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Rakiyah Johnson 4/13/2018

Correlates of light physical activity among cancer survivors:
A report from the American Cancer Society's Studies of Cancer Survivors-I (SCS-I)

By

Rakiyah S. Johnson
Master of Public Health

Behavioral Sciences and Health Education

Carla J. Berg, PhD, MBA, LP
Committee Chair

Elizabeth A. Fallon, PhD, MPH
Committee Member

Colleen McBride, PhD
Department Chair

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By

Rakiyah S. Johnson
B.S. Health and Human Sciences
Loyola Marymount University
2016

Thesis Committee Chair: Carla J. Berg, PhD, MBA, LP

An abstract submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health
in Behavioral Sciences and Health Education
2018

Abstract

Correlates of light physical activity among cancer survivors:
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By Rakiyah Johnson

Background: Despite emerging evidence of positive health benefits of light physical activity (LPA) for cancer survivors, little research has explored modifiable factors that facilitate or hinder LPA in this population.
Purpose: To explore environmental and cognitive predictors of LPA among cancer survivors.
Methods: Data from the third survey of the American Cancer Society's Studies of Cancer Survivors-I were utilized. The Leisure Time Exercise Questionnaire assessed minutes per week of LPA and moderate-to-vigorous physical activity (MVPA). The primary outcome was LPA categorized at 0, 1-59, 60-119, and 120+ minutes per week. Chi-square tests and ANOVAS were conducted to compare two groups created based MVPA level (no MVPA, some MVPA). Multivariable ordinal logistic regressions using forced entry were conducted, stratified by MVPA status.
Results: The sample (N = 1494) was on average 64.8 years old, primarily non-Hispanic white (90.5%), female (60.3%), college-educated (43.0%), married/cohabitating (74.1%), and had ≥2 physical health comorbidities (46.3%). The multivariable models revealed that among those reporting no MVPA, support from a primary care provider (OR = 1.48; p=.049), perceived support from a partner (OR = 1.06; p=.024), and perceived health competence (OR = 1.44; p=.014) were significantly correlated with LPA. No hypothesized constructs were significantly associated with LPA among those engaging in some MVPA.
Conclusion: Among cancer survivors reporting no MVPA, LPA was positively associated with support from a primary care provider, perceived support from a partner, and perceived health competence. Social cognitive constructs are useful for informing the development of interventions aiming to increase LPA among cancer survivors.

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CHAPTER 1: INTRODUCTION

The cancer survivor population in the United States is estimated to grow within the next decade(Alfano, Molfino, & Muscaritoli, 2013; Bluethmann, Mariotto, & Rowland, 2016; Guy et al., 2013; Miller et al., 2016). Cancer survivorship is often associated with treatment-related side effects that have deleterious physical and psychological health effects (Miller et al., 2016). Additionally, cancer survivors also suffer from comorbid conditions that contribute to the overall burden of survivorship (Guy et al., 2017). As the number of cancer survivors increases, the projected economic burden of cancer is also expected to increase due to substantial medical expenditures and loss of productivity (Guy et al., 2013).

Substantial literature suggests that the risk of cancer-related death is greatly decreased by engagement in physical activity (Irwin et al., 2017), and it is recommended that cancer survivors engage in 150 minutes of moderate-to-vigorous physical activity (MVPA) per week for associated physical and psychological health benefits (Kushi et al., 2012). However, the majority of cancer survivors do not meet this recommendation, and older cancer survivors with comorbid conditions are particularly inactive (Kwon, Hou, & Wang, 2012; Miller et al., 2016; Tannenbaum et al., 2016).

In order to further promote physical activity engagement amongst cancer survivors, researchers have taken interest in light physical activity (LPA) because it is associated with positive health outcomes, and may be easier to initiate among older cancer survivors, or those challenged by comorbid conditions and/or adverse health outcomes due to cancer (Blair et al., 2014; Buman et al., 2010; Duvivier et al., 2017). The health benefits of LPA among cancer survivors are preliminary, but promising, and therefore research to identify predictors among cancer survivors is necessary. The majority of existing research examines demographic and

medical correlates of LPA among cancer survivors, but understanding the role of theoretically modifiable correlates is also necessary to build effective behavioral interventions for LPA among cancer survivors. This study, guided by the social cognitive theory (Bandura, 1986), therefore seeks to explore environmental and cognitive correlates of LPA among cancer survivors in the American Cancer Society's Studies of Cancer Survivors-I, time-point 3 dataset.

CHAPTER 2: LITERATURE REVIEW

As of January 2016, there were more than 15.5 million cancer survivors alive in the United States (Miller et al., 2016). The number of cancer survivors is likely to increase to 20 million survivors by 2026 due to an increasing number of new cancer diagnoses, as well as advances in early screening and cancer treatment (Miller et al., 2016). Additionally, the economic cost of premature death due to cancer is projected to increase to $148 billion by 2020 (Chino et al., 2014). For cancer survivors, financial impacts may stem from employment disability and fewer days at work, in addition to out-of-pocket and direct-patient costs for treatment (Chino et al., 2014; Guy et al., 2013).

Cancer survivorship is often characterized by treatment-related side effects such as fatigue, distress, pain, weight changes, or immune suppression that may occur during active treatment, or many years following treatment (Miller et al., 2016). These side effects may co-occur with comorbid conditions such as congestive heart failure, chronic obstructive pulmonary disease, and diabetes, thus contributing to all-cause mortality (Bluethmann et al., 2016; Guy et al., 2017; Williams et al., 2017). Conclusively, the effects of cancer are debilitating, and are an extreme burden to survivors, as well as society at large. Therefore, it is important to understand the unique needs of this population as it continues to grow (Guy et al., 2013).

Growing evidence suggests that the risk of cancer-related death could be decreased up to 50% among those who regularly engage in physical activity following a cancer diagnosis (Irwin et al., 2017). Positive physical outcomes of physical activity include improvements in cancer-related fatigue, lymphedema, muscle strength, and lowered body mass index among select groups of cancer survivors (Fong et al., 2012; Meneses-Echavez, Gonzalez-Jimenez, & Ramirez-Velez, 2015; Paramanandam & Roberts, 2014; Rossi, Friel, Carter, & Garber, 2017; Singh, Disipio, Peake, & Hayes, 2016). Positive psychological outcomes attributed to physical activity include lower levels of depression and anxiety, and higher levels of social functioning, self-esteem, body-image, and overall improved mental health (Fong et al., 2012; Knols, Aaronson, Uebelhart, Fransen, & Aufdemkampe, 2005; Schmitz et al., 2005; Wang et al., 2015). Additionally, physical activity has led to improved health among those with osteoarthritis, heart failure, and chronic obstructive pulmonary disease, and is associated with lower risk of cardiovascular disease in cancer survivors (Keats, Cui, Grandy, & Parker, 2017; Wang et al., 2015). Finally, physically active cancer survivors report improvements in health-related quality of life (Irwin et al., 2017; Rossi et al., 2017; Wang et al., 2015).

To attain these health benefits, current American Cancer Society recommendations suggest that cancer survivors should engage in 150 minutes of moderate-to-vigorous intensity physical activity (MVPA) per week (Kushi et al., 2012). Physical activity is defined as any bodily movement that results in energy expenditure (Caspersen, Powell, & Christenson, 1985). MVPA is defined as physical activity that is $\geq$3 metabolic equivalents characterized by activities such as brisk walking, cleaning, organized sports, or running (Ainsworth et al., 2011; Haskell et al., 2007). Although recommendations for MVPA exist, the majority of cancer survivors do not meet guidelines (Kwon et al., 2012; Tannenbaum et al., 2016).

When reviewing the literature examining correlates of MVPA (Buffart et al., 2017; Coups et al., 2009; Forbes, Blanchard, Mummery, & Courneya, 2014; Hong et al., 2007; Hughes et al., 2015; Kampshoff et al., 2016; Mama et al., 2017; Rogers et al., 2009), cancer survivors are less active than age-adjusted older adults without cancer. Lower levels of MVPA are found among those who do not meet guidelines for smoking and healthy eating, and is associated with older age and higher numbers of comorbidities (Blanchard, Courneya, Stein, & American Cancer Society's, 2008; Miller et al., 2016). These trends suggest that cancer survivors may struggle to initiate and sustain physical activity behavior as they age and report more comorbid health conditions and unhealthy behaviors.

While most cancer survivorship and physical activity research has focused on the benefits of MVPA, emerging evidence suggests LPA may also be beneficial (Blair et al., 2014). LPA is defined as PA that is 1.5-2.9 metabolic equivalents and is characterized by activities such as standing, slow walking, and self-care activities that require less energy to execute (Owen, Healy, Matthews, & Dunstan, 2010).

Amongst older adults in the general population, LPA is positively associated with physical and psychosocial well-being, lowered body mass index, and further cardio-metabolic benefits (Bann et al., 2015; Buman et al., 2010; Duvivier et al., 2017). Specifically, for colorectal and breast cancer survivors, higher levels of LPA were associated with lower levels of fatigue (Van Roekel et al., 2015), as well as lower depressive symptoms (Sylvester, Ahmed, Amireault, & Sabiston, 2017). Additionally, LPA is positively associated with being female, higher income, and lower levels of education (Conroy, Wolin, Blair, & Demark-Wahnefried, 2017; Lynch et al., 2016). Older age, higher body mass index and smoking status have also been negatively associated with LPA in previous research (D'Silva, Bebb, Boyle, Johnson, & Vallance, 2017;

Lynch et al., 2016). While the explicit health benefits of LPA are yet emerging, current evidence provides sufficient rationale for examining the facilitators and barriers of LPA behavior among cancer survivors.

Beyond socio-demographic correlates of physical activity, several studies in the MVPA literature have explicitly utilized theory-based frameworks for studying correlates of MVPA and developing interventions for MVPA. Among the most popular theories in the MVPA and cancer survivorship literature is the social cognitive theory (Buffart et al., 2017; Forbes et al., 2014). The social cognitive theory (Bandura, 1986) is of particular importance because it recognizes the dynamic and reciprocal interactions that occur between behavioral factors (e.g., other health behaviors), personal factors (e.g., mental health, self-efficacy, perceived health competence, perceived susceptibility), and environmental factors (e.g., support from healthcare providers, significant others, friends, and family) that influence behavior (Bandura, 1986).

Recent research has highlighted the need for studies that identify the attitudes and behavioral factors that contribute to overcoming barriers to MVPA (Buffart et al., 2017; Forbes et al., 2014). Studies that utilized the social cognitive theory to examine correlates of MVPA found that task self-efficacy, social support from friends and family, and social-modeling were positively associated with engagement in MVPA among cancer survivors (Kampshoff et al., 2016; Mama et al., 2017; Rogers et al., 2009).

While substantial research exists examining theory-based facilitators and barriers to MVPA, only one study to date has examined theory-based correlates of LPA. Specifically, (Coups et al., 2009) used a social cognitive approach to study the correlates of leisurely walking among lung cancer survivors, and found that lower-self efficacy and lower social support were positively associated with lower levels of leisurely walking (Coups et al., 2009).

Therefore, the purpose of this study is to use a social cognitive framework to explore the environmental and cognitive factors as predictors of LPA among cancer survivors in the American Cancer Society's Studies of Cancer Survivors-I, time-point 3 dataset. The specific aim of this study is to examine whether provider support to engage in physical activity, partner's unsupportive behaviors related to cancer, perceived social support, level of perceived health competence, and perceived susceptibility is associated with LPA. We hypothesize, after controlling for demographic, medical, and health behaviors, that greater healthcare provider support for physical activity, lower partner unsupportive behaviors related to cancer, higher perceived social support, higher perceived health competence, and greater perceived susceptibility are associated with higher levels of LPA.

CHAPTER 3: METHODS

Procedure

This study is a secondary data analysis of the American Cancer Society's Studies of Cancer Survivors-I (SCS-I), time-point 3 survey. The SCS-I study was designed to investigate cancer survivors' adjustment to cancer and the physical and psychological changes in quality of life (T. Smith et al., 2007). Adults with the 10 most incidental cancers were recruited through 11 state cancer registries (T. Smith et al., 2007). Each registry utilized active physician consent or physician notification for recruitment. SCS-I surveyed participants at three time-points, occurring an average of 1.28, 2.31, and 8.91 years post-treatment. Each survey took approximately 60-minutes to complete and was available in English and Spanish. The approval for all three time-points of SCS-I was obtained from the Institutional Review Board of Emory University, as well as each participating state's cancer registry. Prior to conducting this secondary data analysis, the

Institutional Review Board approved this study as exempt and under the purview of the original IRB (Emory University IRB #1853 587-2000).

The SCS-I sampling frame was stratified by age group, oversampled survivors <55 years, and sought to include survivors 1-year post-diagnosis. Eligibility criteria for the SCS-I study included: (1) ≥18 years of age at the time of diagnosis, (2) diagnosed with local, regional, or distant SEER Summary Stage cancer; for urinary bladder, in situ cases were also included, and (3) being a resident of the target state at the time of cancer diagnosis (T. Smith et al., 2007). Survivors were deemed ineligible for the SCS-I study if they were deceased, unable to complete the survey due to mental impairment, had present cancer (usually terminal), or were unable to communicate in English or Spanish. A full description of the rationale and SCS-I study methodology has been published elsewhere (T. Smith et al., 2007).

Participants

There were 6,306 participants enrolled in SCS-I, and 3,168 participants did not complete the third survey and were therefore excluded from this analysis. Additionally, individuals were excluded if they had incomplete data (n = 1,184), were physically unable to exercise (n = 85), or were not cancer free (n = 227). Preliminary analyses of SCS-I data suggested that unemployment status (n = 188) was associated with mental health comorbidities, making this subset of the sample vastly different than the rest; therefore, they were excluded. This left a total sample of 1,454 participants for this analysis (see Figure 1).

Measures

Covariates:

Sociodemographic Variables

Race, education, employment, and marital status were self-reported (T. Smith et al., 2007). Data regarding age and sex were collected from both self-report survey and from respective registries. Demographic data provided by the participants was prioritized when there

was a discrepancy between the self-report and registry data. The employment variable in SCS-I originally captured responses for being employed and being unemployed, where being unemployed indicated individuals were "not employed – disabled", "not employed – retired", and "not employed – seeking a job". As alluded above, those who were "not employed – seeking a job" (n = 188) were excluded from this analysis. Remaining response options were collapsed into two categories where participants were either employed, or not employed (retired, homemaker, or on disability) for this study.

Cancer-Related Variables

Data regarding date of cancer diagnosis, cancer type (e.g., bladder, breast, colon or rectal, kidney, lung, melanoma of the skin, Non-Hodgkin's lymphoma, ovarian, prostate, or uterine (endometrial)), and cancer stage and severity (e.g., in situ, localized, regional, distant, un-staged or unknown) were collected from both registry data and participants (T. Smith et al., 2007). Cancer status was self-reported in response to the question, "in the past 5 years, have any of the following happened to you?" by selecting "yes" or "no" to (a) recurrence of the same cancer, (b) a cancer metastasis, or (c) another cancer diagnosis (T. Smith et al., 2007).

Other Health-Related Variables and Behaviors

Participants responded "yes", or "no", to the following comorbid physical or mental conditions they had received treatment for in the past 12 months: Alzheimer's disease, gastrointestinal problems, diabetes, high blood pressure, heart attack, heart disease or other heart conditions, stroke, arthritis, asthma, osteoporosis, anxiety, depression, or mental health problems other than anxiety and depression (T. Smith et al., 2007). In this study, comorbid conditions were categorized as being physical or mental, where participants had none, 1, or $\geq$2 physical health comorbidities, and none or $\geq$1 mental health comorbidities. Depressive symptoms were also assessed using the Center for Epidemiological Studies Depression Scale, short form, which is a

ten-item scale used to assess depressive symptoms (Andresen, Malmgren, Carter, & Patrick, 1994). Sample items include, "I was bothered by things that don't usually bother me", or, "my sleep was restless". Response options for each question are measured on a Likert-scale from (0) "rarely or none of the time" to (3) "most or all of the time". The range of possible summed scores is 0 – 30. For this study, higher scores are indicative of being symptomatic of depression ($\geq$10 on Center for Epidemiological Studies of Depression Scale, while lower scores are indicative of being asymptomatic of depression (<10 on Center for Epidemiological Studies of Depression Scale) (Andresen et al., 1994). There was a Cronbach's alpha of 0.86 for the Center for Epidemiological Studies of Depression Scale.

Body mass index was collected based upon self-reported height (feet and inches) and weight (pounds). We calculated body mass index [formula: weight kilograms / (height meters^2)] and included underweight/healthy weight (body mass index <25), overweight (body mass index $\geq$25 to <30), and obese (body mass index $\geq$30) categories for use in this study (Rock et al., 2012). Fruit and vegetable recommendations, smoking status, and alcohol consumption were recorded via self-report surveys (Rock et al., 2012; T. Smith et al., 2007). Adherence to American Cancer Society guidelines for fruit and vegetable consumption was self-reported, where participants provided responses to the question – "considering a typical week in the past month, how many days per week did you eat at least 5 servings of fruits and vegetables a day?" (T. Smith et al., 2007). Based upon responses, the two categories, 'did not meet American Cancer Society recommendations for fruit and vegetable servings per week' and 'met American Cancer Society recommendations for fruit and vegetable servings per week' were used in this study. Smoking behavior and alcohol use were adapted from the Behavioral Risk Factor Surveillance System (Rock et al., 2012). Smoking status was assessed by an item stating, "do

you now smoke cigarettes: every day, some days, or not at all", and responses were categorized as 'non-smokers', or 'current smokers' in this study. Participants were asked about the average monthly frequency they had any alcoholic beverage (beer, wine, or liquor), with responses collapsed into "never or less than 1 day per month", "1-4 days per month", and "2-7 days per week" (Rock et al., 2012). These responses were then analyzed to establish whether participants met American Cancer Society guidelines for alcohol use for men (maximum 2 drinks per day), and for women (maximum 1 drink per day) (Kushi et al., 2012). Dichotomous variables were created for both men and women such that participants either 'met American Cancer Society guidelines for alcohol use', or 'did not meet American Cancer Society guidelines for alcohol use'.

Moderate-to-Vigorous Physical Activity

The Godin-Shephard Leisure-Time Exercise Questionnaire (Amireault, Godin, Lacombe, & Sabiston, 2015) is widely used in oncology research to assess leisure time physical activity (Amireault et al., 2015). The original three-item questionnaire measures the frequency of >15 minutes of mild, moderate, and strenuous leisure-time physical activity in a typical week. In concordance with similar studies (Forbes et al., 2014; Hughes et al., 2015), three items assessing the average amount of time per activity were added, allowing the calculation of minutes/week spent by multiplying weekly frequency by duration/activity session in each activity intensity (mild/light, moderate, strenuous). Sample items include, "Considering a typical week in the past four weeks: how many times on the average did you do the following kinds of exercise for more than 15 minutes during your free time", and "for how long per exercise session (in minutes)"? For this study, minutes of moderate and minutes of vigorous physical activity per week were summed to calculate minutes of MVPA per week. Minutes of MVPA per week was used as a covariate in two analyses. MVPA was also grouped into the following three categories: 0

minutes of MVPA/week, <150 minutes of MVPA/week, and ≥150 minutes of MVPA/week. By using these categories, MVPA became a stratifying variable for multivariable analyses.

Primary Predictors:

Support from Primary Care Provider

A single item from the Primary Care Delivery of Survivorship Care Scale was used to assess primary care physician support for physical activity (Brotzman & Robertson, 1998). Participants responded to the statement, "My primary care doctor helps me live a healthier life by discussing diet, exercise, and weight management" by selecting (1) "strongly disagree" to (5) "strongly agree" on a Likert-scale. Higher numbers correspond to participants feeling more strongly supported by their primary care physician.

Perceived Partner Unsupportive Behaviors

The Partner Responses to Cancer Inventory was renamed as the Partner Unsupportive Behaviors Scale, which is a 13-item scale assessing positive and negative responses of partners of individuals with cancer (Manne et al., 2014; Manne & Schnoll, 2001). For this study, seven of the original 13 items were included from the Criticism and Withdrawal subscale. Sample items include, "criticized the way you handled your disease and/or its treatment" (criticism), or "seemed uncomfortable talking to you about your illness" (withdrawal). Response options for each question are measured on a Likert-scale from (1) "never" to (4) "often". The range of possible summed scores is 7 – 28, where a higher score reflects more perceived negative responses from partners. Cronbach's alpha was 0.88.

Perceived Social Support

The Multidimensional Scale of Perceived Social Support is a 12-item scale that reflects the perceived social support from family, friends, and a significant other (Zimet, Powell, Farley, Werkman, & Berkoff, 1990). Sample items include, "my family is willing to help me make decisions" (family), "I can count on my friends when things go wrong" (friends), and "there is a

special person around who is around when I am in need" (significant other). Perceived support for each question is measured on a Likert-scale from (1) "very strongly disagree" to (7) "very strongly agree". The range for possible mean scores is 1 – 7, where higher scores are indicative of greater perceived social support. Cronbach's alpha was 0.95.

Perceived Health Competence

The Perceived Health Competence Scale is an eight-item scale used to assess the perceived self-efficacy of general health practices among participants (M. S. Smith, Wallston, & Smith, 1995). Sample items include "I handle myself well with respect to my health". Response options for each question are measured on a Likert-scale from (1) "strongly disagree" to (5) "strongly agree". The range of possible mean scores is 1 – 5, where higher scores are indicative of greater perceived self-efficacy in health practice. Cronbach's alpha was 0.87.

Perceived Susceptibility to Cancer Recurrence

The 3-item perceived susceptibility subscale of the Adapted Health Belief Model Scale (Champion, 1999) was used to assess perceived susceptibility to cancer recurrence (Champion, 1999). A sample item includes "it is likely that I will get cancer again". Response options for each question are measured on a Likert-scale from (1) "strongly disagree" to (5) "strongly agree". The range of possible summed scores is 3 – 15, where higher scores are indicative of greater perceived susceptibility to cancer recurrence. Cronbach's alpha was 0.89.

Primary Outcome:

Light Physical Activity

As noted above, the Godin-Shephard Leisure-Time Exercise Questionnaire (Amireault et al., 2015) was used to the calculate minutes per week spent in mild or light intensity physical activity (Amireault et al., 2015). For this analysis, LPA was calculated by multiplying minutes of LPA by times per week. Then, LPA was grouped into the following four categories: 0 minutes/week, 1-59 minutes/week, 60-119 minutes/week, and $\geq$120 minutes/week.

Data Analysis

Data were analyzed using SPSS statistical software version 21.0. Descriptive statistics were generated for initial assessment of demographic variables, medical variables, and social cognitive and environmental variables of interest. Because similar studies examining LPA as the primary outcome of interest have controlled for MVPA as a covariate (Conroy et al., 2017; D'Silva et al., 2017; Lynch et al., 2016) and recent research demonstrates a LPA by MVPA interaction for health benefits of LPA among cancer survivors (Fallon, 2018), we stratified the analytic sample by level of MVPA, resulting in two groups: those reporting at least some MVPA (n = 811), and those reporting no MVPA (n = 643; See Figure 1). These two groups were compared using chi-square tests and one-way ANOVAs as appropriate. Because meaningful differences by MVPA level were evidenced for several covariates and primary predictors, three multivariable ordinal logistic regressions using forced entry were conducted. The first regression, Model A (n = 1494), replicated previous research (Coups et al., 2009) where covariates included demographic variables, medical variables, and MVPA, while the independent variables of interest were hypothesized theory-based constructs. Subsequently, two regressions stratified by MVPA level were conducted, Model B (no MVPA, n = 643) and Model C (at least some MVPA, n = 811). These regressions used the same covariates and independent variables included in the first model, as appropriate. For all analyses, significance was established a priori by a *p*-value of $\leq$0.05. In each regression, the proportional odds assumption was tested.

CHAPTER 4: RESULTS

Characteristics of the total sample (n = 1454), as well as bivariate analyses comparing individuals reporting no MVPA (n = 643), and individuals reporting at least some MVPA (n = 811), are presented in Tables 1 and 2. Overall, the average age of the total sample was 64.8 (SD

= 11.40) years, and the majority were female (60.3%; n = 877), non-Hispanic White (90.5%; n = 1316), had graduated college (43.0%; n = 625), were employed (51.2%; n = 744), and were married or cohabitating (74.1%; n = 1077). The majority of participants had no mental health comorbidity (75.4%; n = 1096) and were not symptomatic of depression (>10 on Center for Epidemiological Studies of Depression Scale) (87.0%; n = 1265). The mean body mass index of the total sample was 28.6 (SD = 6.10). Participants engaged in an average of 120.12 (SD = 226.20) minutes of LPA per week, and 103.55 (SD = 183.80) minutes of MVPA per week.

Bivariate Analysis Results

Per Tables 1 and 2, bivariate analyses indicated that there were significant differences between participants reporting no MVPA and at least some MVPA. Specifically, those engaging in no MVPA were older ($p<.001$), less educated ($p<.001$), less likely to be employed ($p<.001$), less likely to be married or cohabitating ($p<.001$), have more physical health comorbidities ($p<.001$), more likely to be depressed ($p<.001$), more likely to be obese ($p<.001$), less likely to meet fruit and vegetable recommendations ($p = .040$), more likely to smoke ($p = .010$), more likely to meet alcohol recommendations ($p = .007$), perceived less support from a primary care provider ($p = .008$), had lower perceived health competence ($p<.001$), and lower LPA ($p<.001$).

Multivariable Regression Results

In the first regression (Model A) using the total sample (n = 1454; See Table 3), multivariable analyses indicated that for one-unit increase in perceived health competence, the odds of engaging in LPA increases multiplicatively by 1.32 ($p=.004$), given all other variables in the model are held constant. When stratifying the regression analysis by MVPA level, substantive differences emerged among those who engaged in no MVPA (Model B, n = 643) and those who engaged in some MVPA (Model C, n = 811). Specifically, analyses restricted to those engaging in no MVPA (Model B) indicated that those who agree their healthcare provider is

supportive of physical activity have greater odds of engaging in LPA (OR = 1.48; p=.049). Additionally, a one unit increase in partner unsupportive behaviors, led to an increase in odds of engaging in LPA (OR = 1.06; p=.024). Finally, a one unit increase in perceived health competence, is associated with greater odds of engaging in LPA (OR = 1.44 times; p=.014). None of the hypothesized theoretical constructs were associated with LPA when isolating those who engaged in some MVPA (Model C).

CHAPTER 5: DISCUSSION

Despite emerging research suggesting the health benefits of LPA for cancer survivors, there is limited understanding of modifiable factors associated with LPA in this population, and therefore little empirical basis for intervention development (Blair et al., 2014; D'Silva et al., 2017; Van Roekel et al., 2015). This study contributes to the literature in two ways. First, from a methodological perspective, there is great benefit in stratifying analyses by MVPA level, which reveals distinct correlates of LPA, depending on MVPA level. Second, among those whose health would benefit most by increasing their LPA, social cognitive interventions aiming to increase provider support for LPA, partner support for LPA, and perceived health competence are indicated.

Comparing groups based on MVPA status reveals a different demographic and health profile among those who get some MVPA and those who do not engage in any MVPA. Specifically, in comparison to participants engaging in some MVPA, those who are not reporting any MVPA are older, have less education, are not employed, and are less likely to be married or cohabitating. This group has more physical health comorbidities, are more likely to be depressed, are more obese, and are not meeting American Cancer Society guidelines for smoking or fruit and vegetable consumption. Additionally, cancer survivors reporting no MVPA report lower

health competence and lower levels of LPA, compared to those reporting they engage in at least some MVPA. Ultimately, these group differences may influence our ability to detect significant correlates in multivariable regressions aiming to better understand cancer survivor engagement in LPA, and more importantly, may influence the type of interventions that are effective in improving LPA.

This is further demonstrated when qualitatively comparing the results of the three multivariable regressions. In replicating previous research by including the entire sample (Table 3, Model A), results showed significant associations between demographic variables and LPA. Additionally, perceived health competence was positively associated with LPA, suggesting that as increasing an individual's health competence might increase engagement in LPA. The regression containing participants engaging in at least some MVPA (Table 3, Model C) displayed significant associations with LPA amongst demographic variables, but did not reveal any significant social cognitive correlates. Finally, in the regression containing only individuals reporting no MVPA (Table 3, Model B), findings revealed that support from a primary care provider, support from a partner, and perceived health competence were positively associated with LPA.

Findings from previous studies suggest that despite a strong desire for healthcare provider advice for physical activity (Hardcastle, Glassey, Salfinger, Tan, & Cohen, 2017; Philip et al., 2014), a low proportion (31%) (Fisher, Williams, Beeken, & Wardle, 2015) of cancer survivors report receiving support from their healthcare providers for physical activity (Cantwell et al., 2017; Fisher et al., 2015; Philip et al., 2014; Short, James, & Plotnikoff, 2013; L. Smith et al., 2017). In our sample, however, a large proportion of survivors (82%) reported receiving support for physical activity from their primary care provider. Although this proportion was high, we still

found provider support to be a positive correlate in one multivariable regression (Model B), meaning that those who report receiving support for physical activity were more likely to engage in LPA. These findings support other studies suggesting that provider support is positively associated with physical activity (Kenison, Silverman, Sustin, & Thompson, 2015). Furthermore, our sample was recruited through cancer registries and physician referral (T. Smith et al., 2007), resulting in a sample that may have been more likely to receive healthcare provider support for physical activity (Kenison et al., 2015; T. Smith et al., 2007). Participants that were referred to the study may have been better managing their cancer, therefore their provider assumed that participation in SCS-I would be beneficial. The high proportion of provider support in our sample may also be due to the question wording, where weight management, nutrition, and physical activity were assessed collectively. Had these behaviors been evaluated separately, we may have seen different percentages of provider support reported for the different categories.

Among individuals that engaged in no MVPA (Table 3, Model B), results indicated a significant positive association between unsupportive behaviors from a partner and LPA, although a negative association was hypothesized. Significant associations were also found between less support from friends and family and lower physical activity in previous studies, but research is unestablished for LPA (Kampshoff et al., 2016). In a study assessing partner support and physical activity behavior following cancer treatment, participants reported less support from their spouse for organization of domestic work, such as cleaning, shopping, cooking, or childcare (Mackenzie, 2015). Less support to maintain these responsibilities may influence the amount of time survivors spend in LPA, as LPA is often characterized by these low-intensity activities. Further research would reinforce the finding that unsupportive behaviors from partners may be a particularly important predictor for LPA engagement among cancer survivors.

While previous studies have reported a positive relationship between perceived social support and physical activity amongst cancer survivors (Barber, 2013; Coleman, Berg, & Thompson, 2014; Faghani et al., 2014), this study did not find a statistically significant relationship between social support and LPA. Our results may be partially due to the measures incorporated in this study. Previous studies used scales that assessed social support specific to physical activity engagement, and our study measured general perceived social support (Barber, 2013; Faghani et al., 2014). Those that reported less physical activity in other studies also reported lower social support per dimension, where distinct subgroups of social support (family, friends, and significant others) were assessed separately (Coleman et al., 2014; Faghani et al., 2014). These findings reinforce that different dimensions of social support may have varying effects on LPA for cancer survivors. Additionally, individuals reporting no MVPA in this study have demographic and psychological characteristics previously associated with lower levels of physical activity including being single, being depressed, and perceiving lower levels of social support (Faghani et al., 2014). These correlates may aid in identifying groups of cancer survivors that could benefit from interventions that include social support for LPA engagement.

Results in this study indicate that perceived health competence was positively associated with LPA among those who engaged in no MVPA (Table 3, Model B), and in the entire sample (Table 3, Model A). This association was particularly strong because it was observed in both analyses, however, the association was driven by those reporting no MVPA. Previous studies report that cancer survivors were not aware of how physical activity could optimize cancer recovery or prevention of cancer recurrence (Hardcastle et al., 2017; Short et al., 2013). Furthermore, these studies concluded that cancer survivors reported mixed knowledge surrounding physical activity guidelines, and that patient education could address these

knowledge gaps (Hardcastle et al., 2017; Short et al., 2013). Because cancer survivors may not be aware of the benefits of engaging in MVPA, they may also be less aware of benefits of LPA, as our understanding of the health benefits of LPA are still emerging (D'Silva et al., 2017; Lynch et al., 2016). Therefore, health education for physical activity is important for increased health competence after cancer (Hardcastle et al., 2017; Short et al., 2013). Our findings suggest that cancer survivors who get no MVPA may be a target for health education provided by health care professionals to increase LPA engagement.

In this study, there was a non-significant association between perceived susceptibility for cancer recurrence and LPA. Previous research examining this relationship for MVPA has been equivocal (Blaney, Lowe-Strong, Rankin-Watt, Campbell, & Gracey, 2013; Custers et al., 2014; Fisher, Beeken, Heinrich, Williams, & Wardle, 2016; Skaali et al., 2009). (Fisher et al., 2016) reported that colorectal cancer patients who were doing some or no physical activity reported higher levels of fear of recurrence, while those who met physical activity guidelines reported less fear of recurrence (Fisher et al., 2016). It is possible that the construct of perceived susceptibility for cancer recurrence is not equivalent to the construct of fear of recurrence, and survivors who are susceptible to cancer recurrence may not actually fear cancer recurrence. Therefore, after finding a non-significant association between perceived susceptibility to cancer recurrence and LPA in this study, more research is needed to further explore this relationship.

In addition to the advantage of the stratification by MVPA status, other advantages of this study include the relatively large sample size (Johnson, Trentham-Dietz, Koltyn, & Colbert, 2009; Van Roekel et al., 2015)and the inclusion of many cancer types (T. Smith et al., 2007). Additionally, this study contributed to the relatively small number of studies examining social cognitive predictors of LPA, independent from MVPA, among cancer survivors. Our findings

support previous literature suggesting that social cognitive variables may aid in predicting physical activity behavior, and knowledge gained through this study will aid in the development of interventions that specifically target improvement of LPA among cancer survivors (Coups et al., 2009). By using theoretical constructs to gain further understanding toward LPA, there is greater opportunity to further improve health outcomes in this population (Short et al., 2013).

Despite these advantages, there are limitations to be considered. The cross-sectional design of our study does not allow for causal inferences between hypothesized predictors and LPA. The data were self-reported which may predispose the study to self-presentation bias. The study sample consisted of survivors that were mostly female, elderly, non-Hispanic white, and highly educated which limits the generalizability to the entire cancer population (Coups et al., 2009). It may be beneficial for interventions to conduct similar studies that focus on rural populations, racial/ethnic minorities, low income, and young adult survivors (Miller et al., 2016). Although the Godin Leisure-Time Exercise Questionnaire is frequently used in oncology research (Amireault et al., 2015; D'Silva et al., 2017) survey questions were limited to leisure-time physical activity behavior, and so inferences regarding sedentary behavior, or other types of physical activity (e.g., occupational, household, activities of daily living, or transportation) are not possible. Additionally, future studies will benefit from measuring LPA, and using both self-report as well as accelerometry (Phillips et al., 2015).

Additionally, this was a secondary data analysis, which was limited by measure-selection. Future studies with the ability to design the survey to examine this research question should include cognitive and environmental measures that specifically relate to physical activity. For example, our measure of social support and unsupportive partners were not specific to physical activity. With the inclusion of physical activity-specific measures, we might expect a stronger

association between these constructs and physical activity in the future. Likewise, this study only included a few constructs of the social cognitive theory framework, and subsequent studies should include other social cognitive theory constructs such as self-efficacy, goal-setting, outcome expectations, and other environmental factors (social support, barriers, and facilitators) (Phillips & McAuley, 2013; Rogers et al., 2017; Stacey, James, Chapman, Courneya, & Lubans, 2015; Young, Plotnikoff, Collins, Callister, & Morgan, 2014). Self-efficacy (Phillips & McAuley, 2013; Rogers et al., 2017; Young et al., 2014) and goals (Stacey, James, Chapman, & Lubans, 2016) were the strongest and most consistent predictors of MVPA in previous literature, and may prove to be particularly powerful when applied to LPA. The roles of outcome expectations and social support are less conclusive in the MVPA literature (Rogers et al., 2017; Young et al., 2014) but may hold a stronger relationship with LPA. Additionally, because physical activity may be influenced by treatment-related fatigue, cancer-specific barriers must be carefully considered when planning interventions (Phillips & McAuley, 2013; Rogers et al., 2017). The complex interrelationships among social cognitive constructs, and potential mediating relationships among these constructs are also inconclusive within the cancer survivor population (Rogers et al., 2017; Stacey et al., 2016), indicating the need for longitudinal data and more advanced modeling to identify relevant facilitators, barriers, and intervention levers for LPA (Rogers et al., 2017; Young et al., 2014).

CONCLUSIONS

This study adds to the literature in several ways. First, there is little previous research examining LPA, and LPA in cancer survivors specifically, filling an important gap in the literature. Additionally, this study shows the importance of stratifying analyses by level of MVPA. Ultimately, this study informs future research aiming to uncover barriers and facilitators

of LPA among cancer survivors and the development of social cognitive interventions aiming to increase LPA in this population.

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Figure 1. Flow diagram of participants included in final analytic sample.

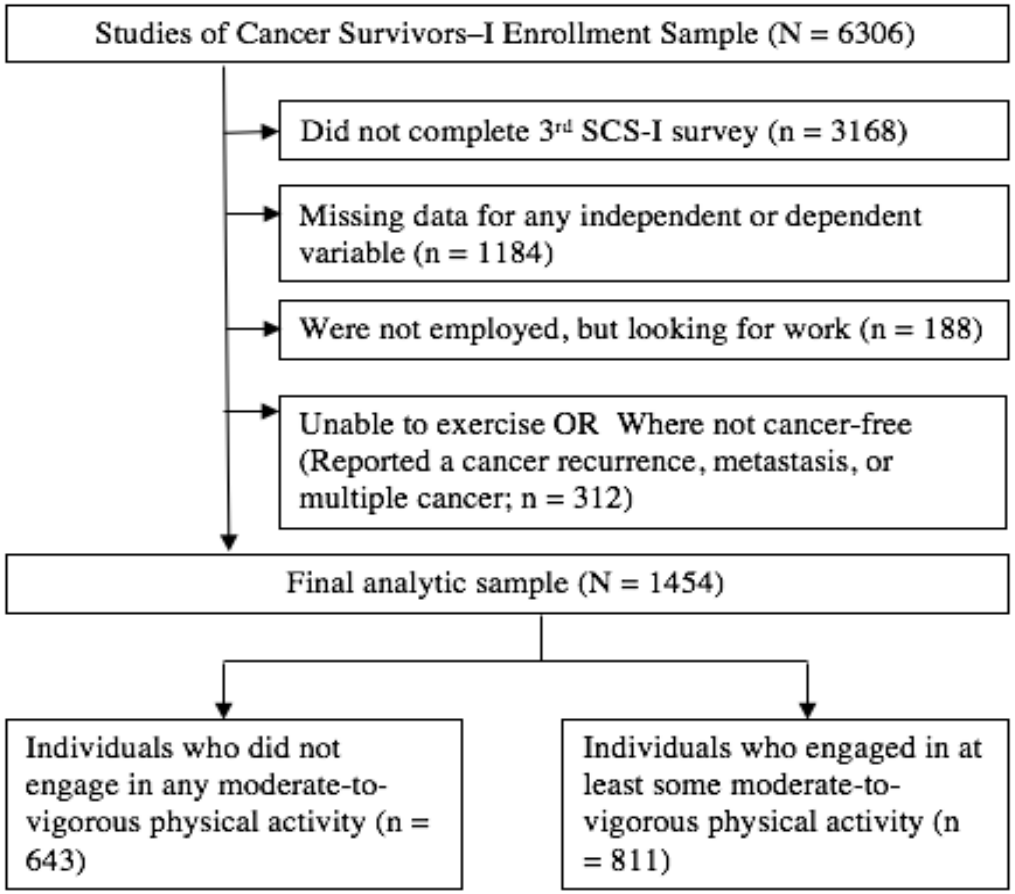

Table 1. Descriptive statistics for categorical variables by moderate-to-vigorous physical activity (MVPA) status.

Characteristic	Total Sample N = 1454 n (%)	No MVPA N = 643 n (%)	Some MVPA N = 811 n (%)	Chi-square
Sociodemographic Variables				
Female	877 (60.3)	401 (62.4)	476 (58.7)	X^2 (1) = 2.02, p=.160
Non-Hispanic White	1316 (90.5)	571 (88.8)	745 (91.9)	X^2 (1) = 3.91, p=.058
Education				X^2 (2) = 36.98, p<.001
≤HS education	423 (29.1)	236 (36.7)	187 (23.1)	
Some College	406 (27.9)	177 (27.5)	229 (28.2)	
College Graduate	625 (43.0)	230 (35.8)	395 (48.7)	
Employed	744 (51.2)	282 (43.9)	462 (57.0)	X^2 (1) = 24.67, p<.001
Married/cohabitating	1077 (74.1)	446 (69.4)	631 (77.8)	X^2 (1) = 13.31, p<.001
Cancer-Related Variables				
Cancer type by sex				X^2 (3) = 3.86, p=.277
Breast (female)	433 (29.8)	188 (29.2)	245 (30.2)	
Other (female)	444 (30.5)	213 (33.1)	231 (28.5)	
Prostate (male)	317 (21.8)	133 (20.7)	184 (22.7)	
Other (male)	260 (17.9)	109 (17.0)	151 (18.6)	
Cancer stage				X^2 (1) = 2.16, p=.146
In situ/Localized	1032 (71.0)	469 (72.9)	563 (69.4)	
Regional/Distant	422 (29.0)	174 (27.1)	248 (30.6)	
Other Health-Related Variables & Behaviors				
Physical health comorbidities				X^2 (1) = 74.85, p<.001
none	359 (24.7)	104 (16.2)	255 (31.4)	
1	422 (29.0)	164 (25.5)	258 (31.8)	

≥2	673 (46.3)	375 (58.3)	298 (36.7)	
≥1 Mental health comorbidities	358 (24.6)	172 (26.7)	186 (22.9)	X^2 (1) = 2.81, p=.098
Symptomatic of depression	189 (13.0)	105 (16.3)	84 (10.4)	X2 (1) = 11.31, p<.001
Body mass index category				X2 (2) = 19.03, p<.001
Underweight/healthy weight	413 (28.4)	167 (26.0)	246 (30.3)	
Overweight (BMI ≥ 25 to < 30)	533 (36.7)	212 (33.0)	321 (39.6)	
Obese (BMI ≥ 30)	508 (34.9)	264 (41.1)	244 (30.1)	
Meets ACS recs for FV intake/week	154 (10.6)	56 (8.7)	98 (12.1)	X2 (1) = 4.31, p=.040
Current smoker	131 (9.0)	72 (11.2)	59 (7.3)	X2 (1) = 6.73, p=.010
Meets ACS recs for alcohol use/day	1224 (84.2)	560 (87.1)	664 (81.9)	X2 (1) = 7.33, p=.007
Primary Predictors				
Support from primary care provider	1229 (84.5)	525 (81.6)	704 (86.8)	X2 (1) = 7.30, p=.008
Primary Outcome				
Light Physical Activity Category				X2 (3) = 94.43, p<.001
0 minutes per week	441 (30.3)	268 (41.7)	173 (21.3)	
1 to <60 minutes per week	226 (15.5)	109 (17.0)	117 (14.4)	
60 to <120 minutes per week	340 (23.4)	136 (21.2)	204 (25.2)	
120+ minutes per week	447 (30.7)	130 (20.2)	317 (39.1)	

Note: LPA = light physical activity; MVPA = moderate-to-vigorous physical activity

Table 2. Descriptive statistics for continuous variables by moderate-to-vigorous physical activity (MVPA) status.

Characteristic	Total Sample N = 1454 M (sd)	No MVPA N = 643 M (sd)	Some MVPA N = 811 M (sd)	ANOVA
Sociodemographic Variables Age (years)	64.79 (11.40)	67.50 (11.60)	62.70 (10.90)	F (1) = 66.88, p<.001
Cancer-Related Variables Time since cancer diagnosis (years)	8.87 (0.62)	8.90 (0.63)	8.90 (0.61)	F (1) = 1.58, p=.209
Other Health-Related Variables & Behaviors Body mass index	28.57 (6.10)	29.50 (6.90)	27.80 (5.30)	F (1) = 27.88, p<.001
MVPA (minutes/week)	103.55 (183.80)	0.00 (0.00)	185.65 (212.94)	--
Primary Predictors Partner unsupportive behaviors	8.66 (3.00)	8.60 (2.90)	8.70 (3.00)	F (1) = 0.17, p=.978
Perceived social support	5.61 (1.10)	5.60 (1.10)	5.70 (1.10)	F (1) = 2.63, p=.105
Perceived health competence	3.57 (0.61)	3.40 (0.57)	3.70 (0.60)	F (1) = 115.37, p<.001
Perceived susceptibility	8.05 (2.60)	8.10 (2.60)	8.00 (2.50)	F (1) = 1.37, p=.241
Primary Outcome LPA (minutes/week)	120.12 (226.20)	86.67 (188.81)	146.64 (248.87)	F (1) = 25.63, p<.001

Note: LPA = light physical activity; MVPA = moderate-to-vigorous physical activity

Table 3. Correlates of light physical activity (LPA) stratified by moderate-to-vigorous physical activity (MVPA) status.

Parameter	Model A: Total Sample N = 1454			Model B: No MVPA N = 643			Model C: Some MVPA N = 811		
	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Sociodemographic Variables									
Age	0.98	0.97, 0.99	.002	0.99	0.97, 1.01	.256	0.98	0.96, 0.99	.004
Non-Hispanic White (ref: Minority)	1.30	0.94, 1.81	.116	1.42	0.88, 2.30	.151	1.17	0.73, 1.87	.524
Education									
≤HS education	ref.	--	--	ref.	--	--	ref.	--	--
Some college	1.75	1.36, 2.26	<.001	2.26	1.55, 3.29	<.001	1.20	0.84, 1.73	.316
College graduate	1.37	1.08, 1.73	.009	1.88	1.32, 2.68	<.001	1.00	0.71, 1.39	.980
Employed (Ref: Unemployed)	0.72	0.56, 0.93	.011	0.62	0.41, 0.94	.023	0.77	0.55, 1.07	.119
Married/cohabitating (Ref: Not)	1.28	1.01, 1.61	.043	1.36	0.96, 1.93	.089	1.21	0.87, 1.68	.265
Cancer-Related Variables									
Time since diagnosis	0.98	0.84, 1.14	.763	1.02	0.80, 1.29	.895	0.98	0.79, 1.21	.828
Cancer-type by sex									
Breast (female)	ref.	--	--	ref.	--	--	ref.	--	--
Other (female)	1.02	0.80, 1.31	.846	0.98	0.67, 1.44	.934	1.01	0.72, 1.40	.972
Other (male)	1.28	0.96, 1.72	.096	1.00	0.63, 1.58	.984	1.48	0.99, 2.20	.055
Prostate (male)	1.17	0.88, 1.57	.275	1.14	0.73, 1.77	.558	1.21	0.82, 1.80	.333
Cancer stage									
In situ/Localized	ref.	--	--	ref.	--	--	ref.	--	--
Regional/Distant	1.06	0.85, 1.31	.604	0.97	0.70, 1.36	.873	1.09	0.82, 1.45	.548

Other Health-Related Variables and Behaviors									
Physical health comorbidities (ref: 0)									
1	1.08	0.83, 1.41	.557	1.50	0.93, 2.43	.098	0.93	0.67, 1.29	.672
>2	1.08	0.83, 1.41	.575	1.41	0.89, 2.24	.142	1.05	0.74, 1.49	.778
>1 Mental health comorbidities (ref: 0)	1.10	0.88, 1.39	.399	1.10	0.77, 1.56	.596	1.09	0.79, 1.50	.606
Symptomatic of depression (ref: Not)	1.08	0.80, 1.45	.625	0.97	0.63, 1.51	.904	1.32	0.85, 2.04	.221
BMI (ref: Underweight; healthy weight)									
Overweight (BMI >25 to <30)	1.29	1.01, 1.64	.041	1.00	0.68, 1.47	.979	1.40	1.02, 1.94	.039
Obese (BMI >30)	1.00	0.77, 1.30	.986	0.60	0.40, 0.89	.012	1.41	0.98, 2.02	.063
Meets recs for FV intake/week (ref: Not)	1.15	0.84, 1.58	.387	0.99	0.59, 1.68	.980	1.36	0.91, 2.05	.135
Current smoker (ref: Nonsmoker)	0.82	0.58, 1.15	.251	0.62	0.38, 1.01	.055	1.18	0.71, 1.96	.527
Meets recs for alcohol use/day (ref: Not)	0.92	0.70, 1.21	.575	1.03	0.66, 1.61	.907	0.85	0.60, 1.20	.354
MVPA (minutes per week)	1.00	1.00, 1.00	<.001	--	--	--	1.00	1.00, 1.00	.015
Primary Predictors									
Support from provider (ref: Disagree)	1.22	0.93, 1.59	.151	1.48	1.00, 2.19	.049	0.92	0.62, 1.35	.658
Partner unsupportive behaviors	1.01	0.98, 1.05	.417	1.06	1.01, 1.12	.024	0.98	0.93, 1.02	.324
Perceived social support	0.99	0.89, 1.09	.805	1.01	0.87, 1.17	.929	0.99	0.86, 1.13	.842
Perceived health competence	1.32	1.09, 1.59	.004	1.44	1.08, 1.93	.014	1.11	0.86, 1.44	.412
Perceived susceptibility	1.03	0.99, 1.07	.150	1.03	0.98, 1.10	.265	1.02	0.96, 1.07	.566

Note: LPA = light physical activity; MVPA = moderate-to-vigorous physical activity