Original Article

Associations Between Lifestyle Factors and Quality of Life Among Older Long-Term Breast, Prostate, and Colorectal Cancer Survivors

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BACKGROUND: Older cancer survivors are at increased risk for secondary cancers, cardiovascular disease, obesity, and functional decline and, thus, may benefit from health-related interventions. However, to the authors' knowledge, little is known regarding the health behaviors of older cancer survivors and the associations of those behaviors with quality-of-life outcomes, especially during the long-term post-treatment period. **METHODS:** In total, 753 older (aged ≥65 years) long-term survivors (≥5 years postdiagnosis) of breast, prostate, and colorectal cancer completed 2 baseline telephone interviews to assess their eligibility for a diet and exercise intervention trial. The interviews assessed exercise, diet, weight status, and quality of life. **RESULTS:** Older cancer survivors reported a median of 10 minutes of moderate-to-vigorous exercise per week, and only 7% had Healthy Eating Index scores >80 (indicative of healthful eating habits relative to national guidelines). Despite their suboptimal health behaviors, survivors reported mental and physical quality of life that exceeded age-related norms. Greater exercise and better diet quality were associated with better physical quality-of-life outcomes (eg, better vitality and physical functioning; $P < .05$), whereas greater body mass index was associated with reduced physical quality of life ($P < .001$). **CONCLUSIONS:** The current results indicated a high prevalence of suboptimal health behaviors among older, long-term survivors of breast, prostate, and colorectal cancer who were interested in lifestyle modification. In addition, the findings pointed to the potential negative impact of obesity and the positive impact of physical activity and a healthy diet on physical quality of life in this population. **Cancer 2009;115:4001–9. © 2009 American Cancer Society.**

KEY WORDS: survivorship, breast carcinoma, prostate carcinoma, colorectal carcinoma, health, diet, physical activity, quality of life.

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Currently, there are greater than 11 million cancer survivors in the United States alone, and 61% of survivors are aged ≥65 years.[1] Because of trends toward aging and continued progress in cancer screening and care, the number of older cancer survivors is expected to double over the next 50 years.[2] Although the rapid increase in cancer survivorship is encouraging, the long-term health consequences of cancer and its treatment are fast becoming a public health concern. Research indicates that, compared with individuals who do not have a history of cancer, cancer survivors are more likely to develop progressive, recurrent, and secondary cancers, cardiovascular disease, and other chronic diseases.[3-6] Although all older adults are at increased risk for functional decline, the risk is even greater for those who have a history of cancer.[7-9] Reasons for cancer survivors' increased risk of developing illnesses and health conditions may include cancer treatment-related sequelae, genetic predisposition, or lifestyle factors.[10]

Healthy lifestyle practices, including regular moderate-to-vigorous exercise and consumption of a plant-based, low-fat diet, have been associated with better physical functioning among breast and prostate cancer survivors aged ≥60 years.[11] Positive associations between exercise and physical and functional well being have been replicated among colorectal and breast cancer survivors of various ages.[12-14] Data also suggest that exercise may reduce the risk of cancer recurrence and mortality among colorectal and breast cancer survivors.[15-17] Unfortunately, a large proportion of cancer survivors do not adhere to national guidelines regarding physical activity and diet.[18,19] National surveys reveal few lifestyle differences between individuals diagnosed with cancer and the general population, and the vast majority do not adhere to national guidelines.[18,19] Cancer survivors who are men, those who are less educated, and those aged >65 years are even less likely to make healthy lifestyle changes or to maintain those changes.[20]

Although the majority of cancer survivors are aged ≥65 years, little research has been conducted specifically among older survivors to examine their health behaviors and quality of life (QoL), especially during the long-term post-treatment period.[21] In conducting screening interviews for a diet and exercise intervention trial that targeted older long-term survivors of breast, prostate, and colorectal cancer, we had an opportunity to assess exercise, diet quality, body weight status, and physical and mental QoL by sex and cancer type and also to explore associations between lifestyle practices and body weight status in relation to physical and mental QoL.

MATERIALS AND METHODS

Participants were older long-term breast, prostate, and colorectal cancer survivors who underwent screening and baseline interviews for the Reach Out to Enhance Wellness (RENEW) Trial.[22] This National Cancer Institute-supported, randomized clinical trial examines whether a home-based diet and exercise intervention of tailored mailed materials and telephone counseling can reduce functional decline and improve QoL among survivors. The institutional review boards at the Duke University Health System and the North Carolina Central Cancer Registry (NCCCR) approved the research protocol. Participants were recruited through the NCCCR, the Duke Cancer Registry, and self-referral in 20 states, 1 Canadian province, and the United Kingdom. The cancer registry databases and oncologists provided survivors' demographic and medical information, including cancer type and stage, date of diagnosis, age, race, and sex. TNM staging was unavailable for the majority of cancer cases, because the NCCCR classifies cases as in situ, localized, regional, distant, or unknown. The following eligibility criteria were determined at the time of case ascertainment or screening: 1) age ≥65 years; 2) at least 5 years beyond the date of diagnosis of breast, prostate or colorectal cancer with no evidence of progressive disease or second primaries; 3) approved for contact by their oncologist; 4) able to speak and write in English; 5) no medical conditions precluding unsupervised exercise (dementia, uncontrolled congestive heart failure or angina, recent myocardial infarction, breathing difficulties requiring oxygen use or hospitalization, walker or wheelchair use, or plans to have hip or knee replacement) or a diet high in fruits and vegetables (renal insufficiency); 6) residence within the community; 7) overweight (body mass index [BMI] >24.9), but not morbidly obese (BMI <40), thus requiring a supervised exercise program; and 8) not adhering to the Surgeon General's recommendation of at least 30 minutes of exercise per day at least 5 days per week (≥150 minutes per week).[23]

Cancer survivors were mailed a letter inviting their participation in the trial. Survivors who provided signed informed consent and were considered eligible based on the screening assessment ($N = 753$) underwent 2 45-minute to 60-minute telephone surveys administered by the Diet Assessment Center at Pennsylvania State University. The length of time between interviews ranged from 2 days to 3 weeks. All measures reported herein were completed before the intervention and assessed the following factors:

Physical Activity

The Community Healthy Activities Models Program for Seniors is a validated and sensitive assessment of older adults' physical activity that has been adapted for telephone use.[24-26] Mean weekly minutes of moderate-to-vigorous exercise were computed for the current research.

Dietary Intake

Overall diet quality was assessed from 2 unannounced, 24-hour recalls performed by trained interviewers. The 24-hour dietary recall represents 1 of the most widely used methods to collect dietary data, and 2-day recalls have been performed for a variety of major studies, such as the National Health and Nutrition Examination Survey[27] and the Women's Intervention Nutrition Study.[28] Interviewers obtained dietary intake data using revised interactive Nutrition Data System software (Nutrition Coordinating Center [NCC] Food and Nutrient Database System, version 2006; NCC, University of Minnesota, Minneapolis, Minn). Data obtained from recalls were averaged over the 2-day period and used to calculate the Healthy Eating Index 05 (HEI05),[29] which ranges from 0 (worst) to 100 (best) with scores >80 indicating good diet quality.

Body Mass Index

Self-reported height and weight were used to compute BMI (kg/m^2).

Quality of Life

The Medical Outcomes Survey (MOS) Short Form-36 (SF-36)[30] is a brief, reliable, and valid 36-item QoL measure that has proven reliability among older adults and cancer survivors.[7,31] The SF-36 was used to assess the following 8 domains of QoL: physical and social functioning, role limitations caused by physical and emotional problems, mental health, vitality, pain, and general health perceptions. These 8 subscales provide the basis for calculating 2 summary measures, the Physical Component Summary and the Mental Component Summary. Higher scores represent better functioning on the 2 summary measures and the 8 subscales. Norm-based scaling is used for both summary scores, so that a score of 50 represents the US national average. A score 10 points above or below the mean score of 50 represents a difference of 1 standard deviation from the national average.

Comorbidities

Six medical conditions (eg, arthritis, heart conditions) were assessed using a measure that was developed previously by our research center.[32]

Statistical Analyses

Descriptive statistics were used to characterize the demographics and health behaviors of the study sample. Omnibus tests with 3 degrees of freedom were conducted using ordinary least squares (OLS) regression to determine whether exercise, diet quality, BMI, and physical and mental QoL varied by sex and cancer type. For the non-normally distributed measures (ie, minutes of exercise and some SF-36 subscales), we conducted parallel, unadjusted nonparametric and adjusted ordinal logistic regression analyses, which delivered a set of inferences similar to that delivered by using OLS. For simplicity, we present the OLS parametric measures of means, standard deviations, and P values. In addition, post hoc pairwise comparisons among the 4 sex/cancer groups were conducted using the Tukey honestly significant differences (HSD) procedure. Next, Pearson (or, where appropriate for non-normally distributed measures, Spearman) correlations were computed to examine the associations between diet quality and BMI and mental and physical QoL. All analyses were conducted with and without control for demographic and medical factors that were associated significantly with study variables. With the exception of using the Tukey HSD procedure for pairwise comparisons of sex/cancer groups, no correction for Type I error was conducted for

these exploratory analyses. All reported P values were 2-sided, and a value of $P < .05$ was considered statistically significant. Data were analyzed with SAS statistical software (version 9.1; SAS Institute Inc, Cary, NC).

RESULTS

Sample Characteristics

Complete descriptions of the sample and statistical analyses of the accrual procedures have been reported previously.[22] To briefly summarize, 20,015 cancer survivors were mailed a letter inviting their participation, and a preliminary response was obtained from 2156 survivors who called for more information (11% response rate). After receiving a consent form and additional study information, 1208 survivors completed screening and consent forms (6% overall response rate). Respondents (n = 1208) differed significantly from nonrespondents (n = 18,807) with respect to age (mean age, 73 years vs 76 years, respectively; $P < .0001$), race (13% vs 17% minority, respectively; $P < .0001$), sex (50% vs 45% women, respectively; $P = .0004$), and time since diagnosis (mean elapsed time, 9 years vs 10 years postdiagnosis, respectively; $P < .0001$). Of the 1208 survivors who provided informed consent, 455 were ineligible based on responses to the written screener and were not considered for further evaluation. Reasons for ineligibility included medical conditions (n = 207), BMI <25 kg/m^2 (n = 138), >150 minutes of exercise per week (n = 84), and morbid obesity (n = 26). Thus, 753 survivors who completed 2 baseline telephone interviews were included in the current analyses. Because some individuals were ineligible for the study intervention based on further assessment of their BMI or weekly minutes of exercise, only 641 of these survivors ultimately were enrolled in the intervention phase of the trial.

Demographic and medical characteristics of the sample appear in Table 1, and descriptive statistics for study variables appear in Table 2. Participants were primarily white and well educated survivors from North Carolina (92%) or other US states (7%). The participants ranged in age from 65 years to 87 years (median age = 73 years). The average time since diagnosis at the time of telephone screening was 9 years. The vast majority of participants (94%) were nonsmokers. Because of the weight criterion for study enrollment, 60% of participants were overweight and 38% were obese at baseline. In addition, a more comprehensive assessment of survivors' physical activities relative to the screening assessment indicated that almost half (47.5%) of participants did not engage in moderate or vigorous exercise each week, and most participants (86%) did not meet national exercise guidelines. Only 7% of the sample had HEI05 scores >80, indicative of good eating habits relative to national guidelines. Despite suboptimal health behaviors, the sample's mental and physical QoL exceeded US age-related norms.[33]

Table 1. Demographic, Disease, and Health-related Characteristics of Older Long-term Cancer Survivors (N=753)

Characteristic	No. of Survivors (%)
Age at evaluation, y	
Mean±SD	73 ± 5
Median [range]	73 [65-87]
Women	394 (52)
Race/ethnicity	
White, non-Hispanic	667 (89)
African American	79 (10)
Other or unknown	7 (1)
Education	
<High school	56 (7)
High school/GED	217 (29)
Some college/college degree	356 (47)
Professional/graduate degree	121 (16)
Cancer type	
Breast cancer, women	321 (43)
Prostate cancer	319 (42)
Colorectal cancer	113 (15)
Stage at diagnosis	
In situ or localized	523 (69)
Regional	203 (27)
Unknown	27 (4)
Time since diagnosis, y	
Mean±SD	9 ± 3
Median [range]	8 [5-26]
No. of comorbidities	
Mean±SD	2 ± 1
Median [range]	2 [0-6]
Tobacco use,	
Current smoker	46 (6)
Nonsmoker	707 (94)

SD indicates standard deviation; GED, General Education Degree.

Preliminary Analyses

Study outcomes were correlated such that weekly minutes of exercise were associated with lower BMI ($\rho = -.10$; $P =$

Table 2. Means, Standard Deviations, and Comparisons for Study Variables by Sex and Cancer Type

Measure	Mean±SD (Median)*					P†
	Total Sample of Cancer Survivors, N=753	Colorectal Cancer Survivors, n=73 Women	Colorectal Cancer Survivors, n=40 Men	Breast Cancer Survivors, n=321 Women	Prostate Cancer Survivors, n=319 Men	
Moderate-to-vigorous exercise, min/wk	62.1 ± 106.7 (10)	56.2 ± 101.4	96 ± 164.5	43.9 ± 77.7	77.7 ± 120.3	.0025
Healthy Eating Index 05	59.9 ± 13.7 (60.2)	60.9 ± 12.9	53.6 ± 13.1	61.8 ± 12.6	58.7 ± 14.8	.0002
BMI, kg/m^2	29.1 ± 3.6 (28)	29.3 ± 3.6	28.4 ± 3.3	29.4 ± 3.9	28.8 ± 3.3	.90
Physical Quality of Life	45.7 ± 8.6 (47.3)	45.4 ± 8.4	46.3 ± 7.5	44.8 ± 9.1	46.7 ± 8.2	.62
Mental Quality of Life	56.7 ± 6.4 (58)	57.2 ± 5.9	56.5 ± 7.6	56.4 ± 7	56.9 ± 5.8	.69
Pain	73.2 ± 21.5 (74)	73.5 ± 22.2	77.3 ± 20.1	70.5 ± 21.7	75.4 ± 21.1	.68
Health Perceptions	73 ± 16.3 (77)	75.4 ± 12.5	69.8 ± 18.1	73.2 ± 16.1	72.6 ± 17	.006
Physical Functioning	76.8 ± 18.8 (80)	74.1 ± 18.6	78.6 ± 14.7	73.2 ± 20.2	80.8 ± 17.2	.0004
Role-Physical	75.8 ± 33.5 (100)	74.3 ± 34.6	78.5 ± 30.3	74.5 ± 34.8	77.1 ± 32.4	.99
Vitality	62.8 ± 17.7 (65)	63.4 ± 17.4	61.1 ± 17.6	61.3 ± 18.8	64.4 ± 16.7	.30
Mental health	86.3 ± 11.7 (88)	86 ± 11.8	87.7 ± 12.5	85.1 ± 12.3	87.3 ± 10.8	.33
Social Functioning	90.9 ± 16.7 (100)	91.6 ± 16.1	90.9 ± 17.9	90.2 ± 17.8	91.5 ± 15.5	.77
Role-Emotional	92.5 ± 20.9 (100)	93.6 ± 19.8	92.5 ± 20.7	90.8 ± 23.6	94 ± 18.2	.32

SD indicates standard deviation; BMI, body mass index.
*Higher scores indicate better quality-of-life outcomes, and norm-based scaling is used for Physical Quality of Life and Mental Quality of Life Summary scores. *P* values for each sex/cancer group were adjusted for age, race, level of education, and number of comorbidities.
†*P* values for regression models that examined overall differences in study variables across the 4 sex/cancer groups.

Table 3. Associations Between Demographic and Medical Characteristics and Study Outcomes

Measure	Correlation (P)				
	Age	Education Level	Race*	Cancer Stage†	No. of Comorbidities
Moderate-to-vigorous exercise, min/wk‡	−.06 (.08)	.17 (<.0001)	.02 (.57)	.00 (.87)	−.15 (<.0001)
Healthy Eating Index 05	.05 (.14)	.09 (.017)	−.04 (.24)	.01 (.82)	.11 (.003)
BMI, kg/m^2	−.11 (.0026)	−.07 (.042)	−.07 (.034)	.08 (.03)	−.31 (<.0001)
Physical Quality of Life	−.11 (.0022)	.14 (.0001)	−.02 (.53)	.00 (.99)	−.34 (<.0001)
Pain	.04 (.24)	.08 (.024)	−.04 (.26)	.06 (.125)	−.31 (<.0001)
Health Perceptions	−.03 (.41)	.09 (.014)	.05 (.20)	.00 (.86)	−.25 (<.0001)
Physical Functioning	−.18 (<.0001)	.16 (<.0001)	.00 (.91)	−.03 (.42)	−.28 (<.0001)
Role-Physical	−.13 (.0005)	.08 (.02)	−.05 (.16)	.00 (.94)	−.23 (<.0001)
Vitality	−.02 (.56)	.05 (.17)	−.16 (<.0001)	.02 (.54)	−.21 (<.0001)
Social Functioning	−.08 (.0231)	.05 (.16)	−.01 (.64)	.04 (.26)	−.09 (.01)
Role-Emotional	−.04 (.23)	.03 (.39)	−.02 (.55)	.03 (.34)	−.08 (.02)

*Coded 0 for nonwhite and 1 for white.
†Range, 0 to 5.
‡Spearman correlations were computed between exercise and participant characteristics, whereas Pearson correlations were computed for all other variables.

.0064) and better diet quality ($\rho = .14$; $P = .0002$). BMI was not associated with diet quality ($r = -.05$; $P = .21$).

Significant bivariate correlations between study outcomes and demographic and medical characteristics are shown in Table 3. Older age was associated with lower BMI and worse physical and social QoL outcomes. Higher levels of education were associated with more weekly minutes of exercise, better diet quality, lower BMI, and better physical QoL outcomes. White race was related to reduced BMI and vitality, and cancer stage was correlated positively with BMI. Finally, having more comorbidities was associated with fewer weekly minutes of exercise, better diet quality, lower BMI, and worse physical, social, and role functioning. None of the other

Table 4. Correlations Between Quality-of-Life Outcomes and Lifestyle Factors and Body Weight Status (N=753)*

	Moderate-to-Vigorous Exercise, min/wk (*P*)		Healthy Eating Index (*P*)		BMI, kg/m^2 (*P*)	
Measure	ρ	Adjusted ρ†	*r*	Adjusted *r*‡	*r*	Adjusted *r*§
Physical Quality of Life	.21 (<.0001)	.15 (<.0001)	.06 (.07)	.10 (.005)	−.26 (<.0001)	−.24 (<.001)
Mental Quality of Life	−.009 (.80)	.003 (.94)	.00 (.97)	.004 (.91)	−.03 (.32)	.04 (.25)
Pain	.12 (.0006)	.085 (.02)	.04 (.23)	.07 (.048)	−.20 (<.0001)	−.16 (<.0001)
Health Perceptions	.14 (.0002)	.094 (.01)	.06 (.12)	.079 (.03)	−.15 (<.0001)	−.12 (.001)
Physical Functioning	.27 (<.0001)	.22 (<.0001)	.07 (.046)	.10 (.005)	−.29 (<.0001)	−.29 (<.0001)
Role-Physical	.11 (.002)	.07 (.053)	.01 (.77)	.035 (.34)	−.12 (.002)	−.10 (.004)
Vitality	.16 (<.0001)	.14 (.0001)	.07 (.048)	.095 (.01)	−.13 (.0002)	−.125 (.0007)
Mental Health	.06 (.12)	.048 (.19)	−.02 (.58)	−.01 (.74)	−.06 (.10)	−.03 (.36)
Social Functioning	.10 (.004)	.08 (.025)	.05 (.16)	.06 (.097)	−.06 (.11)	−.05 (.15)
Role-Emotional	.03 (.41)	.016 (.65)	.01 (.77)	.018 (.62)	−.03 (.41)	−.02 (.52)

BMI indicates body mass index.
* Higher scores indicate better quality-of-life outcomes.
† Spearman correlations adjusted for age, level of education, and number of comorbidities.
‡ Pearson correlations adjusted for age, level of education, and number of comorbidities.
§ Pearson correlations adjusted for age, level of education, race, cancer stage, and number of comorbidities.

correlations between demographic and medical factors (ie, age, race, education level, cancer stage, comorbidities, time since cancer diagnosis) and study outcomes were statistically significant.

Differences in Study Variables by Sex and Cancer Type

Means, standard deviations, and *P* values for comparisons of study variables by sex and cancer type appear in Table 2. Results of the OLS regression models adjusted for age, race, education level, and comorbidities indicated that only weekly minutes of exercise, diet quality, health perceptions, and physical functioning varied across the 4 sex/cancer groups. Pairwise comparisons revealed that breast cancer survivors (women) reported fewer weekly minutes of exercise and better diet quality relative to men who were colorectal cancer survivors and prostate cancer survivors. Women who were colorectal cancer survivors reported better diet quality only relative to men who were colorectal cancer survivors. Finally, women who were colorectal cancer and breast cancer survivors reported worse physical functioning relative to prostate cancer survivors. By using the Tukey HSD method, none of the other pairwise comparisons yielded statistically significant differences as a function of sex or cancer type.

When the models described above were analyzed without adjusting for demographic covariates, the same pattern of results was obtained with 2 exceptions. In unadjusted analyses, pain varied significantly as a function of sex and cancer type ($P = .02$) such that women who were breast cancer survivors reported more pain than prostate cancer survivors. The pain levels of other sex/cancer groups did not significantly differ from one another. In addition, health perceptions did not vary as a function of sex or cancer type.

Correlations of QoL Outcomes With Lifestyle Factors and Body Weight Status

Associations between weekly minutes of exercise, diet quality, BMI, and QoL outcomes were examined (see Table 4). In analyses with and without adjustment for age, level of education, and comorbidities, greater weekly minutes of exercise were associated with better physical QoL, including less pain and better health perceptions, physical functioning, and vitality. More exercise also was correlated with better social functioning. Diet quality had a positive association with a range of physical QoL outcomes in analyses that were adjusted for age, level of education, and comorbidities. However, only physical functioning and vitality were correlated significantly and positively with diet quality in unadjusted analyses. Finally, greater BMI was associated with worse physical QoL, including greater pain and role limitations because of physical problems and worse health perceptions, physical

functioning, and vitality. These associations remained significant when adjusting for age, race, level of education, cancer-type, and comorbidities.

DISCUSSION

This study focused on older long-term cancer survivors who were screened for participation in a diet and exercise intervention trial. Our sample reported a median of 10 minutes of exercise per week, and only 7% had HEI05 scores >80 (indicative of healthful eating habits compared with national guidelines). Despite their suboptimal health behaviors, all sex/cancer subgroups reported mental and physical QoL that exceeded levels previously reported for older cancer survivors and noncancer controls.[7] The exclusion of survivors with significant comorbidities and functional limitations from this intervention trial and the younger age of respondents relative to nonrespondents may partially explain these findings.

Several demographic variables were associated significantly with health behaviors, body weight status, and QoL outcomes. Older age, less education, and more comorbidities were associated with reduced physical functioning and greater role limitations because of physical problems. In addition, higher levels of education were associated with greater weekly minutes of exercise, better diet quality, and lower BMI. Similar associations have been obtained in prior research with cancer survivors.[7,20] Also consistent with previous findings,[34] greater BMI was associated with ethnic minority status.

Health behaviors varied by sex and cancer type, and these results did not appear to be entirely driven by sex. Whereas prostate cancer survivors in this study and in previous research have had greater physical activity relative to breast cancer survivors, results have been mixed with regard to dietary outcomes.[11,35] It should be noted that breast, prostate, and colorectal cancer survivors reported suboptimal dietary and exercise behaviors in previous research[36]; therefore, all cancer groups may benefit from interventions to improve healthy lifestyle practices.

Examination of associations between dietary and exercise habits, body weight status, and QoL outcomes revealed that weekly minutes of moderate-to-vigorous exercise were associated with better physical QoL, including less pain and role limitations because of physical problems and better health perceptions, physical functioning, and vitality. A positive association between exercise and improved physical functioning has been documented consistently among older adults,[37,38] and 1 study reported this association among older breast and prostate cancer patients within 18 months of diagnosis.[11] The current study is the first to our knowledge demonstrating this association exclusively among older long-term cancer survivors. Weekly minutes of exercise were not associated with any mental health outcomes, with the exception of better social functioning. Associations between exercise and mental QoL among cancer survivors have been mixed,[13,39] and scarce research has examined these variables among older cancer survivors. It will be important to include specific mental health outcomes, such as depressive symptoms and positive emotion, in future research on older cancer survivors' health behavior.

In the current study, diet quality was associated positively with physical functioning and vitality. Better physical functioning was associated with less fat intake and greater fruit and vegetable intake in another study of older cancer survivors.[11] Further research is needed to assess the impact of older cancer survivors' adherence to a low-fat, plant-based diet on multiple QoL indices over time.

In our sample of primarily overweight and obese, older cancer survivors, greater BMI was associated with worse physical QoL in all domains, including health perceptions, physical functioning, vitality, pain, and role limitations. However, BMI was found to be unrelated to mental QoL. Although these results do not corroborate the findings of studies conducted in Australia, which reported no link between BMI and QoL,[40,41] they do support studies attributing distress regarding weight gain and subsequent reduced QoL among women with breast cancer,[42] and they endorse findings of the majority of studies in the general population, which reported negative effects of obesity on health-related QoL, with more pronounced effects on physical well being relative to mental well being.[43] Given older adult cancer survivors' increased risk of functional decline relative to noncancer controls,[21] it is especially important to examine the impact of obesity on physical functioning and other QoL outcomes in this population.

Primary limitations of the current research include respondent and sampling biases, reliance on self-report measures, and the cross-sectional design. The low response rate may be related to 2 aspects of the study design: 1) baseline surveys were linked to accrual efforts

for a 2-year behavioral intervention trial; and 2) institutional and budgetary constraints did not permit telephone contact with survivors who did not respond to the initial study invitation letter. Although we identified some demographic differences (eg, ethnicity) between respondents and nonrespondents, we were unable to assess the socioeconomic status, health status, and lifestyle behaviors of those who did not respond. Associations between QoL and lifestyle practices may differ for ethnic minority individuals, who often adopt unhealthy lifestyle practices because of poverty and cultural norms. Our findings also may not generalize to individuals with advanced cancer, who often have unique dietary patterns and barriers to regular exercise (eg, severe pain and fatigue). In addition to respondent bias, our eligibility criteria that excluded individuals with an active lifestyle, significant comorbidities, and normal weight or morbid obesity limit the generalizability of the current findings. Further research efforts are needed to examine the health behaviors and QoL of older long-term cancer survivors who are diverse with regard to medical and weight status, lifestyle practices, ethnicity, and socioeconomic status. Finally, causal relations between weight, exercise, diet, and physical QoL could not be established in the current cross-sectional study. Longitudinal research that incorporates objective indicators of diet quality and exercise habits in this population would extend the current findings.

Despite limitations, the current study represents 1 of the larger survey efforts to date aimed at exploring health behaviors and their associations with QoL among older cancer survivors. Results suggest that the prevalence of obesity and suboptimal dietary and exercise habits is high among older long-term survivors of prostate cancer, colorectal cancer (men and women), and breast cancer (women) who are interested in a diet and exercise intervention. In addition, findings point to the potential negative effect of obesity and the positive impact of regular exercise and a healthy diet on physical QoL outcomes in this population. Further research is needed to confirm associations between lifestyle factors and physical functioning in this rapidly growing segment of cancer survivors for whom functional losses may threaten independent living. Ultimately, results of randomized clinical trials, such as the RENEW Trial, will reveal the extent to which lifestyle modifications prevent functional decline among older cancer survivors.

Conflict of Interest Disclosures

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