Published in final edited form as:
Cancer. 2009 September 1; 115(17): 4001–4009. doi:10.1002/cncr.24436.

Associations between Lifestyle Factors and Quality of Life among Older, Long-term Breast, Prostate, and Colorectal Cancer Survivors

Catherine E. Mosher, Ph.D.[1], **Richard Sloane, M.S., M.P.H.**[2,3], **Miriam C. Morey, Ph.D.**[2,4,5], **Denise Clutter Snyder, M.S., R.D.**[3], **Harvey J. Cohen, M.D.**[2,3,4,5], **Paige E. Miller, M.S.**[6], and **Wendy Demark-Wahnefried, Ph.D., R.D.**[3,7]

[1]Memorial Sloan-Kettering Cancer Center, New York, NY

[2]Duke University Older Americans Independence Center, Center for the Study of Aging and Human Development, Duke University Medical Center (DUMC), Durham, NC

[3]Duke University School of Nursing, Durham, NC

[4]Department of Medicine, DUMC, Durham, NC

[5]Durham VA Medical Center Geriatric Research, Education and Clinical Center, Durham, NC

[6]Department of Nutritional Sciences, Pennsylvania State University, College Park, PA

[7]University of Texas - M.D. Anderson Cancer Center, Houston TX

Abstract

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, little is known regarding older cancer survivors' health behaviors and their associations with quality of life outcomes, especially during the long-term post-treatment period. Methods: A total of 753 older (age ≥ 65 years), long-term (≥ 5 years post-diagnosis) breast, prostate, and colorectal cancer survivors completed two baseline telephone interviews to assess eligibility for a diet and exercise intervention trial. 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 above 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 (e.g., better vitality and physical functioning; *p*s ≤ .05), whereas greater body mass index was associated with reduced physical quality of life (*p*s < .001).

Conclusions—Results indicate a high prevalence of suboptimal health behaviors among older, long-term breast, prostate, and colorectal cancer survivors who are interested in lifestyle modification. In addition, findings point to the potential negative impact of obesity and positive impact of physical activity and a healthy diet on physical quality of life in this population.

Correspondence: Catherine E. Mosher, Ph.D., Memorial Sloan-Kettering Cancer Center, Department of Psychiatry and Behavioral Sciences, 641 Lexington Avenue, 7th Floor, New York, NY 10022. Tel: 646-888-0091. Fax: 212-888-2584. mosherc@mskcc.org.

Conflicts of interest: The authors have no financial conflicts of interest to disclose.

Keywords

survivorship; breast carcinoma; prostate carcinoma; colorectal carcinoma; health; diet; physical activity; quality of life

Currently, there are over 11 million cancer survivors in the United States alone, and 61% of survivors are 65 years of age and older.1 As a result 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 to persons without cancer histories, 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 with cancer histories.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 and older.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, of whom the vast majority do not adhere to national guidelines.18, 19 Male cancer survivors and those who are less educated or over the age of 65 are even less likely to make healthy lifestyle changes or maintain them.20

Although the majority of cancer survivors are 65 years of age and older, 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 gender and cancer type and also 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 trial (RENEW).22 This NCI-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 via the NCCCR, the Duke Cancer Registry, and self-referral in 20 states, one 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 gender. 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) at least 65 years of age; (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 (F&V) (renal insufficiency); (6) community-dwelling; (7) overweight, but not morbidly obese (body mass index [BMI]: 25 kg/m^2< BMI < 40 kg/m^2) and 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/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 two, 45-60 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 prior to the intervention and assessed the following factors:

Physical activity

The Community Healthy Activities Models Program for Seniors (CHAMPS) 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 present research.

Dietary intake

Overall diet quality was assessed from two unannounced 24-hour recalls performed by trained interviewers. The 24-hour dietary recall represents one 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 (NHANES)27 and the Women's Intervention Nutrition Study (WINS).28 Interviewers obtained dietary intake data using the interactive Nutrition Data System-Revised (NDS-R) software (NCC Food and Nutrient Database System Version 2006, Minneapolis, MN). 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 above 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 assessed the following eight domains of QoL: physical and social functioning, role limitations due to physical problems and due to emotional problems, mental health, vitality, pain, and general health perceptions. These eight subscales provide the basis for calculating two summary measures, the Physical Component Summary and the Mental Component Summary. Higher scores represent better functioning on the two

summary measures and eight subscales. Norm-based scaling is used for both summary scores such that a score of 50 represents the U.S. national average. A score 10 points above or below the mean score of 50 represents a difference of one standard deviation from the national average.

Comorbidities

Six medical conditions (e.g., arthritis, heart conditions) were assessed using a measure previously developed 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 gender and cancer type. For the non-normally distributed measures (i.e., minutes of exercise and some SF-36 subscales), we conducted parallel unadjusted non-parametric and adjusted ordinal logistic regression analyses, which delivered a similar set of inferences as 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 four gender/cancer groups were conducted using the Tukey's Honestly Significant Differences (HSD) procedure. Next, Pearson (or Spearman, where appropriate for non-normally distributed measures) 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 significantly associated with study variables. With the exception of using the Tukey's HSD for the pairwise comparisons of the gender/cancer groups, no correction for Type I error was conducted for these exploratory analyses. All reported *p* values are 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 2,156 survivors who called for more information (11% response rate). After receiving a consent form and additional study information, 1,208 survivors completed screening and consent forms (6% overall response rate). Respondents (n = 1,208) differed significantly from nonrespondents (n = 18,807) with respect to age (mean of 73 vs. 76 years, respectively; $p < .0001$), race (13% vs. 17% minority, respectively; $p < .0001$), gender (50% vs. 45% female, respectively; $p = .0004$), and time since diagnosis (mean elapsed time of 9 vs. 10 years post-diagnosis, respectively; $p < .0001$). Of the 1,208 who provided informed consent, 455 were ineligible based on responses to the written screener and 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 two baseline telephone interviews were included in the present 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 were ultimately 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 U.S. states (7%). Age ranged from 65 to 87 years with a median of 73 years. Average time since diagnosis at the time of telephone screening was 9 years. The vast majority of participants (94%) were non-smokers. Due to the weight criterion for study enrollment, 60% of the sample was 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 their suboptimal health behaviors, the sample's mental and physical QoL exceeded U.S. age-related norms.33

Preliminary Analyses

Study outcomes were correlated such that weekly minutes of exercise were associated with lower BMI (ρ = -.10, p = .0064) and better diet quality (ρ = .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 positively correlated 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 correlations between demographic and medical factors (i.e., age, race, education level, cancer stage, comorbidities, time since cancer diagnosis) and study outcomes were statistically significant.

Differences in Study Variables by Gender and Cancer Type

Means, standard deviations, and p values for comparisons of study variables by gender 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 four gender/cancer groups. Pairwise comparisons revealed that female breast cancer survivors reported fewer weekly minutes of exercise and better diet quality relative to male colorectal cancer survivors and prostate cancer survivors. Female colorectal cancer survivors only reported better diet quality relative to male colorectal cancer survivors. Finally, female colorectal cancer and breast cancer survivors reported worse physical functioning relative to prostate cancer survivors. Using the Tukey's HSD method, none of the other pairwise comparisons yielded statistically significant differences as a function of gender or cancer type.

When the abovementioned models were conducted without adjusting for demographic covariates, the same pattern of results was obtained with two exceptions. In unadjusted analyses, pain significantly varied as a function of gender and cancer type (p = .02) such that female breast cancer survivors reported more pain than prostate cancer survivors. The pain levels of other gender/cancer groups did not significantly differ from each other. In addition, health perceptions did not vary as a function of gender 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 showed positive associations with a range of physical QoL outcomes in analyses that adjusted for age, level of education, and comorbidities. However, only physical functioning and vitality were significantly and positively correlated with diet quality in unadjusted analyses. Finally, greater BMI was associated with worse physical QoL, including greater pain and role limitations due to 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 focuses 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 above 80 (indicative of healthful eating habits compared to national guidelines). Despite their suboptimal health behaviors, all gender/cancer subgroups reported mental and physical QoL that exceeded levels previously reported for older cancer survivors and non-cancer 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.

A number of demographic variables were significantly associated with health behaviors, body weight status, and QoL outcomes. Older age, less education, and greater comorbidities were associated with reduced physical functioning and greater role limitations due to 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 gender and cancer type, and these results did not appear to be entirely driven by gender. Whereas prostate cancer survivors in this study and prior research have shown 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 prior research,36 and, 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 due to physical problems and better health perceptions, physical functioning, and vitality. A positive association between exercise and improved physical functioning has been consistently documented among older adults,37, 38 and one study found this association among older breast and prostate cancer patients within 18 months of diagnosis.11 This study is the first to show 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 this study, diet quality was positively associated with physical functioning and vitality. Better physical functioning was associated with less fat intake and greater F&V 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 unrelated to mental QoL. While these results do not corroborate the findings of studies conducted in Australia, which have found 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 as well as endorse findings of the majority of studies in the general population which have found 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 two 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 (e.g., 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 due to 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 (e.g., 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 relationships between weight, exercise, diet, and physical QoL could not be established in this 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 one of the larger survey efforts 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 prostate, colorectal, and female breast cancer survivors who are interested in a diet and exercise intervention. In addition, findings point to the potential negative effect of obesity and 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 RENEW, will reveal the extent to which lifestyle modifications prevent functional decline among older cancer survivors.

Acknowledgments

RENEW is supported by the National Institutes of Health through the following grants CA106919 and P30AG028716 and a grant from the Veterans Affairs Research & Development E3386R. The work of the first author is supported by the National Cancer Institute (F32CA130600). The authors dedicate this manuscript in memory of our esteemed and beloved colleague, Dr. Elizabeth C. Clipp. The authors also wish to thank the following individuals who have and are continuing to contribute expertise and support: Valeda Stull, Teresa Baker, Barbara Parker, and Linda Phelps. We also are grateful to our participating institutions (Duke University Medical Center, Durham VA Medical Center, North Carolina Central Cancer Registry, and the University of Chicago), cancer registrars (Cheri Willard and Karen Knight), and a host of participating oncology care providers and, of course, our cancer survivors.

References

1. American Cancer Society. American Cancer Society; [October 21, 2008]. Cancer Facts and Figures-2008. Available from URL: http://www.cancer.org/docroot/STT/stt_0.asp
2. Yancik R, Ries LA. Aging and cancer in America. Demographic and epidemiologic perspectives. Hematol Oncol Clin North Am. 2000; 14(1):17–23. [PubMed: 10680069]
3. Jemal A, Siegel R, Ward E, Hao Y, Xu J, Murray T, et al. Cancer statistics, 2008. CA Cancer J Clin. 2008; 58(2):71–96. [PubMed: 18287387]
4. Rowland J. Cancer survivorship-United States 1971-2001. MMWR CDC Surveill Summ. 2004; 53(24):526.
5. Aziz NM, Rowland JH. Trends and advances in cancer survivorship research: challenge and opportunity. Semin Radiat Oncol. 2003; 13(3):248–66. [PubMed: 12903014]
6. Yabroff KR, Lawrence WF, Clauser S, Davis WW, Brown ML. Burden of illness in cancer survivors: findings from a population-based national sample. J Natl Cancer Inst. 2004; 96(17): 1322–30. [PubMed: 15339970]
7. Baker F, Haffer SC, Denniston M. Health-related quality of life of cancer and noncancer patients in Medicare managed care. Cancer. 2003; 97(3):674–81. [PubMed: 12548610]
8. Chirikos TN, Russell-Jacobs A, Jacobsen PB. Functional impairment and the economic consequences of female breast cancer. Women Health. 2002; 36(1):1–20. [PubMed: 12215000]
9. Hewitt M, Rowland JH, Yancik R. Cancer survivors in the United States: age, health, and disability. J Gerontol A Biol Sci Med Sci. 2003; 58(1):82–91. [PubMed: 12560417]
10. Doyle C, Kushi LH, Byers T, Courneya KS, Demark-Wahnefried W, Grant B, et al. Nutrition and physical activity during and after cancer treatment: an American Cancer Society guide for informed choices. CA Cancer J Clin. 2006; 56(6):323–53. [PubMed: 17135691]
11. Demark-Wahnefried W, Clipp EC, Morey MC, Pieper CF, Sloane R, Snyder DC, et al. Physical function and associations with diet and exercise: Results of a cross-sectional survey among elders with breast or prostate cancer. Int J Behav Nutr Phys Act. 2004; 1(1):16. [PubMed: 15516261]
12. Alfano CM, Smith AW, Irwin ML, Bowen DJ, Sorensen B, Reeve BB, et al. Physical activity, long-term symptoms, and physical health-related quality of life among breast cancer survivors: a prospective analysis. J Cancer Surviv. 2007; 1(2):116–28. [PubMed: 18648952]
13. Hong S, Bardwell WA, Natarajan L, Flatt SW, Rock CL, Newman VA, et al. Correlates of physical activity level in breast cancer survivors participating in the Women's Healthy Eating and Living (WHEL) Study. Breast Cancer Res Treat. 2007; 101(2):225–32. [PubMed: 17028988]
14. Lynch BM, Cerin E, Owen N, Aitken JF. Associations of leisure-time physical activity with quality of life in a large, population-based sample of colorectal cancer survivors. Cancer Causes Control. 2007; 18(7):735–42. [PubMed: 17520334]
15. Holmes MD, Chen WY, Feskanich D, Kroenke CH, Colditz GA. Physical activity and survival after breast cancer diagnosis. JAMA. 2005; 293(20):2479–86. [PubMed: 15914748]
16. Meyerhardt JA, Heseltine D, Niedzwiecki D, Hollis D, Saltz LB, Mayer RJ, et al. Impact of physical activity on cancer recurrence and survival in patients with stage III colon cancer: findings from CALGB 89803. J Clin Oncol. 2006; 24(22):3535–41. [PubMed: 16822843]

17. Meyerhardt JA, Giovannucci EL, Holmes MD, Chan AT, Chan JA, Colditz GA, et al. Physical activity and survival after colorectal cancer diagnosis. J Clin Oncol. 2006; 24(22):3527–34. [PubMed: 16822844]

18. Bellizzi KM, Rowland JH, Jeffery DD, McNeel T. Health behaviors of cancer survivors: examining opportunities for cancer control intervention. J Clin Oncol. 2005; 23(34):8884–93. [PubMed: 16314649]

19. Coups EJ, Ostroff JS. A population-based estimate of the prevalence of behavioral risk factors among adult cancer survivors and noncancer controls. Prev Med. 2005; 40(6):702–11. [PubMed: 15850868]

20. Demark-Wahnefried W, Aziz NM, Rowland JH, Pinto BM. Riding the crest of the teachable moment: promoting long-term health after the diagnosis of cancer. J Clin Oncol. 2005; 23(24): 5814–30. [PubMed: 16043830]

21. Rao AV, Demark-Wahnefried W. The older cancer survivor. Crit Rev Oncol Hematol. 2006; 60(2):131–43. [PubMed: 16965920]

22. Snyder DC, Morey M, Sloane R, Stull V, Cohen H, Peterson B, et al. Reach out to enhance wellness in older cancer survivors (RENEW): Design, methods and recruitment challenges of a home-based exercise and diet intervention to improve physical function among long-term survivors of breast, prostate, and colorectal cancer. Psycho-Oncology. in press.

23. U.S. Department of Health and Human Services. Physical activity and health: a report of the Surgeon General National Center for Chronic Disease Prevention and Health Promotion. Atlanta, GA: U.S Government Printing Office; 1996.

24. Harada ND, Chiu V, King AC, Stewart AL. An evaluation of three self-report physical activity instruments for older adults. Med Sci Sports Exerc. 2001; 33(6):962–70. [PubMed: 11404662]

25. Stewart AL, Mills KM, Sepsis PG, King AC, McLellan BY, Roitz K, et al. Evaluation of CHAMPS, a physical activity promotion program for older adults. Ann Behav Med. 1997; 19(4): 353–61. [PubMed: 9706362]

26. Stewart AL, Mills KM, King AC, Haskell WL, Gillis D, Ritter PL. CHAMPS physical activity questionnaire for older adults: outcomes for interventions. Med Sci Sports Exerc. 2001; 33(7): 1126–41. [PubMed: 11445760]

27. McDowell MA. The NHANES III Supplemental Nutrition Survey of older Americans. Am J Clin Nutr. 1994; 59(1 Suppl):224S–26S. [PubMed: 8279430]

28. Chlebowski RT, Blackburn GL, Thomson CA, Nixon DW, Shapiro A, Hoy MK, et al. Dietary fat reduction and breast cancer outcome: interim efficacy results from the Women's Intervention Nutrition Study. J Natl Cancer Inst. 2006; 98(24):1767–76. [PubMed: 17179478]

29. Guenther, P.; Reedy, J.; Krebs-Smith, S.; Reeve, B.; Basiotis, P. Development and Evaluation of the Healthy Eating Index-2005: Technical Report. Center for Nutrition Policy and Promotion, US Department of Agriculture; 2007.

30. Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care. 1992; 30(6):473–83. [PubMed: 1593914]

31. Walters SJ, Munro JF, Brazier JE. Using the SF-36 with older adults: a cross-sectional community-based survey. Age Ageing. 2001; 30(4):337–43. [PubMed: 11509313]

32. Morey MC, Schenkman M, Studenski SA, Chandler JM, Crowley GM, Sullivan RJ Jr, et al. Spinal-flexibility-plus-aerobic versus aerobic-only training: effect of a randomized clinical trial on function in at-risk older adults. J Gerontol A Biol Sci Med Sci. 1999; 54(7):M335–M42. [PubMed: 10462164]

33. Ware, J.; Snow, K.; Koskinski, M. SF-36 Health Survey Manual and Interpretation Guide. Lincoln, RI: Quality Metric Incorporated; 2000.

34. Clarke P, O'Malley PM, Johnston LD, Schulenberg JE. Social disparities in BMI trajectories across adulthood by gender, race/ethnicity and lifetime socio-economic position: 1986-2004. Int J Epidemiol. 2008

35. Demark-Wahnefried W, Peterson B, McBride C, Lipkus I, Clipp E. Current health behaviors and readiness to pursue life-style changes among men and women diagnosed with early stage prostate and breast carcinomas. Cancer. 2000; 88(3):674–84. [PubMed: 10649263]

36. Blanchard CM, Courneya KS, Stein K. Cancer survivors' adherence to lifestyle behavior recommendations and associations with health-related quality of life: results from the American Cancer Society's SCS-II. J Clin Oncol. 2008; 26(13):2198–204. [PubMed: 18445845]

37. Nagi, S. Disability concepts revisited: implications for prevention. In: Pope, A.; Tarlov, A., editors. Disability in America: Toward a national agenda for prevention. Washington, DC: National Academy Press; 1991. p. 1309-27.

38. Seeman T, Chen X. Risk and protective factors for physical functioning in older adults with and without chronic conditions: MacArthur Studies of Successful Aging. J Gerontol B Psychol Sci Soc Sci. 2002; 57(3):S135–44. [PubMed: 11983740]

39. Kendall AR, Mahue-Giangreco M, Carpenter CL, Ganz PA, Bernstein L. Influence of exercise activity on quality of life in long-term breast cancer survivors. Qual Life Res. 2005; 14(2):361–71. [PubMed: 15892425]

40. Beesley VL, Eakin EG, Janda M, Battistutta D. Gynecological cancer survivors' health behaviors and their associations with quality of life. Cancer Causes Control. 2008; 19(7):775–82. [PubMed: 18322812]

41. Steginga SK, Lynch BM, Hawkes A, Dunn J, Aitken J. Antecedents of domain-specific quality of life after colorectal cancer. Psychooncology. in press.

42. Rock CL, Demark-Wahnefried W. Nutrition and survival after the diagnosis of breast cancer: a review of the evidence. J Clin Oncol. 2002; 20(15):3302–16. [PubMed: 12149305]

43. Fontaine KR, Barofsky I. Obesity and health-related quality of life. Obes Rev. 2001; 2(3):173–82. [PubMed: 12120102]

Table 1

Demographic, disease, and health-related characteristics of older, long-term cancer survivors (N = 753)

Characteristic	
Age at evaluation in yrs.	
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 (%)	
Female breast cancer	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 in yrs.	
Mean (SD)	9 (3)
Median (range)	8 (5-26)
Number of comorbidities	
Mean (SD)	2 (1)
Median (range)	2 (0-6)
Tobacco use (%)	
Current smoker	46 (6)
Non-smoker	707 (94)

SD: standard deviation

Table 2

Means, standard deviations, and comparisons for study variables by gender and cancer type

	Total Sample of Cancer Survivors (*N* = 753)	**Female Colorectal Cancer Survivors (*n* = 73)**	**Male Colorectal Cancer Survivors (*n* = 40)**	**Female Breast Cancer Survivors (*n* = 321)**	**Prostate Cancer Survivors (*n* = 319)**	***P* value[a]**
	Mean (SD) Median	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	
Weekly minutes of moderate-to-vigorous exercise	62.1 (106.7) 10.0	56.2 (101.4)	96.0 (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) 28.0	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) 58.0	57.2 (5.9)	56.5 (7.6)	56.4 (7.0)	56.9 (5.8)	.69
Pain	73.2 (21.5) 74.0	73.5 (22.2)	77.3 (20.1)	70.5 (21.7)	75.4 (21.1)	.68
Health Perceptions	73.0 (16.3) 77.0	75.4 (12.5)	69.8 (18.1)	73.2 (16.1)	72.6 (17.0)	.006
Physical Functioning	76.8 (18.8) 80.0	74.1 (18.6)	78.6 (14.7)	73.2 (20.2)	80.8 (17.2)	.0004
Role-Physical	75.8 (33.5) 100.0	74.3 (34.6)	78.5 (30.3)	74.5 (34.8)	77.1 (32.4)	.99
Vitality	62.8 (17.7) 65.0	63.4 (17.4)	61.1 (17.6)	61.3 (18.8)	64.4 (16.7)	.30
Mental Health	86.3 (11.7) 88.0	86.0 (11.8)	87.7 (12.5)	85.1 (12.3)	87.3 (10.8)	.33
Social Functioning	90.9 (16.7) 100.0	91.6 (16.1)	90.9 (17.9)	90.2 (17.8)	91.5 (15.5)	.77
Role-Emotional	92.5 (20.9) 100.0	93.6 (19.8)	92.5 (20.7)	90.8 (23.6)	94.0 (18.2)	.32

SD: 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 gender/cancer group were adjusted for age, race, level of education, and number of comorbidities.

[a] *p* values for regression models that examined overall differences in study variables across the four gender/cancer groups.

Table 3

Associations between demographic and medical characteristics and study outcomes

	Age	Education Level	Race[b]	Cancer Stage[c]	Number of Comorbidities
Weekly minutes of moderate-to-vigorous exercise[a]	-.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)

Standard deviations are in parentheses.

[a] Spearman correlations were computed between exercise and participant characteristics, whereas Pearson correlations were computed for all other variables.

[b] Coded 0 = non-White, 1 = White.

[c] Range = 0 to 5.

Table 4

Correlations between quality of life outcomes and lifestyle factors and body weight status

	Weekly minutes of moderate-to-vigorous exercise		Healthy Eating Index		BMI (kg/m^2)	
	ρ	adjusted ρ^a	r	adjusted r^b	r	adjusted r^c
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
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)

N = 753. BMI: body mass index. p values are in parentheses. Higher scores indicate better quality of life outcomes.

[a] Spearman correlations adjusted for age, level of education, and number of comorbidities.

[b] Pearson correlations adjusted for age, level of education, and number of comorbidities.

[c] Pearson correlations adjusted for age, level of education, race, cancer stage, and number of comorbidities.

Cancer. Author manuscript; available in PMC 2010 September 1.