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The Prevalence of Increasing Physical Activity among Female Cancer Survivors in the United States, 2016 National Health Interview Survey (NHIS)

Purva Bulsara

ABSTRACT

THE PREVALENCE OF INCREASING PHYSICAL ACTIVITY AMONG FEMALE CANCER SURVIVORS IN THE UNITED STATES, 2016 NATIONAL HEALTH INTERVIEW SURVEY (NHIS)

by

PURVA BULSARA

MAY 1ST, 2018

Introduction: Cancer is one of the most common diseases in US. Physical Activity (PA) is associated with lower risk of second malignancy among cancer survivors. Improved cancer treatment led to increase in cancer survivors' cohort, a population at high risk of a second malignancy. Engaging in PA may reduce this risk, and behavioral interventions may use cancer diagnosis as a "teaching opportunity."

Aim: We examined prevalence of the intent to increase PA among female cancer survivors to inform future policy regarding possible behavioral interventions.

Methods: Data were collected by the 2016 National Health Interview Survey (NHIS), a cross-sectional study. Female cancer survivors, age ≥20, and diagnosed with the most prevalent malignancies among survivors (Melanoma, Breast, Colorectal, Thyroid and Uterine) were included.

Results: Among various characteristics, older age (>74 vs. <=74, OR=0.58, 95% CI:0.35-0.96) and reduction of dietary fat/calories (Yes vs No, OR=8.31, 95% CI: 5.44-12.69) were associated with PA increase. Examining interactions among various characteristics, we found that the association between increase in PA and recommendation from the doctor was the strongest among Colorectal Cancer survivors.

Discussion: Certain comorbidities, demographics, health behavior risk factors and characteristics were not associated with PA increase as found in other studies. This may be due to relatively limited sample size. However, age and reducing fat/calories in diets demonstrated correlation among those who were currently increasing PA.

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APPROVAL PAGE

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Author's Statement Page

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Introduction:

Over the past several decades, the term cancer has become a part of daily language. According to the World Health Organization (WHO), cancer is defined as "uncontrolled growth and spread of cells" and this can potentially occur in any area of the body (WHO, 2018). There are different forms of cancer and researchers are still searching for a cure to this day. The American Cancer Society (ACS) estimates about 1.7 million new cases of cancer in 2018, which does not include noninvasive cancer of any area besides urinary bladder, basal cell or squamous cell skin cancers as well, while the estimated deaths due to cancer this year is 609,640 (ACS, 2018). Based on the data collected in 2015, the Center for Disease Control and Prevention (CDC) demonstrated that the number one cause of death was heart disease, and cancer was the second cause of death (CDC, 2017). Cancer is a public health issue and research regarding prevention and recommendations for cancer is still progressing.

Cancer survivors can be defined as any individual who has a history of cancer from the time they were diagnosed to the rest of their lifespan; the 3 phases are 1.) the timeframe from diagnosis to the end of initial treatment; 2.) the timeframe from treatment to extended survival; and lastly 3.) the timeframe from extended survival to long-term survival (ACS, 2016). According to the American Cancer Society, the five groups with the highest number of female cancer survivors as of January 1st, 2016 were among breast cancer survivors (3,560,570), uterine corpus cancer survivors (757,190), colorectal cancer survivors (727,350), thyroid cancer survivors (630,660) and melanoma cancer survivors (612,790) (ACS, 2016).

For 2018, the American Cancer Society has generated estimated statistics in respect to new cases (incidences) of cancer and mortality among each of the 5 cancers mentioned previously. For this year there are to be 266,120 new cases of invasive breast cancer in women

while the mortality is 40,920 in women; some of the risk factors are age, body mass index, hormones, alcohol use, physical inactivity, family history (ACS, 2018). As for colorectal cancer among both genders, 97,220 colon cancer cases are to be expected along with 43,030 rectal cancer cases; there are approximately 50,630 deaths expected in 2018 associated with colorectal cancer; some of the risk factors are obesity, physical inactivity, heavy alcohol consumption, family history (ACS, 2018). When examining skin cancer cases among both genders, 91,270 new cases are expected to be melanoma and the expected deaths due to melanoma are 9,320; some of the risk factors are family history, exposure to ultraviolet radiation and use of indoor tanning facilities (ACS, 2018). In addition, it is estimated there are 53,990 new cases of thyroid cancer among both genders, 3 out of 4 of them are expected to occur in women, as for deaths 2,060 are approximated; some of the risk factors are family history and obesity (ACS, 2018). Lastly, for uterine corpus cancers there are to 63,230 cases to be expected along with 11,350 deaths some of the risk factors are obesity, abdominal fat, polycystic ovarian syndrome, and not having children (ACS, 2018).

By being able to target the risk factors of cancer, one can make decisions regarding their health to prevent the risk of attaining cancer. It is estimated that in 2018, at approximately 729,000 cases, which is 42% of the new cancer cases, can be evaded; from these cases 19% are due to smoking while 18% of them are due to an amalgamation of poor nutrition, increased alcohol consumption, increased body weight and physical inactivity (ACS, 2018). Obesity and physical activity are risk factors that are linked with most of the cancers listed above. Physical activity (PA) is defined as "as any bodily movement produced by skeletal muscles that requires energy expenditure" (WHO, 2018). Some of the issues regarding PA among cancer survivors is due to communication between patients and healthcare professionals.

The American Cancer Society has created guidelines to help with healthy lifestyle choices. They discovered that the International Agency for Research on Cancer found that the risk for 13 cancers increased due to individuals being obese or overweight; among the 5 cancers stated earlier the ones of interest are uterine corpus, colorectal, breast and thyroid (ACS, 2018). The recommended guidelines in respect to PA is 150 minutes of moderate-intensity or 75 minutes of vigorous intensity approximately each week among adults (ACS, 2018). In addition to PA, implementing plant foods in one's diet can help establish healthy weight, such as 2.5 cups of day of fruits and vegetables, reducing the intake of red and processed meat, and decreasing alcohol intake up to 2 drinks a day for men and 1 drink a day for women (ACS, 2018). Since the latest data from the National Health Interview Survey (NHIS) is from 2016, the aim of this study was to conduct an analysis to examine the prevalence female cancer survivors who were currently increasing PA among the top 5 cancers. This information is important for future policy implications in respect to cancer survivors. Furthermore, it will be helpful to know how many are being told to increase their PA and if they are adhering the recommendation that has been made.

Literature Review:

All the studies utilized in the literature review were cross-sectional studies in respect to cancer and PA. In 2016, data from the 2015 NHIS was examined among adults between the ages of 18-44 in the United States to estimate the prevalence of potential cancer risk factors in a cross-sectional study. The exclusion criteria consisted of those who stated that they had a history of cancer other than non-melanoma skin cancer. The race/ethnicity subgroups included non-Hispanic whites, non-Hispanic black and Hispanics with sufficient sample size which consisted of 6,382 men and 7,333 women (White et al., 2017). The results demonstrated high prevalence of certain risk factors among women; specifically, one in four women were physically inactive, one in eight women engaged in binge drinking, one in seven women engaged in cigarette smoking and frequent red meat consumption was found among one in six women (White et al., 2017). The limitations to this study is that the participants may be prone to reporting bias (White el al., 2017). Information regarding the prevalence of PA and other risk factors is of importance when determining new programs and policies for cancer survivors.

A study regarding the adherence of PA among older cancer survivors in the U.S. was conducted utilizing 2014 NHIS data. The sample size was narrowed down to 2,069 cancer survivors, which was classified as middle aged between the ages of 45 to 64, young-old which was classified from 65 to 74 and old-old which was 75 and older, the respective frequencies were 786, 627, and 656 (Tarasenko, Chen, & Schoenberg, 2017). When analyzing the adherence to recommendations for PA by the comprehensive guidelines for cancer survivors, it was found that the prevalence of not meeting the guidelines for aerobic or muscle-strengthening for middle-aged, young-old and old-old groups was 52.5%, 57.5% and 60.5% respectively (Tarasenko, Chen, & Schoenberg, 2017). Furthermore, there was a lower prevalence of adequate aerobic PA

when comparing the older to the middle-aged cancer survivors, while there was a slightly higher percent of young-old cancer survivors engaging in muscle strengthening PA (Tarasenko, Chen, & Schoenberg, 2017).

A meta-analysis review was conducted to view the correlation between PA and cancer mortality and the WHO endorsements to help reduce cancer mortality. To conduct the analysis MEDLINE and EMBASE were utilized on May 13th, 2014 for prospective cohort studies that examined the association between PA and cancer mortality which met the criteria (Li et al., 2015). There were population-based studies and additional studies that focused on cancer survivors, separate analyses were generated for both. When examining the results among the general population, a hazard ratio (HR) was calculated comparing the highest amount of PA to the minimal amount which was 0.83 and it was statistically significant in protection against cancer related death (Li et al., 2015). In addition, it demonstrated that there was a 17% decrease in cancer mortality among males and females for those who engaged in the highest levels vs. high levels of PA as compared to those who participated in high levels of PA (Li et al., 2015). Among cancer survivors, there was a statistically significant HR of 0.78 in respect to the association of high levels of PA and cancer mortality; while North American studies had a statistically significant HR of 0.75 for the association between PA and cancer mortality although European studies did not (Lit et al., 2015). Limitations of the meta-analysis were that the analysis did not examine specifically by race age or cancer type due to the variation found and there were complexities regarding the measurement of PA and characteristics of it (Li et al., 2015). The overall strength of this study was that it provided evidence that PA does decrease the hazard of cancer related deaths based on compilation of previous studies. Also, there was a statistically significant impact on cancer mortality and PA based on location which could be due to the

societal and cultural structure in North America compared to that of Europe. Further research would need to be conducted to view the prevalence of cancer on each continent.

In 2007 a cross sectional study was conducted to examine the association between levels of physical activity (LPA) pre-diagnosis and after treatment with medical and demographic factors. The LPA was based on a scoring system developed by an adapted version of the Leisure Score Index which is derived from the *Godin Leisure Time Exercise Questionnaire* (Gjerset et al., 2011). The statistical analyses were conducted with logistic regression and only statistically significance variables were included in the model. The sample size consisted of 975 cancer survivors; prior to diagnosis 48% engaged in PA and after diagnosis that decreased to 45% (Gjerset et al., 2011). The adjusted logistic regression analyses concluded older age and obesity hold a negative association with being physically active after treatment while there was a positive association with high education. Furthermore, having a comorbidity decreased the odds about 50% of being physically active compared to those without one and similar odds were found among smokers compared to non-smokers for those physically active post treatment. The limitation of the study may be due to selection bias since there was a response rate of 51% and there is no information regarding those who did not respond (Gjerset et al., 2011). The prevalence of PA from the results of this study ranged between 45-48%, however the associations between older age, obesity, being a smoker, and having comorbidities demonstrate a negative association between PA.

A cross-sectional study was conducted utilizing data collected from the NHIS from 2010 to examine the mental and physical health related quality of life (HRQOL) among cancer survivors in the United States. The sample included those who did not report a history of only non-melanoma skin or unknown skin cancers and participants who did not provide a response to

the type of cancer they were diagnosed with, thus 1,822 cancer survivors and 24,805 adults without a history of cancer were included (Weaver et al., 2012). When examining the demographic characteristics of the cancer survivors, the non-cancer morbidities consisted of hypertension with a weighted percent of 47%, heart disease at 25.9%, stroke at 6.9%, diabetes at 18.1%, lung disease at 17.3% and arthritis at 46.4% respectively (Weaver et al., 2012). While the weighted prevalence of cancer survivors with a physical health score less than one standard deviation (40) was 24.5% and the population estimate for cancer survivors was 3,278,00 with a standard error of 184,000 (Weaver et al., 2012). Multivariate adjusted models were utilized to analyze the data. The odds ratio and confidence intervals of having a physical HRQUOL t-score less than 40 was 4.36 (2.42-7.83) for those with less than a high school education, 2.01 (1.24-3.27) for those with a high school education and 2.43 (1.47-4.00) for those with some college education compared to the reference group which was a 4-year degree (Weaver et al., 2012). This demonstrated that education was statistically significant in the model controlling for other variables in relation to HRQUOL. Furthermore, the odds of poor HRQUOL among those whose treatment status is current was 4.02 times those whose treatment status was not recent (Weaver et al., 2012). Acknowledgement of comorbidities among cancer survivors is important because they have the potential to influence daily life and physiological functioning. By examining this, future treatment plans may be developed to take comorbidities into consideration and how they impact PA. The limitation of this study was that it was prone to recall bias and that there were not any defined cutoff points for clinical significance and those who were in nursing homes were not included in the study due to the nature of the NHIS sampling design (Weaver et al., 2012).

In addition to the importance of comorbidities, a cross-sectional study was conducted to examine the prevalence of comorbidities prior to cancer diagnosis and after. The data was

derived from the National Cancer Institute (NCI) funded Follow-up Care Use of Cancer Survivors (FOCUS) study. The FOCUS study was population based and cross-sectional while the cancer cases came from the Los Angeles County Cancer Surveillance Program (LACCSP) and the Cancer Prevention Institute of California (CPIC) Surveillance, Epidemiology, and End Results (SEER) cancer registries (Leach et al., 2015). The cases consisted of breast, colorectal, prostate, ovarian, or endometrial cancer among participants of the ages of 21 years or older and the diagnosis of cancer must have occurred between 4-14 years prior to the data being obtained, they must have completed active treatment for cancer and be verbally fluent in English (Leach et al., 2015). Cancer survivors who were diagnosed 10-14 years prior to the study had statically significant higher total numbers of comorbidities compared to those who were diagnosed 4-9 years prior (Leach et al., 2015). Furthermore, breast cancer survivors, compared to colorectal, prostate and ovarian cancer survivors demonstrated the highest numbers of medical conditions ever experienced as well as the highest number of medical conditions experienced post-cancer diagnosis (Leach et al., 2015). When examining the multivariate regression model, for total conditions post-cancer, being physically inactive increased comorbidities compared to those who were active while controlling for body mass index (Leach et al., 2015). One of the limitations of the study was that data was collected from urban and suburban areas, which meant it may not be generalizable to rural areas and older survivors and colorectal survivors were less likely to be responsive and there was difficulty locating those survivors 11-14 years post diagnosis as well as Latino and Asian survivors (Leach et al., 2015). However, a strength was that the sample size was large and racially/ethnically diverse among long-term cancer survivors (Leach et al., 2015). Addressing comorbidities is important because the time after diagnosis can demonstrate that

there is an increase in them. Furthermore, lack of PA led to report an increase of comorbidities among participants which may affect long term survival.

A study regarding the racial disparities in healthy behaviors was conducted among women in the United States, comparing those with and without breast cancer. Data for the study was from the National Health Interview Survey (NHIS) from 2005. The sample consisted of women ages 40 and older who had completed the cancer questionnaires; those that had missing information regarding cancer history or other cancers than breast cancer was omitted. The comparison group consisted of those who were never diagnosed with cancer. In terms of ethnicity, the inclusion criteria consisted of Caucasians, Hispanics and African Americans. This study was a cross-sectional study since publicly available data was utilized. The statistical analysis consisted of a multivariate logistic regression to examine the association of healthy behaviors of those with breast cancer stratified by race controlling for other variables. The results demonstrated that when examining the results there were statistically significant p-values associated only for multivitamin use for the interaction of race with other behaviors while controlling for other variables, PA was not statistically significant in the model (Yaghjyan et al., 2014). However, PA was statistically significant among the three groups in women without cancer and breast cancer survivors (Yaghjyan et al., 2014). Since this study was focused on specific racial categories, it should be noted that the results may be generalizable towards populations with similar demographics. Furthermore, this study did not account for all races/ethnicities which is why the current study does not specify certain races/ethnicities so that the results are generalizable to diverse populations.

Examining the health of cancer survivors after post treatment is vital. Thus, what is discussed after treatment can potentially affect the lifestyle of survivors and decisions that are

made later in life. There was cross-sectional study conducted utilizing the NHIS data from 2005 and 2010 to analyze if the counseling of a healthcare practitioner (HCP) was associated with the PA levels in cancer survivors in the United States. Those who qualified were those who visited a HCP in the last 12 months prior to the survey. The outcome of interest was level of leisure time aerobic PA which was created in three categories while the main independent variable was a HCP's PA recommendation controlling for other variables (Tarasenko et al., 2017). Statistical analysis was conducted utilizing an ordinal logistic regression model and the results demonstrated that there was a statistically significant association with higher level of PA levels in cancer survivors and those who were not diagnosed with cancer (Tarasenko et al., 2017). In respect to the adjusted prevalence of HCP providing recommendations to cancer survivors, 47% were not recommended PA while 38.1% were (Tarasenko et al., 2017). Out of the cancer survivors that were not recommended PA the respective adjusted prevalence for those who were inactive, insufficiently active and sufficiently active was 47.0%, 17.8% and 35.3% (Tarasenko et al., 2017). While those did receive PA recommendation the adjusted prevalence for those were inactive, insufficiently active and sufficiently active was 38.1%, 23.1% and 38.7% respectively (Tarasenko et al., 2017). Some of the limitations of the study is that it does not consider stage of diagnosis or if survivors are undergoing treatment (Tarasenko et al., 2017). However, the results regarding the prevalence of PA is important for healthcare practitioners and those developing policy regarding post-treatment for cancer survivors.

Methods:

The data utilized in this analysis came from the 2016 NHIS from The National Center for Health Statistics (NCHS), Division of Health and Nutrition Examination Surveys (DHNES) which is a part of the CDC (CDC, 2018). The objective of conducting this survey was to examine health related data among the U.S. population (CDC, 2018). Those who were in long-term care facilities, on active duty in the Armed Forces (including their dependents), incarcerated in prison, or U.S. nationals residing abroad in foreign countries were not included (CDC, 2018). This was a cross-sectional survey and a multistage probability design was utilized to ensure that at the household level there was not oversampling any races/ethnicity groups (CDC, 2018).

The dataset of interest came from the sample adult file. From the sample adult file the variables of interest for the analysis were AGE_P (age), BMED_4 (body mass index), DBHVPAY (In the past 12 months have you been told by a doctor or health professional to increase PA or exercise), DBHVCLN (Are you reducing the amount of fat or calories in your diet?), DBHVWLN (Are you now participating in a weight loss program?), DBHVCLY (During the past 12 months have you been told by a doctor or health professional to reduce the amount of fat or calories in your diet), DBHVWLY (During the past 12 months have you been told by a doctor or health professional to participate in a weight loss program), DIBEV1 (Have you ever been told by a doctor/health professional that you have diabetes/sugar diabetes), HYPEV (Have you ever been told by a doctor/health professional that you have hypertension/high blood pressure), CHLEV (Have you ever been told by a doctor/health professional that you had high cholesterol), HRTEV (Have you ever been told by a doctor/health professional that you had any kind of heart condition or heart disease (other than heart attack, angina pectoris, & coronary

heart disease), and SMKSTAT2 (smoking status). The outcome variable was DBHVPAN (Are you now increasing your PA or exercise).

The sample of interest included female cancer survivors who were 20 and older who had either colorectal cancer, breast cancer, thyroid cancer, melanoma or uterine cancer. These cancer types were selected because they were the highest group with female cancer survivors on January 1st, 2016 (ACS, 2016). The NHIS 2016 data consisted of 33,028 women who participated in the survey, from that amount 2,112 were told by a doctor that they had cancer. Those who had other cancers in addition to the 5 cancer types of interest were excluded from the sample. Furthermore, those who had 2 or more of the 5 cancers of interest were separated in a group of multiple cancers. Since colon cancer patients and rectal cancer patients were coded separately in the survey, they were recoded into one group to create colorectal cancer group. The final sample consisted of 950 female cancer survivors with the cancer of interest. The p-values from the Rao-Scott Chi-Square f-test statistics were utilized to determine statistical significance for the bivariate relationships among the categorical variables and current increase of PA status among cancer survivors. Statistical significance was set at alpha level of 0.05. All response that were either refused/not ascertained/don't know/unknown were recoded as missing and were not included in the analyses. The p-values calculated for each type of cancer were based on 2x2 contingency tables to compare the cancer diagnosis of interest compared to all other cancers.

The analysis was conducted in SAS with the use of PROC SURVEYFREQ, PROC SURVEYMEANS and PROC SURVEY logistic procedures. The PROC SURVEYFREQ procedure was utilized to generate the descriptive statistics for those engaging and not engaging in PA. The CHISQ option in PROC SURVEYFREQ was utilized to generate the p-values to determine if there were any statistically significant associations. The PROC SURVEY logistic

was utilized to generate the estimates of beta coefficients and the corresponding standard errors for calculations of odds ratios and confidence intervals for the associations between X and Y. Since survey data was utilized, in SAS the stratum was identified by the PSTRAT variable, cluster by the PPSU variable and weight by the WTFA_SA variable for all analyses. Statistical significance was set at alpha = 0.05.

Results:

Among 905 female cancer survivors, approximately half (N = 496) indicated that they were currently increasing PA. Tables 1-4 demonstrated the crude associations between increase in PA and various characteristics, including comorbidity, other health behavior risk factors, and demographics.

Table 1 examined the relationship between increase in PA and comorbidities of cancer survivors. No association was found between increasing PA and the reporting diabetes, hypertension, and heart conditions. The prevalence of increasing PA among cancer survivors who were told that they had high cholesterol was 56.6% compared to 48.9% among those who were not told that they had high cholesterol (P = 0.0015).

Table 2 analyzed the relationships among health behavior risk factors and increasing PA among cancer survivors. The prevalence of increasing PA among cancer survivors was greater among those who reported reducing fat/calories in their diet (74.9% vs. 27.9%, P < 0.0001), currently participating in a weight loss program (76.6% vs. 50.1%, P < 0.0001), and who were told in past 12 months to reduce fat/calories (65.7% vs. 47.5%, P = 0.0002) and to lose weight (64.2% vs. 51.1%, P = 0.0156). Also, the prevalence of increasing PA among cancer survivors who were told to increase PA in the past 12 months was 65.4% compared to 43.4% among those who were not told to increase PA (P = 0.0005). Smoking status was not associated with increasing PA.

Table 3 presented the relationships between demographic characteristics of cancer survivors and increasing PA. The prevalence of increasing PA among cancer survivors was greater among women ≤ 74 years of age (55.5% vs. to 44.6%, P = 0.0086). However, there was no association between increasing PA and body mass index (BMI) and increasing PA as well as

residency region. Table 4 displayed the cancer diagnoses and concern regarding cost of health care. The prevalence of increasing PA among thyroid cancer survivors was lower, 49.3% compared to 52.5% of the rest of the cancer survivors (P = 0.0403). No association was found with other cancer diagnoses and with the concern regarding medical cost of healthcare.

Logistic Regression was utilized for the adjusted analysis. The response variable was reporting currently increasing their PA; the predictors in the model consisted of all the variables mentioned previously. Table 5 examines results of the adjusted analysis. Table 5 was split into 5 sections in respect to comorbidities, health behavior risk factors, demographics, characteristics and interaction. Among comorbidities, diabetes, hypertension, high cholesterol and heart condition/disease variables were not associated with increased PA. Among demographics variables, age > 74 was inversely associated with increased PA (OR=0.58, 95% CI: 0.35-0.96), confirming that cancer survivors < 74 are more likely to increase PA; BMI and regions were not associated with increased PA. Among the examined health behavior risk factors, reporting currently reduce in dietary fat/calories was strongly associated with PA increase (OR=8.31; 95% CI: 5.44-12.69). Being told to increase PA in the past 12 months was weakly associated with increase in PA and this association was not statistically significant (OR=1.60; 95% CI: 0.96-2.67). Other behavioral variables, specifically, smoking status, current participation in weight loss, being told to reduce fat/calories or to participate in weight loss program were not associated with the likelihood of PA increase in this cancer survivor population. The concern regarding the medical costs of healthcare and cancer diagnosis were not associated with increased PA in the model. Table 6 demonstrates the main effects of cancer diagnosis and being told to increase PA from the adjusted model, in addition to the interaction between cancer diagnosis and being told to increase PA. Specifically, we found that female cancer survivors did not differ in their

likelihood to increase PA if they were diagnosed with breast, melanoma, thyroid, or uterine cancer. In contrast, female cancer survivors with colorectal cancer were much more likely to increase their PA if they were advised by a physician/hcp (OR 8.79; 95% CI: 1.65-45.56).

Table 1: Comorbidities of Cancer Survivors

Characteristic	Currently Increasing Physical Activity (N = 496)		Not Currently Increasing Physical Activity (N = 454)		P-values	Proportion of currently increasing PA
Frequency (Weighted %)		95% CI		95% CI		
Ever been told you have diabetes					0.6651	
Yes	84 (16.3)	12.0-20.7	76 (15.1)	10.9-19.2		0.525
No	388 (78.6)	73.9-83.3	363 (81.3)	76.5-86.0		0.517
Borderline or prediabetes	23 (5.1)	2.4-7.7	14 (3.6)	1.1-6.2		0.622
Missing (N = 2)						
Ever been told you have hypertension					0.3498	
Yes	253 (51.2)	45.1-57.4	232 (47.2)	41.1-53.3		0.522
No	243 (48.8)	42.6-54.9	222 (52.8)	46.7-58.9		0.523
Ever told you had high cholesterol					0.0015*	
Yes	239 (49.2)	43.4-55.0	183 (36.1)	30.6-41.6		0.566
No	257 (50.8)	45.0-56.6	269 (63.9)	58.4-69.4		0.489
Missing (N = 2)						
Ever been told you had a heart condition/disease other than angina pectoris, a heart attack or coronary heart disease					0.8499	
Yes	70 (14.7)	10.4-19.0	69 (14.1)	10.2-18.0		0.504
No	426 (85.3)	81.0-89.6	385 (85.9)	82.0-89.8		0.525

*p-value <0.05 is statistically significant

Missing observations were classified as responses given as either refused/not ascertained/don't know/unknown

Table 2: Health Behavior Risk Factors of Cancer Survivors

Characteristic	Currently Increasing Physical Activity (N = 496)		Not Currently Increasing Physical Activity (N = 454)		P-values	Proportion of currently increasing PA
Frequency (Weighted %)		95% CI		95% CI		
Currently reducing fat/calories in diet					<.0001*	
Yes	368 (73.0)	67.6-78.4	123 (26.9)	21.9-31.9		0.749
No	128 (27.0)	21.6-32.4	331 (73.1)	68.1-78.1		0.279
Currently participating in weight loss program					<.0001*	
Yes	59 (13.6)	9.2-18.0	18 (3.6)	1.6-5.6		0.766
No	437 (86.4)	82.0-90.8	436 (96.4)	94.4-98.4		0.501
Told to reduce fat/calories in past 12 months					0.0002*	
Yes	161 (32.2)	26.4-37.9	84 (18.6)	14.3-23.0		0.657
No	335 (67.8)	62.1-73.6	370 (81.4)	77.0-85.7		0.478
Told to participate in weight loss program in the past 12 months					0.0156*	
Yes	52 (12.6)	8.4-16.7	29 (6.6)	3.8-9.4		0.642
No	444 (87.4)	83.3-91.6	425 (93.4)	90.6-96.2		0.511
Told to increase physical activity in the past 12 months					0.0005*	
Yes	248 (47.7)	41.7-53.6	131 (32.2)	26.0-38.4		0.654
No	248 (52.3)	46.4-58.3	323 (67.8)	61.6-74.0		0.434
Smoking Status					0.8336	
Current Every day Smoker	40 (8.8)	5.3-12.2	57 (10.3)	6.9-13.7		0.412
Current Some day Smoker	14 (2.5)	0.9-4.2	10 (2.1)	0.8-3.5		0.583
Former Smoker	147 (29.2)	23.8-34.5	139 (30.8)	25.2-36.5		0.514
Never Smoker	292 (59.5)	53.8-65.3	244 (56.7)	50.9-62.6		0.545
Missing (N = 7)						

*p-value <0.05 is statistically significant

Missing observations were classified as responses given as either refused/not ascertained/don't know/unknown

Table 3: Demographics of Cancer Survivors

Characteristic	Currently Increasing Physical Activity (N = 496)		Not Currently Increasing Physical Activity (N = 454)		P-values	Proportion of currently increasing PA
Frequency (Weighted %)		95% CI		95% CI		
Dichotomized Age					0.0086*	
<= 74	368 (78.8)	74.3 - 83.2	295 (69.5)	64.2 - 74.7		0.555
> 74	128 (21.2)	16.8 - 25.7	159 (30.5)	25.3 - 35.8		0.446
Body Mass Index					0.9281	
Underweight: <18.50	10 (1.7)	0.4 - 3.0	14 (2.1)	0.9-3.3		0.417
Normal: 18.50 to <25	164 (36.2)	29.8-42.6	145 (36.5)	30.4-42.6		0.531
Overweight: =>25 & <30	148 (31.6)	25.6-37.6	133 (33.1)	27.0 - 39.3		0.527
Obese => 30	152 (30.5)	24.9-36.1	132 (28.3)	23.1-33.4		0.535
Missing (N = 52)						
Region					0.1059	
Northeast	86 (20.0)	14.6-25.4	71 (16.8)	13.5-20.1		0.548
Midwest	135 (29.0)	24.7-33.4	101 (23.0)	19.2-26.9		0.572
South	165 (31.9)	27.2-36.6	156 (33.0)	28.7-37.4		0.514
West	110 (19.0)	15.6-22.4	126 (27.1)	22.3-31.9		0.466

*p-value <0.05 is statistically significant

Missing observations were classified as responses given as either refused/not ascertained/don't know/unknown

Table 4: Characteristics of Cancer Survivors

Characteristic	Currently Increasing Physical Activity (N = 496)		Not Currently Increasing Physical Activity (N = 454)		P-values	Proportion of currently increasing PA
Frequency (Weighted %)		95% CI		95% CI		
How worried are you about…medical costs of healthcare					0.9148	
Very worried	49 (10.4)	6.5-14.2	46 (11.6)	7.3-15.9		0.516
Moderately worried	78 (14.6)	10.6-18.6	59 (14.2)	9.6-18.8		0.582
Not too worried	135 (29.2)	23.9-34.4	100 (26.7)	21.3-32.1		0.574
Not worried at all	221 (45.9)	40.2-51.6	233 (47.4)	41.5-53.4		0.487
Missing (N = 29)						
Cancer Diagnosis						
Breast	273 (58.7)	52.7-64.6	269 (60.5)	54.7-66.4	0.6693	0.798
Melanoma	58 (12.9)	8.8-17.0	49 (9.2)	5.7-12.6	0.16	0.542
Colorectal	53 (8.7)	5.7-11.7	30 (5.5)	2.8-8.1	0.1197	0.639
Thyroid	36 (5.7)	3.4-8.0	37 (10.2)	6.2-14.2	0.0403*	0.493
Uterus	60 (11.5)	7.6-15.5	53 (11.8)	7.8-15.7	0.9397	0.531
Have at least 2 of the 5 cancers	16 (2.5)	1.0-4.0	16 (2.9)	1.1-4.8	0.7244	0.500

*p-value <0.05 is statistically significant

Missing observations were classified as responses given as either refused/not ascertained/don't know/unknown

The p-values for each cancer diagnosis was generated by creating a 2x2 contingency table for the cancer of interest compared to all other cancers

Table 5: Adjusted Analyses of the Associations between Cancer Survivors Characteristics and Reporting Increase in Physical Activity

Category	Variable	Adjusted Regression		
		OR	95% CI	P-value
Comorbidities	Ever been told you have diabetes			0.7048
	Yes	0.805	0.470 - 1.378	
	No	ref		
	Borderline or prediabetes	0.773	0.194 - 3.083	
	Ever been told you have hypertension			0.3959
	Yes	1.22	0.771 - 1.930	
	No	ref		
	Ever told you had high cholesterol			0.7012
	Yes	1.093	0.694 - 1.722	
	No	ref		
	Ever been told you had a heart condition/disease other than angina pectoris, a heart attack or coronary heart disease			0.8649
	Yes	0.948	0.511 - 1.759	
	No	ref		
Demographics	Dichotomized Age			0.0332*
	<= 74	ref		
	> 74	0.579	0.350 - 0.957	
	BMI (kg/m2)			0.1933
	underweight <18.50	1.857	0.624 - 5.526	
	normal 18.50 to <25	ref		
	overweight 25 to <30	0.665	0.362 - 1.223	
	obese => 30	0.62	0.340 - 1.129	
	Region			0.2908
	Northeast	1.138	0.602 - 2.151	
	Midwest	1.412	0.858 - 2.325	

	South	ref		
	West	0.823	0.474 - 1.429	
Health Behavior Risk Factors	Currently reducing fat/calories in diet			<.0001*
	Yes	8.306	5.437 - 12.690	
	No	ref		
	Currently participating in weight loss program			0.1681
	Yes	1.908	0.761 - 4.785	
	No	ref		
	Told to reduce fat/calories in the past 12 months			0.4826
	Yes	0.817	0.464 - 1.438	
	No	ref		
	Told to increase physical activity in the past 12 months			
	Yes	1.604	0.965 - 2.665	0.0683
	No	ref		
	Told to participate in weight loss program in the past 12 months			0.7257
	Yes	0.865	0.384 - 1.948	
	No	ref		
	Smoking Status			0.5977
	Current Every day Smoker	0.697	0.321 - 1.514	
	Current Some day Smoker	1.37	0.418 - 4.495	
	Former Smoker	0.816	0.515 - 1.293	
	Never Smoker	ref		
Characteristics	How worried are you about medical costs of healthcare			0.9546
	Very worried	0.822	0.383 - 1.765	
	Moderately worried	1.047	0.532 - 2.061	
	Not too worried	1.039	0.639 - 1.690	
	Not worried at all	ref		
	Cancer Diagnosis			

Breast	ref		
Melanoma	1.304	0.609 - 2.792	0.266
Colorectal	1.383	0.703 - 2.720	0.1239
Thyroid	0.531	0.249 - 1.129	0.0881
Uterus	0.647	0.321 - 1.305	0.2562
Have at least 2 of the 5 cancers	0.835	0.307 - 2.274	0.8704

*p-value < 0.05 is statistically significant

Table 6: Interaction between Being Told to Increase Physical Activity * Cancer Diagnosis

Characteristic	Adjusted Regression		
	OR	95% CI	P-value
Told to increase physical activity (PA) in the past 12 months			
Yes	1.604	0.965 - 2.665	0.0683
No	ref		
Cancer Diagnosis			
Breast	ref		
Melanoma	1.304	0.609 - 2.792	0.266
Colorectal	1.383	0.703 - 2.720	0.1239
Thyroid	0.531	0.249 - 1.129	0.0881
Uterus	0.647	0.321 - 1.305	0.2562
Have at least 2 of the 5 cancers	0.835	0.307 - 2.274	0.8704
Told to increase PA among Breast Cancer Survivors	0.341	0.057 - 2.041	0.239
Told to increase PA among Colorectal Survivors	8.793	1.645 - 45.56	0.0159*

*p-value < 0.05 is statistically significant

Discussion:

There are multiple risk factors for cancer. Some of these risk factors are not modifiable, such as age and family history. Other risk factors can be modified through a change in lifestyle, such as obesity, physical inactivity, alcohol consumption and lack of proper nutrition. These factors increase the risk of recurrence and/or second malignancy among cancer survivors. Although it may be difficult to control family history or age, some preventative measures can be taken to decrease the risk of secondary cancer in this population. Cancer survivors can make choices that affect the risk of recurrence or second malignancy. For example, if a woman is diagnosed with breast cancer, she may choose to have a mastectomy if she believes that this would prevent cancer reoccurrence. To reduce melanoma risk, individuals can decrease sun exposure and utilize skin protectorates against ultraviolet radiation. This demonstrates that as individuals we can change our health and our actions can play a role in the outcome.

This analysis is focused on one of the behavioral risk factors among cancer survivors, specifically, physical activity. We explore the factors that can possibly affect this choice. These factors include comorbidities, suggestions from physicians/healthcare practitioners, and health-related behavior of cancer survivors, such as participation in weights loss programs. The secondary objective was to determine if there was an interaction between the type of cancer and recommendation to increase PA by a physician/healthcare professional, i.e. whether physician recommendation may have a different effect in patients with different cancer types on increase in PA. Furthermore, in this prevalence study, data collected from the NHIS was nationally representative of the U.S. population and the sampling design included oversampling of racial/ethnic minorities. Since the data for the NHIS had just been released, this analysis presents the latest relevant data. Also, instead of examining one specific cancer, the top five prevalent

cancers were chosen for examination, because these diagnoses will most likely be prevalent among cancer survivors in the future.

The strength of this study was that participants who were certain they had other cancers besides the five of interest were excluded from the study. This is important because those who have other cancers may have weakened immune systems due to high doses of chemotherapy. Furthermore, comorbidities were accounted for in the study which were diabetes, hypertension, high cholesterol, heart disease/condition other than a heart attack, angina pectoris or coronary heart disease, and smoking status. Characteristics of the participants consisted of age, body mass index, and region. While questions in respect to current health contained of if they were currently reducing fat/calories in diet, currently participating in a weight loss program, told to reduce fat/calories in the past 12 months, told to participate in weight loss program in past 12 months, told to increase PA in the past 12 months and how worried they are about the medical costs of healthcare. Examining the recommendations made by physicians/healthcare professionals is important as well as the cancer survivors adhering to the recommendations that are made. Being able to visualize this relationship can help effect future policy that needs to be implemented.

The limitation of this study was that the duration of PA and the rigor were not accounted for. Furthermore, information regarding the years of cancer diagnosis, alcohol/substance abuse, metabolism/nutritional/endocrine problems, and chemotherapy status were not included in the model due to large quantities of missing data. The NHIS consists of many questions that appear to be repetitive and it would be best if in the future the survey consisted of less questions which are more concise, so participants would be willing to complete the survey. The length of the survey impacts the quality of the data which affects future research. The study is subject to recall bias, since participants may think that they have recalled certain events accurately when they

have not. In addition, including race/ethnicity in the study would have been helpful to examine the characteristics of the sample.

We analyzed the association between comorbidities and increased PA because we believe that some comorbidities can make it difficult to engaged in PA. For instance, it could be that having diabetes, high cholesterol, or obesity would encourage cancer survivors to increase PA because it would affect not only their risk of cancer recurrence or second malignancy but also these comorbidities. The crude analysis demonstrated an association with high cholesterol and increased PA while there was no association in the adjusted analysis. Diabetes and obesity showed no association with increased PA in the crude and adjusted analyses. The assumption was made that hypertension/heart condition would prevent cancer survivors to increase PA since it would be difficult with these conditions. The crude and adjusted analyses showed no association between those factors and increased PA.

Next, we analyzed the association between health behaviors and increased PA because we believe that cancer is a "teaching moment" in life and changes are made to stay healthy. More specifically, behavioral changes in respect to fat/calories, weight loss, being told to increase PA by a physician/health care provider, were assumed to be associated with PA increase among cancer survivors to maintain health. The crude analysis demonstrated that current reduction in fat/calories, weight loss as well as the medical advice to reduce fat/calories, engage in weight loss, and increase PA were all associated with the prevalence of PA increase. However, the adjusted analysis demonstrated that none of these behavioral changes were associated with increase in PA. It was hypothesized that smoking would be inversely associated with increased PA as a marker of a negative health behavior. The crude and adjusted analyses showed no association with smoking.

Among demographics, it was assumed that cancer survivors who were older, were less likely to increase PA since they are more prone to health issues and do not have the energy to increase PA. The crude and adjusted analyses confirmed this assumption. The region in which cancer survivors resided was thought to be associated with PA increase due to different lifestyles and diets found in areas of the U.S. The results displayed that residence region was not associated with increased PA in the crude and adjusted analyses.

When examining the characteristics of cancer survivors, it was presumed that there would be increased PA among those who were concerned about the medical costs of healthcare. Cancer survivors who have this concern may be more likely to take care of themselves. The crude and adjusted analyses demonstrated that there was no association between concern regarding healthcare cost and increased PA. Lastly, it was theorized that the cancer diagnosis would be associated with increased PA due to the assumption that physicians/health care practitioners are encouraging patients to stay healthy. The crude analysis showed that survivors from thyroid cancer were less likely to increase PA; However, this association was not seen in the adjusted analysis.

Lastly, the conjecture was made that cancer diagnosis and being told to increase PA by physicians/health care providers would lead to increase PA. We found an interaction between physicians/health care providers advice to increase PA and colorectal cancer. Specifically, an advice to increase PA was strongly associated with increased PA among females with colorectal cancer, whereas no association was found among survivors with other cancers.

Previous studies also mentioned that there was a negative association with PA in respect to be a smoker and having comorbidities. However, the adjusted model demonstrated that statistical significance was not achieved with smoking status and the selected comorbidities of

this study. A possible reason as to why the results of the study are contradictory may be explained to the sample size of the study. A larger sample size would enable detection of statistical significance. This may be achieved by including those with other cancers in the analyses.

Conclusion:

Based on the prevalence estimates, approximately half of the cancer survivors showed an increase in PA. The increase of PA was associated with younger age, health behaviors, and recommendations made by physicians/health care providers in the crude analyses. in the adjusted analyses This suggests that recommendations of the physicians/health care providers play a role in behaviors of cancer survivors and that interventions in respect to instructing cancer survivors is beneficial to help increase PA.

Further studies should be conducted in respect to increase in PA among cancer survivors in the United States. In addition, conducting randomized controlled trials in respect to increase in PA will allow for causal inference, since all the studies conducted in the literature were cross-sectional. This study only established correlation.

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