

Impact of exercise on physical health status in bladder cancer patients

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ABSTRACT

Introduction: There is a scarcity of data on the impact of behavioral habits, such as exercise, on physical health in patients with bladder cancer. We investigated the association of exercise on self-reported physical health status and examined the prevalence of bladder cancer patients with sedentary lifestyle.

Methods: We examined cross-sectional data of participants diagnosed with bladder cancer within the Behavioral Risk Factor Surveillance System (BRFSS) from 2016–2020. Patient health status was surveyed using self-reported measures such as the total days per month when their “physical health is not good.” The primary outcome was patient-reported poor physical health for more than 14 days within a one-month period.

KEY MESSAGES

- Approximately 1 in 3 bladder cancer patients report a sedentary lifestyle.
- Patients that are active are less likely to self-report poor physical health status.
- Implementation of exercise programs might improve health status.
- Clinicians of bladder cancer patients should engage in increasing activity levels.

Results: Out of 2 193 981 survey participants, we identified 936 with a history of bladder cancer. Nearly one in three bladder cancer patients reported being sedentary within the last month, as a total of 307 (32.8%) patients reported no exercise within the last 30 days. The remaining 628 (67.2%) reported exercising for at least one day within the last month. In multivariable logistic regression model analysis, we found that exercise is protective for self-reported poor physical health status (odds ratio 0.37, 95% confidence interval 0.25–0.56, $p < 0.001$). Patients that exercised were less likely to report bad physical health.

Conclusions: Approximately one in three bladder cancer patients report no exercise within 30 days, suggesting a sedentary lifestyle. Patients that are active are less likely to self-report poor physical health status. Implementation of exercise programs for bladder cancer patients could be promising in improving health status.

INTRODUCTION

Strategies to improve bladder cancer outcomes and reduce surgical complications are critical, although there is a paucity of data regarding the impact of patient's physical health (PH) after cancer diagnosis and treatment. Cancer survivors report a low level of physical exercise after their treatment.^{1,2} While body weight and smoking are modifiable factors after a cancer diagnosis, a large majority of patients did not show behavioral change or achieved weight loss or smoking cessation following the primary diagnosis.^{3,4} Lifestyle factors including any form of exercise seem to decrease the risk of bladder cancer death.⁵ Indeed, there is evidence that exercise has a positive impact on health, survival, and quality of life (QoL) for urological cancer patients.^{6,7} Nevertheless, patients with bladder cancer report a significant decline in functional status and overall health, including both physically and mentally related QoL after diagnosis.^{8,9} In addition, many cancer treatments themselves such as major extirpative surgery like radical cystectomy are subject to complications which may prohibit patients from exercising during the post-operative recovery period. Thus, many patients who have been treated for cancer are not physically active and often face issues such as dealing with readmissions to the hospital due to complications or need for reoperations after cystectomy.^{10,11}

Although, exercise seems to improve health-related outcomes, the overall evidence of the effects of exercise in bladder cancer is still limited.^{12,13} Providers do not routinely assess patient exercise levels or provide directed recommendations. Therefore, there is a need to gain knowledge about this understudied subject and assess patient self-reported PH status in bladder cancer patients after diagnosis. In this study we aim to investigate the association of exercise on self-reported physical health status and prevalence of sedentary behavior of bladder cancer patients. We hypothesized that less active patients are more likely to self-report poor physical health.

METHODS

Data source

We examined cross-sectional data of participants self-diagnosed with bladder cancer within the Behavioral Risk Factor Surveillance System (BRFSS) between 2016 and 2020. The BRFSS is a national health-related survey conducted by the Centers for Disease Control and Prevention (CDC) in collaboration with all states in the United States (U.S.) and participating U.S. territories. Patients are contacted via telephone in the U.S. on both landlines and cell phones to collect data on health-related risk behaviors, chronic health conditions, health care access, and use of preventive services from the noninstitutionalized adult population. The states use a standardized core questionnaire, optional modules, and state-added questions. All responses are self-reported; the BRFSS does not conduct proxy interviews. The survey is conducted using Random Digit Dialing techniques. BRFSS completes more than 400,000 adult interviews each year, making it the largest continuously conducted health survey system in the world.¹⁴ The questionnaire was designed by a working group of BRFSS state coordinators and CDC staff. The questionnaire is approved by all state coordinators.¹⁴

Study population, endpoints, and covariates

BRFSS datasets between 2016 and 2020 were merged. We identified patients with self-reported bladder cancer diagnosis using the variable CNCRTYP1. Our endpoint was the respondent's health status and exercise status. For the health status, we used the question "Now thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?". We coded 0-13 vs 14+ days of poor physical status per month. For exercise, we use the survey question "During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?" and it was coded as Yes or No. For each participant in our study population covariates including age, gender, income, smoking status, BMI, physical health status, exercise, and treatment status were assessed. Further details on included variables and the available responses to each of these variables are displayed in Table 1. No exercise was considered a sedentary lifestyle. Note that certain variables were consistently labeled across years of BRFSS datasets, while others were not (Appendix). Thus, we recoded all variables of interest using a new unifying label before appending the datasets for analysis. Survey questions inquiring on exercise time and patterns that were not consistently captured across the survey years were excluded.

Statistical analysis

Descriptive statistics were used to report characteristics and differences in demographics between those who reported exercise 0 vs ≥ 1 day per month. Chi-square tests (or Fisher exact tests) were used to assess the differences among both groups. For continuous variables we used a t-test. A univariable and a multivariable logistic regression model for the outcome of the adjusted

binary poor physical health status 14+ days per month was calculated, adjusting for age, gender, income, smoking status, BMI, cancer treatment, and exercise. We assessed our model using a goodness of fit test and conducted an accuracy analysis using the area under Receiver Operating Characteristic (ROC) curve (AUC) model. Further, a sensitivity analysis for time from diagnosis to survey accounting for age, gender, BMI, smoking status, treatment status, income and exercise status for patients with only having a bladder cancer history was conducted. A Pearson correlation coefficient was assessed to check for collinearity between the two main outcomes physical health and exercise. Two-sided statistical significance was defined as $P < 0.05$. All statistical analyses were performed using Stata v.16.0 (StataCorp, College Station, TX, USA).

An institutional review board waiver (protocol number: 2015P000341) was obtained before conducting this study, following the Brigham and Women's hospital regulations regarding the use of de-identified administrative data.

RESULTS

Demographic characteristics

Out of 2,193,981 survey participants, we identified 936 with a history of bladder cancer, 935 of whom answered at least one question of interest (Table 1). Included participants were mostly male (70.13%) and had a total mean age of 71 years (SD=8.66). Most were former smokers (N=4915, 2.74%) while 17.29% (N=161) were current smokers and 29.97% (N=279) were never-smokers. Additionally, 40.00% (N=131) were overweight (BMI 25-29.9) and 32.82% (N=297) were obese (BMI>30). Participants most commonly had an annual income over \$50,000 (42.82%) while only 7.5% earned less than \$15,000 per year. In this bladder cancer patient cohort, the majority (66.9%) had already completed their treatment, while 15.56% were currently receiving treatment. The remaining patients did not start treatment yet, refused treatment, stated no treatment would have been needed or other reasons. Nearly a third (32.8%, N=307) of participants reported no exercise outside their regular job within the last 30 days. Of the 67.17% (N=628) who reported ≥ 1 day of exercising, 35.57% were overweight, and 42.95% were obese.

Multivariable logistic regression model

Through multivariable logistic regression model analysis (MVA), we found that exercise is a significant negative predictor of poor physical health status (OR 0.37, 95% CI 0.25 – 0.56, $p < 0.001$) (Table 2). Exercise was found to be protective against poor patient reported health and patients that exercised were less likely to report bad physical health >14 days per month. Income was also found to be a significant negative predictor of poor physical health status. Compared to patients with an annual income <\$15,000, those earning >\$15,000 were less likely to report bad physical health >14 days per month (OR 0.39, 95% CI 0.19-0.84, $p < 0.015$), as were those earning >\$50,000 (OR 0.25; 95%CI 0.12-0.51, $p < 0.001$). Active smoking was also shown to be a positive predictor of poor physical health (OR 1.82, 95%CI 1-3-31, $p = 0.05$). Gender, BMI, and

treatment status were not significant predictors of physical health status. Model diagnostics for our MVA were performed using standard tools for logistic regression models, and the goodness of fit was tested using Hosmer-Lemeshow test ($P=0.54$). Receiver operating characteristic (ROC) analysis yielded an area under the curve (AUC) of 0.72. In our sensitivity analysis for time from diagnosis to survey the only significant change was seen for the family income with \$15,000-\$34,999 (OR 0.58, 95%CI 0.22-1.53], $p=0.269$ and OR 0.42, 95%CI 0.14-1.30, $p=0.133$). Between the two main outcomes physical health and exercise we found a weak correlation ($r=0.21$).

DISCUSSION

In our cross-sectional study of participants with a history of bladder cancer, we identified three key findings. First, we demonstrated a high prevalence of sedentary behavior. Approximately 33% of participants reported no exercise outside of their regular job within the last month. The remaining 67% reported exercising within the last month for at least one day, which on the lower end still represents a sedentary lifestyle. Second, 22% of participants reported ≥ 14 days of poor physical-health status within the last month which may indicate a significant association with bladder cancer patients and physical impairment. Third, patients who exercised >1 day per month reported better physical health than those who did not. In line with these findings, we found that exercise may be protective against poor patient reported health.

In this paper we found that 33% of respondents with a history of bladder cancer are sedentary, which is comparable to a recent study by Cao et al. showing that 35.8% of patients within a cohort of U.S. cancer survivors are not physically active.¹⁵ While exercise may be associated with multiple benefits on QoL, mental and physical health, our results showing high levels of inactivity are concerning.^{16, 17} Our finding that exercise was shown to be protective for poor physical health status within bladder cancer patients is in line with prior interventional studies showing that exercise in patients with genitourinary cancers can improve cancer-specific QoL, cancer-specific fatigue, and fitness.^{7, 17} Furthermore, Liss et al. observed a 47% decreased risk of bladder cancer death in individuals who reported any form of exercise compared with those who did not exercise.⁵ This data highlights the benefits of exercise for patients with bladder cancer, and there is an unmet need for bladder cancer programs with specific consideration for their feasibility in this population of often older patients with about 22% being reported as frail and up to 30% as malnourished.^{18, 19}

It is notable that treatment status was not a significant predictor of physical health as one may hypothesize an effect of treatment on self-reported physical health, or that there would be a difference in physical health between those actively receiving treatment and those who had completed it. Further, there might be a number of patients that are not able to exercise due to their physical health status, side-effects or complications of treatment. These findings may suggest that impairments in physical health are caused, at least in part, by the cancer or the cancer diagnosis rather than by treatment, or at least that these impairments are already present at

the time of cancer diagnosis and may not change significantly throughout care pathways. The number one risk factor for bladder cancer is smoking and the negative health consequences of smoking are well established.²⁰ Active and former smokers have higher rates of cardiovascular disease, pulmonary disease and may be more prone to sedentary lifestyles.^{21, 22} Thus, clinicians should begin counseling their patients about positive health behaviors including exercise immediately after cancer diagnosis rather than waiting until patients begin or complete treatment.

Given that physical inactivity is often associated with increased BMI or obesity, it is interesting to find that more obese patients report exercising rather than no to (≥ 1 day of exercise per month rather than 0), while patients of normal weight more often reported sedentary behavior. Whether this finding is due to patients with obesity actually exercising more in an effort to control their weight, or to response bias as a consequence of these patients being more self-conscious of societal pressures to exercise and control their health-related behavior, providers should positively reinforce self-reports of physical activity regardless. Given that BMI was not shown to be a predictor of their physical health status, providers should encourage physical exercise regardless of BMI. Further, we identified age to be slightly protective for poor physical health (OR 0.97, 95%CI 0.95-1, $p=0.028$) while one would expect the opposite. The perception of poor physical health is subjective and it might not be too bad among older respondents. This effect in our study could be affected by the overall heterogeneous distribution of age among the study cohort with a mean age of 72 y and 69y for the binary physical health status.

With patients earning lower incomes reporting significantly lower physical health status, it is clear that socioeconomic status has a significant and independent effect on physical health status and must be taken into consideration when caring for patients with bladder cancer. Bladder cancer is shown to be the most costly cancer among the elderly, with direct and indirect costs that influence patient's post-diagnosis and treatment behavior.²³ Socioeconomic status may impact a patient's access to exercise facilities, healthy food, and rehabilitation programs, which could all mediate differences in self-reported PH status after bladder cancer diagnosis. Exercise interventions such as daily aerobic training can be done outdoors and weight resistance exercise requires a small amount of equipment (e.g. resistance bands or dumbbells).^{24, 25} Therefore, physical health interventions can be pragmatic and remains financially accessible to patients of all socioeconomic levels regardless of income level.

For patients diagnosed with bladder cancer multiple interventions may be available to promote physical and mental well-being after a diagnosis. Prehabilitation is a multimodal approach to preparing patients for their bladder cancer treatment.²⁶ Studies have shown that prehabilitation can be performed prior to major oncologic surgery, including in cystectomy patients, and patients may be able to engage in structured exercise programs that improve overall fitness through weight-based resistance training or aerobic activity.²⁷⁻²⁹ However, barriers to participations include creating scalable and cost-effective programs that result in clinically meaningful differences in a variety of healthcare settings. Establishing local programs that

leverage unique institutional strengths or promoting telehealth-based programs, may be strategies to improve patient access to prehabilitation in the future.

This study has several limitations. First, there is a lack of granularity on cancer stage and received treatment (which may be correlated with physical health status). Due to the survey construct we are missing data on the cancer stage or grading and are not able to expand further, then patients having a history of bladder cancer. Second, exercise lacked detailed description beyond a binary evaluation of physical exercise (a continuous variable for exercise may allow for improved exploration of how exercise affects physical health status). Third, the survey question on health status is not a validated instrument to measure health status, it captures respondent-reported health status which might be more important.³⁰ Further, the converse of your hypothesis could be true: It is the poor health causing less exercise rather than the other way around. We checked the correlation between the two main outcomes physical health and exercise found a weak correlation ($r=0.21$). These unmeasured confounders may influence the generalizability of the results to specific populations however the theme of sedentary behavior being prevalent remains. Additionally, data on received interventions such as pre- or rehabilitation programs is not available and would allow for extrapolation of potential health benefits. Finally, given that these data are all patient-reported, they may suffer from response bias. Due to the selection of patients via telephone it cannot be guaranteed that a patient was not interviewed twice. Furthermore, telephone-based interviews lack of interpersonal data interpretation and interpretations of responses. Despite these limitations, using a large, contemporary, and updated bladder cancer cohort focusing on patient-reported outcomes, we were able to highlight the prevalence of sedentary behavior among patients diagnosed with bladder cancer.

Patients diagnosed with bladder cancer should at least follow the general recommendations on exercising for a better overall functional status.³¹ To improve patient care for bladder cancer patients, special strategies regarding exercises after diagnosis and treatment need to be developed. The effectiveness and clinical utility of various approaches to modifying lifestyle factors must be empirically determined in additional implementation studies. Regardless, all clinicians treating patients with bladder cancer can begin by engaging in a dialogue with their patients about their overall activity levels after a diagnosis of cancer.

CONCLUSIONS

Approximately, 1 in 3 bladder cancer patients report no exercising within 30 days suggesting a sedentary lifestyle. Patients that are active are less likely to self-report poor physical health status. Implementation of physical activity and exercise programs for bladder cancer patients may be promising in improving health status and warrants further investigation.

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Figures and Tables

Table 1. Characteristics of bladder cancer participants in BRFSS data sets between 2016 and 2020				
	N	Mean	SD	p50 (median)
Age (continuous)				
0–14 days of poor physical status in last 30 days	704	72	8.15	73
14+ days when physical health not good	202	69	10.04	71
Total	906	71	8.66	73
Time from diagnosis to survey (in years, continuous)				
0–14 days of poor physical status in last 30 days	441	8.32	8.75	6
14+ days when physical health not good	125	6.83	7.68	4
Total	566	7.99	8.54	5
Characteristic variables (categorical)	All study cohort (%)	No physical activity or exercise in last 30 days (%)	Had physical activity or exercise (%)	p
Exercise				
No physical activity in last 30 days	307 (32.83%)	307 (100%)	-	
Yes, physical activity in last 30 days	628 (67.17)	-	628 (100)	
Total	935 (100%)	307 (100%)	628 (100)	
Physical status				
0 –14 days of poor physical status in last 30 days	704 (77.7%)	516 (85.01%)	188 (62.88%)	
14+ days when physical health not good	202 (22.3%)	91 (14.99%)	111 (37.12%)	
Total	906 (100%)	607 (100%)	299 (100%)	<0.001
Gender				
Female	279 (29.87%)	182 (29.03%)	97 (31.6%)	
Male	655 (70.13%)	445 (70.97%)	210 (68.4%)	
Total	934 (100%)	627 (100%)	307 (100%)	0.420
Are you currently receiving treatment for cancer?				
No, I haven't started treatment	35 (4.09%)	19 (3.3%)	16 (5.73%)	
Yes	133 (15.56%)	93 (16.15%)	40 (14.34%)	
No, I've completed treatment	572 (66.9%)	387 (67.19%)	185 (66.31%)	

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No, I've refused treatment	4 (0.47%)	3 (0.52%)	1 (0.36%)	
Don't know/not sure	18 (2.11%)	14 (2.43%)	4 (1.43%)	
Treatment was not necessary	93 (10.88%)	60 (10.42%)	33 (11.83%)	
Total	855 (100%)	576 (100%)	279 (100%)	0.483
Income				
\$0–14 999	59 (7.5%)	34 (6.38%)	25 (9.84%)	
\$15 000–24 999	148 (18.81%)	86 (16.14%)	62 (24.41%)	
\$25 000–34 999	88 (11.18%)	54 (10.13%)	34 (13.39%)	
\$35 000–49 999	155 (19.7%)	100 (18.76%)	55 (21.65%)	
\$50 000 or more	337 (42.82%)	259 (48.59%)	78 (30.71%)	
Total	787 (100%)	533 (100%)	254 (100%)	<0.001
Three-level smoker status				
Never smoked	279 (29.97%)	215 (34.4%)	64 (20.92%)	
Current smoker	161 (17.29%)	87 (13.92%)	74 (24.18%)	
Former smoker	491 (52.74%)	323 (51.68%)	168 (54.9%)	
Total	931 (100%)	625 (100%)	306 (100%)	<0.001
Body mass index				
Underweight (<18.5)	13 (1.44%)	8 (1.32%)	5 (1.68%)	
Normal Weight (18.5–24.9)	233 (25.75%)	174 (28.67%)	59 (19.8%)	
Overweight (25–29.9)	362 (40%)	256 (42.17%)	106 (35.57%)	
Obese (>30)	297 (32.82%)	169 (27.84%)	128 (42.95%)	
Total	905 (100%)	607 (100%)	298 (100%)	<0.001

Table 2. Multivariable logistic regression model for the outcome of having poor physical health >14 days per month in bladder cancer patients

Variables	Odds ratio (95% CI)	p
Age (continuous)	0.97 (0.95–1)	0.028
Gender		
Female	Ref	
Male	1 (0.63–1.6)	0.987
Income		
\$0–14 999	Ref	
\$15 000–24 999	0.39 (0.19–0.84)	0.015
\$25 000–34 999	0.37 (0.16–0.86)	0.021
\$35 000–49 999	0.32 (0.15–0.68)	0.003
\$50 000 or more	0.25 (0.12–0.51)	<0.001
Smoking status		
Never smoked	Ref	
Current smoker	1.82 (1–3.31)	0.05
Former smoker	1.25 (0.75–2.06)	0.39

Body mass index		
Normal weight (18.5–24.9)	Ref	
Underweight (<18.5)	1.07 (0.22–5.16)	0.935
Overweight (25–29.9)	1.18 (0.68–2.03)	0.556
Obese (>30)	1.43 (0.83–2.47)	0.201
Are you currently receiving treatment for cancer?		
No, I've completed treatment	Ref	
Yes	1.95 (0.51–3.74)	0.010
No, I haven't started treatment	1.42 (0.28–1.78)	0.458
Don't know/not sure	1.04 (0.12–4.32)	0.965
Treatment was not necessary	0.94 (0.22–1.99)	0.863
Physical activity/exercise outside of regular job in last 30 days		
No, physical activity in last 30 days	Ref	
Yes, physical activity in last 30 days	0.37 (0.25–0.56)	<0.001

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