month an individual felt that he or she had not had adequate sleep (zero/any), how satisfied an individual is with their life (very satisfied/not very satisfied), current cigarette smoking status (smoker/ not smoker) and any alcoholic beverage intake in the last month (none/any). Physical activity was reported according to the healthy people 2010 goal. Engaging in thirty minutes of moderate physical activity five times a week or twenty minutes of vigorous physical activity three times a week [27,

**Table 3:** Demographic characteristics by lifestyle factor, Maryland adult cancer survivors, Behavioral Risk Factor Survey, 2008.

Variable	N	No Physical Activity	Overweight	Inadequate Sleep*	Less life satisfaction*	Current Smoking*	Alcohol use*
<b>Race (p value)</b>		<b>0.009</b>	<b>0.009</b>	0.127	0.878	0.752	<b>&lt;0.001</b>
White	726	28.8%	39.8%	58.4%	54.0%	10.7%	55.7%
Nonwhite	93	41.9%	25.8%	66.7%	54.8%	11.8%	32.3%
<b>Sex (p value)</b>		<b>0.026</b>	<b>0.032</b>	<b>&lt;0.001</b>	0.313	0.131	<b>0.001</b>
Female	501	33.1%	41.1%	65.7%	55.5%	12.2%	46.5%
Male	318	25.8%	33.7%	49.4%	51.9%	8.8%	63.2%
<b>Region (p value)</b>		<b>0.030</b>	<b>0.040</b>	0.412	<b>0.007</b>	<b>0.003</b>	<b>0.032</b>
Baltimore City	44	39.6%	40.9%	65.9%	70.4%	20.5%	43.2%
Baltimore Suburbs	202	32.2%	41.1%	54.0%	48.0%	9.4%	55.5%
Montgomery County	100	17.0%	50.0%	63.0%	44.0%	1.0%	65.0%
Prince Georges County	49	28.6%	36.7%	59.2%	53.1%	12.2%	42.9%
Rural MD	424	31.8%	34.0%	60.4%	57.8%	12.7%	51.2%
<b>Age (Years) (p value)</b>		0.0481	0.672	<b>&lt;0.001</b>	0.295	<b>&lt;0.001</b>	0.444
18-39	31	22.6%	45.2%	83.9%	67.7%	9.7%	51.6%
40-64	326	29.2%	37.2%	71.4%	53.9%	17.9%	55.7%
65 and older	452	31.6%	38.5%	48.7%	53.3%	5.8%	51.1%
*In the past 30 days or month							

28]. According to Steinberger and Groves life style behaviors such as alcohol consumption, smoking and lack of physical activity can have adverse impacts on survival and quality of life for cancer survivors [24].

Stata 11.2 software was used for analysis. Chi square analysis was performed to test the pairwise independence of categorical variables. Multi-variate logistic regression modeled each behavior with time since cancer diagnosis, no health insurance, last physical exam and demographics as covariates. This form of analysis was conducted to minimize confounding. We report here single p values and consider significant, values <0.05 since our hypotheses were specified *a priori*. If one desired a Bonferroni adjustment, p values would be considered significant at 0.0028.

## Results

### *Demographics & their Relationship to Time since Cancer diagnosis and Access to Health Care*

Females were more likely to have survived more than five years after their cancer diagnosis ( $p=0.015$ ) (Table 2). Older age individuals shared a weak association ( $p=0.057$ ) with more years since cancer diagnosis. In our sample only 4.4 % of cancer survivors had no access to health care. 14.5% of cancer survivors had no recent physical exam. Individuals of white race and younger age ( $p<0.001$ ) were found to have last physical exam more than one year prior. Similarly younger age was associated with having no access to health care ( $p<0.001$ ) while white race was accompanied by greater likelihood of having access to health care ( $p<0.001$ ).

### *Demographics & Unhealthy Behaviors among Cancer Survivors*

In order of most to least prevalent, unhealthy behaviors among cancer survivors ranked as follows: overweight (61.8%), inadequate sleep (59.3%), less life satisfaction (54.1%), any alcohol use (53.0%), no physical activity (30.3%), and current smoking (10.9%). The relationship



**Table 4:** Lifestyle factors by time since cancer diagnosis, health insurance and last physical exam, Maryland adult cancer survivors, Behavioral Risk Factor Surveillance Survey 2008.

	Time since cancer diagnosis				Access to Health care			Last Physical Exam		
	0-2 Years (N= 148)	3-4 Years (N= 126)	≥5years (N= 545)	P Value	No (N= 36)	Yes (N=783)	P Value	Past Year (N=700)	>1 Year (N= 119)	P Value
<b>Physical Activity</b>				0.949			0.250			0.051
Any	104 (70.3%)	89 (70.6%)	378 (69.4%)		22 (62.1%)	549 (70.1%)		479 (68.4%)	92 (77.3%)	
None	44 (29.7%)	37 (29.4%)	167 (30.6%)		14 (38.9%)	234 (29.9%)		221 (31.6%)	27 (22.7%)	
<b>Overweight</b>				0.706			0.537			<b>0.032</b>
BMI ≤25	58 (39.2%)	44 (34.9%)	211 (38.7%)		12 (33.3%)	301 (38.4%)		257 (36.7%)	56 (47.1%)	
BMI > 25	90 (60.8%)	82 (65.1%)	334 (61.3%)		24 (66.7%)	482 (61.6%)		443 (63.3%)	63 (52.9%)	
<b>Sleep</b>				0.454			<b>0.050</b>			<b>0.002</b>
Adequate	54 (36.5%)	55 (43.7%)	224 (41.1%)		9 (25.0%)	324 (41.4%)		300 (42.9%)	33 (37.7%)	
Inadequate	94 (63.5%)	71 (56.4%)	321 (58.9%)		27 (75.0%)	459 (58.6%)		400 (57.1%)	86 (72.3%)	
<b>Life Satisfaction</b>				0.881			<b>0.001</b>			0.129
Very	69 (46.6%)	60 (47.6%)	247 (45.3%)		7 (19.4%)	369 (47.1%)		329 (47.0%)	47 (39.5%)	
Not Very	79 (53.4%)	66 (52.4%)	298 (54.7%)		29 (80.6%)	414 (52.9%)		371 (53.0%)	72 (60.5%)	
<b>Smoking</b>				0.524			<b>&lt;0.001</b>			0.510
Current	17 (11.50%)	17 (13.5%)	55 (10.1%)		11 (30.6%)	78 (10.0%)		74 (10.6%)	15 (12.6%)	
Not Current	131 (88.5%)	109 (86.5%)	490 (89.9%)		25 (69.4%)	705 (90.0%)		626 (89.4%)	104 (87.4%)	
<b>Alcohol</b>				0.324			<b>0.038</b>			0.326
None	74 (50.0%)	52 (41.3%)	259 (47.5%)		23 (63.9%)	362 (46.2%)		334 (47.4%)	51 (42.9%)	
Any	74 (50.0%)	74 (58.7%)	286 (52.5%)		13 (36.1%)	421 (53.8%)		366 (52.3%)	68 (57.1%)	

\*In past 30 days or month

between demographics and the six unhealthy behaviors among cancer survivors is shown in Table 3. Race, sex, and place of residence were statistically significant predictors of alcohol use, no physical activity, and being overweight (Table 3). Higher prevalence of no physical activity was associated with nonwhite race ( $p=0.009$ ) and female sex ( $p=0.026$ ). Overweight was more prevalent in whites ( $p=0.009$ ), female sex ( $p=0.032$ ) and Montgomery County residence ( $p=0.040$ ). Overweight ranged from 34.0% in rural Maryland to 50.0% in Montgomery County. Less life satisfaction among cancer survivors differed only by region ( $p=0.007$ ); the range among Maryland regions ranged from 65.9% (Baltimore

City) to 56.0% (Montgomery County). With regards to prevalence of inadequate sleep, sex and age differences were found to be statistically significant ( $p<0.001$ ), with females and those of younger age over-represented (Table 3). Current smoking status was found to be statistically significant ( $p<0.001$ ), with adult cancer survivors age 40-64 having a higher rate of current smoking than other age groups. Also smokers were differentiated based on their place of residence ( $p=0.003$ ), with more in Baltimore City (38.6%) compared to Montgomery County (17%). Prevalence of any alcohol use was higher among whites ( $p<0.001$ ) and male cancer survivors ( $p<0.001$ ) and again differed by region ( $p=0.032$ )

**Table 5:** Multivariate model results predicting unhealthy behaviors in Maryland adults cancer survivors (N=819), Behavioral Risk Factor Surveillance Survey, 2008.

	No Physical Activity (Model 1) OR (95% CI)	Overweight(Model 2) OR (95% CI)	Inadequate Sleep (Model 3) OR (95% CI)	Less Life Satisfaction (Model 4) OR (95% CI)	Smoking (Model 5) OR (95% CI)	Alcohol Use (Model 6) OR (95% CI)
<b>Time Since Cancer Diagnosis</b>						
0-2 years	Reference	Reference	Reference	Reference	Reference	Reference
3-4 years	0.98 (0.57-1.67)	0.74 (0.45-1.23)	1.51 (0.90-2.53)	1.03 (0.63-1.68)	1.28 (0.60-2.73)	0.67 (0.41-1.11)
5+ years	1.01 (0.67-1.52)	0.89 (0.61-1.31)	1.20 (0.81-1.79)	0.92 (0.63-1.34)	0.99 (0.54-1.84)	0.80 (0.55-1.18)
<b>Access to health care</b>						
Yes	Reference	Reference	Reference	Reference	Reference	Reference
No	0.67 (0.33-1.40)	1.18 (0.56-2.50)	1.23 (0.54-2.80)	<b>3.41</b> <b>(1.44-8.09)</b>	<b>0.36</b> <b>(0.16-0.81)</b>	0.53 (0.25-1.11)
<b>Last Physical Exam</b>						
Past Year	Reference	Reference	Reference	Reference	Reference	Reference
2+ Years	0.68 (0.43-1.10)	1.47 (0.98-2.21)	<b>0.57</b> <b>(0.36-0.90)</b>	0.76 (0.51-1.15)	1.00 (0.53-1.88)	0.88 (0.58-1.34)
<b>Age (Years)</b>						
18-39	Reference	Reference	Reference	Reference	Reference	Reference
40-64	1.71 (0.70-4.21)	0.73 (0.34-1.57)	1.69 (0.62-4.60)	1.58 (0.70-3.54)	2.70 (0.75-9.69)	1.14 (0.53-2.47)
65 and older	2.15 (0.87-5.30)	0.79 (0.34-1.57)	<b>4.05</b> <b>(1.50-11.00)</b>	1.47 (0.66-3.31)	0.84 (0.22-3.19)	1.71 (0.78-3.72)
<b>Region</b>						
Montgomery County	Reference	Reference	Reference	Reference	Reference	Reference
Baltimore Suburbs	<b>2.53</b> <b>(1.37-4.66)</b>	0.71 (0.43-1.16)	1.42 (0.85-2.39)	0.86 (0.94-1.40)	<b>9.73</b> <b>(1.27-74.44)</b>	<b>1.76</b> <b>(1.05-2.95)</b>
Baltimore City	<b>2.70</b> <b>(1.19-6.12)</b>	0.87 (0.42-1.84)	0.87 (0.39-1.90)	<b>0.33</b> <b>(0.15-0.72)</b>	<b>25.05</b> <b>(2.99-210.19)</b>	<b>2.16</b> <b>(1.01-4.63)</b>
Prince Georges County	1.80 (0.78-4.13)	0.65 (0.32-1.33)	1.27 (0.61-2.65)	0.70 (0.35-1.40)	<b>13.82</b> <b>(1.58-120.66)</b>	<b>2.44</b> <b>(1.17-5.09)</b>
Rural MD	<b>2.48</b> <b>(1.40-4.38)</b>	0.51 (0.32-1.25)	1.09 (0.68-1.76)	<b>0.58</b> <b>(0.37-0.91)</b>	<b>13.90 (1.89-102.51)</b>	<b>2.07</b> <b>(1.29-3.32)</b>
<b>Sex</b>						
Male	Reference	Reference	Reference	Reference	Reference	Reference
Female	<b>1.59</b> <b>(1.15-2.20)</b>	<b>1.36</b> <b>(1.00-1.84)</b>	<b>0.58</b> <b>(0.43-0.78)</b>	0.87 (0.65-1.17)	1.32 (0.80-2.18)	<b>2.28</b> <b>(1.68-3.10)</b>
<b>Race</b>						
None white	Reference	Reference	Reference	Reference	Reference	Reference
White	<b>1.87</b> <b>(1.16-3.02)</b>	0.49 (0.29-1.02)	0.80 (0.49-1.32)	1.12 (0.70-1.79)	0.78 (0.37-1.66)	<b>2.71</b> <b>(1.65-4.43)</b>
*In past 30 days or month OR: Odds ratio 95% CI, 95% confidence interval						

with more in Montgomery County (65%) relative to the lowest region, Prince George's county (42.9%).

*Time since Cancer Diagnosis, Access to Health care, Last Physical Exam and Unhealthy Behaviors*

Pairwise relationships of time since cancer diagnosis, timing of last physical exam, and no health insurance to unhealthy behaviors are highlighted in Table 4. No behaviors were univariately associated with time since cancer diagnosis (Table 4). No health insurance had a significant association with four cancer unhealthy behaviors: less life satisfaction ( $p < 0.001$ ),

inadequate sleep ( $p=0.050$ ), current smoking ( $p<0.001$ ) and alcohol use ( $p=0.038$ ). Having a physical exam more than a year ago had a significant association with physical activity (borderline,  $p=0.051$ ), normal body mass index ( $p<0.032$ ) and with inadequate sleep ( $p<0.01$ ).

### *Multivariate Prediction of Healthy Behaviors*

Results of multivariate modeling of each unhealthy behavior are shown in Table 5. Odds ratios (95% confidence intervals) are presented.

#### *No physical activity (Model 1)*

Compared to Montgomery County, all counties except neighboring Prince George's County conveyed statistically significant higher odds of no physical activity having controlled for age, region, and race. Sex and race were also significant predictors of no exercise.

#### *Overweight (Model 2)*

After adjustment, being overweight was predicted by sex with the added risk present in females, as shown by the  $OR=1.36$  (1.00-1.84). Time since cancer diagnosis and access to health care did not reveal a significant association in individuals with a  $BMI \geq 25$  after controlling for age, region, and race.

#### *No recent physical exam and Inadequate sleep (Model 3)*

Female cancer survivors ( $OR=0.58$ , 0.43-0.78) and those with no recent physical exam ( $OR=0.57$ , 0.36-0.90) reported inadequate sleep less often, after controlling for race, sex, and age.

#### *Life satisfaction (Model 4)*

The odds of less life satisfaction were significantly increased among those with no health care with an  $OR=3.41$  (1.44-8.09). Residence in Baltimore City ( $OR=0.33$ , 0.15-0.72) or rural Maryland ( $OR=0.58$ , 0.37-0.91) was protective from less life satisfaction, compared to the reference group of Montgomery County residence, after controlling for race, sex, and age.

#### *Smoking (Model 5)*

After controlling for race, sex, and age, residence in any region other than Montgomery County predicted greater likelihood of being a cancer survivor who currently smokes, despite wide confidence intervals due to small numerators. The odds ratio between smoking and place of residence was highest among those living in the Baltimore suburbs, where the  $OR$  was 25.1 (2.99-210.19) but statistically significantly different from Montgomery county in all regions (Table 5). No health insurance predicted lower odds of current smoking ( $OR=0.36$ , 0.16-0.81).

#### *Alcohol use (Model 6)*

Survivors at higher risk of alcohol use compared to Montgomery County were found in all regions ( $OR$  ranged from 1.76 to 2.44), were of white race ( $OR=2.71$ , 1.65-4.43) or female sex ( $OR=2.28$ , 1.68-3.10).

### **Discussion**

Unhealthy behaviors have significant biomedical and psychosocial effects for cancer survivors. In our study, we hypothesized that time since cancer diagnosis, lack of access to health care and more distance physical exam would predict six unhealthy behaviors in cancer survivors and advice from their physician may help in changing these unhealthy behaviors. In our study sample, adaptation to healthy behaviors in cancer survivors showed no relationship to the time since cancer diagnosis. Because risk for developing cancer is present throughout the life cycle and these are cancer preventive behaviors, it is perhaps a better public health policy for physicians to promote healthy life behaviors with every patient in their practice [29]. Other research has shown that there are reductions in healthy behaviors when individuals are focused on the present rather than the future [30]. Thus after immediate cancer treatment and recovery from its effects, health care professionals should focus largely on the long term health of cancer survivors by creating individualized preventive plans that



emphasize self-care awareness, and promotion of healthy behaviors [4].

Access to health care through health insurance was found to be positively associated with life satisfaction while negatively associated with current smoking status. Another issue where cost may be a factor is less life satisfaction, where the root cause may be an underlying and untreated depression, an explanation consistent with high odds of less life satisfaction when uninsured – a group that may go untreated for their depression. Jeffery *et al.*, 2012 reported that cancer survivors working in the US military, a group with universal coverage, one in five cancer survivors were diagnosed and treated for depression [31]. A meta-analysis has shown that cancer survivors with depression can be effectively treated [32] and if untreated become persistently affected [33], seek more medical care, delay return to work, go on to disability and in some cases, commit suicide [32]. Poverty goes hand in hand with the incidence of depression and overall life satisfaction. A study performed on the financial burdens in cancer survivors, reported that financial burden is frequently seen among cancer survivors and has a relation to patient's health-related quality of life. In the study 48% of participants had difficulties living on their household income and high financial burden was also associated with poorer quality of life [34].

Though less life satisfaction is not usually reported as a cancer unhealthy behavior, in this analysis adjusting for region, race, sex and age, no health insurance has shown persistent and large odds for less life satisfaction and bodes poorly for cancer survivor quality of life and well-being. Changes should be brought about in health care in order to increase overall health coverage. This will aid physicians by giving them the ability to screen patients through frequent visits and treat individuals that suffer from less life satisfaction which may be related to undiagnosed or untreated depression.

No access to health care was demonstrated to some extent in two of the six unhealthy behaviors for adult cancer survivors, yet there was no effect

in the cancer unhealthy behaviors for physical activity, overweight and alcohol use, indicating a gap or a lack of influence of health care providers on these behaviors among cancer survivors. This further emphasizes the need for health care involvement in shaping healthy behaviors before, during and after cancer diagnosis.

Inadequate sleep among cancer survivors is an unhealthy behavior which can be treated by a primary care provider. Treating sleep issues among cancer survivors may be a problem associated with lack of access to health care or incomplete coverage for treatment expenses [35]. Roscoe and colleagues reported that almost 50% prescriptions for cancer patients are sleep aids [36]. The investigators revealed a link between cancer related fatigue and sleep disorders in cancer patients. Physicians should target their treatment goals towards cancer related fatigue or sleep disorders in order to effectively manage these interrelated conditions [36].

Only three of the six cancer unhealthy behaviors had a direct association with access to health care – no health insurance or no recent physical exam. Physical activity, overweight and alcohol use were influenced by differing demographics with no direct association, at this time, with either measure of access to health care. Residence was a significant predictor of no physical activity, current smoking and alcohol use but not being overweight. The importance of region to physical activity, current smoking and alcohol use argues for local context being important to promoting these healthy behaviors. A potentially effective intervention is physician's advice to quit smoking and all too often cancer survivors are neither asked by their providers about their current smoking status nor advised to quit [37]. Nevertheless, physicians should be aware that female patients were more likely to be overweight, and adult cancer survivors 65 or older were more likely to have inadequate sleep and that physicians could intervene with these subgroups as well.

Female sex and white race exhibited greater probability of no physical activity and alcohol use.

Combined with obesity in women and the preponderance of breast cancer among female cancer survivors, these findings point to needed intervention to address weight, physical activity and alcohol use, when present [5]. Bellizzi's findings of lack of physical activity among older adults cancer survivors compared to younger adults, could not be confirmed in our study [9]. Lee's study on predictors of healthy behaviors in long term survivors of childhood cancer, found low prevalence of healthy behaviors associated with low frequency of primary health care interaction [38]. We were not able to find this age effect in our study.

There are some limitations to our study. First, this was a random-digit dialed, cross sectional telephone survey measuring self-reported behaviors. This study included Maryland BRFSS survey results for one year and only those adults who reported they had been diagnosed with cancer were included; there may have been some under-reporting of this fact for a number of reasons including ability and willingness to respond to a survey request. These factors may have limited the number of participants in the study but do not impinge on the validity and reliability of the BRFSS findings [4]. Second, our approach of examining only cancer survivors may be considered a limitation but it was not our purpose to contrast those with or without cancer. This study focused on predictors of unhealthy behaviors among cancer survivors, though implications may be addressed with interventions in the entire population since unhealthy behaviors are too common.

### Conclusion

This study contributes towards the awareness about Maryland adults and can be correlated to adults nationwide and worldwide with a prior history of cancer who continue to engage in unhealthy behaviors. Contrary to our hypothesis, cancer survivors did not participate more in healthy behaviors with increasing time since cancer diagnosis. Access to health insurance was expected to play a critical role in promoting healthy behaviors among cancer survivors,

however, this is true for only 2 out of 6 unhealthy behaviors. These findings may motivate physicians to promote and monitor healthy behaviors among their patients with or without cancer.

### Learning Points

This study is intended to increase the awareness among health care professionals and the general public by revealing the relationship of unhealthy behaviors, access to health care, time since cancer diagnosis and demographics in adult cancer survivors.

The importance of health insurance is highlighted in this study and should give health policy makers an overview of the dire need to implement policy change toward universal health coverage.

This study also highlights the need of every adult cancer survivor to incorporate healthy behaviors into their life style in order to prevent comorbidities and the incidence of other carcinomas during their lifetime.

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### Conflict of Interest statement

The authors of this manuscript certify that they have no affiliations with or involvement in any organization or entity with any financial interest with a direct financial or any other interest in the subject matter or materials discussed in this manuscript.

### Authors' Contribution

SNS and NK carried out the literature search and SNS, NK, and AYK prepared the draft manuscript, SNS carried out the experiments and SNS and NK interpreted the results, NK designed the study and SNS and NK performed the analysis, NK conceived the study, SNS and NK participated in

design and SNS and AYK edited the final manuscript.

### Ethical Considerations

The study was approved by the Institute Review Board (IRB).

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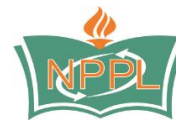
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