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Barriers to Physical Activity and Healthy Diet among Breast Cancer Survivors: A Multilevel Perspective

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Abstract

Cancer survivors engage in suboptimal levels of health behaviours and report many barriers to health behaviours, but we lack a solid understanding of the different levels of barriers and how they relate to enacted health behaviours. To address these issues, we conducted mixed-method research in 97 breast cancer survivors. Participants' barriers to PA and healthy diet, asked as an open-ended question, were coded as *individual-level*, *social-level*, and *organizational/environmental-level* for each health behaviour. Moderate-to-vigorous PA and fruit and vegetable (F&V) intake were assessed. Most participants perceived at least one PA (72.7%) and diet (64.9%) individual-level barrier (e.g., physical symptoms/injury); only 15.2% (PA) and 15.6% (diet) reported at least one social-level barrier (e.g., family obligations). 28.8% (PA) and 29.9% (diet) perceived at least one organizational/environmental-level barrier (e.g., job demand, cost of F&V). Survivors perceiving individual-level dietary barriers consumed less F&V (−.65 servings/day) than those not perceiving dietary barriers at this level. Survivors perceiving social-level dietary barriers reported marginally lower F&V intake (−.65 servings/day) than their counterparts. Those perceiving organizational/environmental-level PA barriers reported marginally fewer minutes (−44.30/week) of moderate-to-vigorous PA than their counterparts. Barriers at multiple levels should be addressed to improve health behaviours among breast cancer survivors.

Keywords

health behaviour; cancer survivors; barriers; socio-ecological models; mixed-method research

Introduction

Despite the demonstrated associations between healthy lifestyle and decreased mortality among breast cancer survivors (Chlebowski et al., 2006; Ibrahim & Al-Homaidh, 2011), research has shown that many do not engage in enough physical activity or eat enough fruits

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Declaration of interest

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and vegetables (Blanchard, Courneya, & Stein, 2008; Bellizzi, Rowland, Jeffery, & McNeel, 2005). Also, breast cancer survivors tend to progressively gain weight after completing their treatments (Vance, Mourtzakis, McCargar, & Hanning, 2011). Generally, there is little evidence that cancer diagnosis and treatment impel survivors towards better health behaviours (Williams, Steptoe, & Wardle, 2013) indicating the urgent need for quality care for survivors to promote healthy lifestyles, including physical activity, healthy diet, and weight management.

Understanding barriers to health behaviours across multiple contexts

Socio-ecological models (Sallis, Owen, & Fisher, 2008; Stokols, 1996) contend that health behaviours are affected by factors at multiple levels of influence, including the individual, social, organizational, and community levels. This socio-ecological framework provides an important perspective for understanding survivors' health behaviours, given that factors at each level may hinder or facilitate their engagement in health behaviours. Thus, investigation of the existence of barriers at different levels and their correspondence with survivors' actual behaviours may be an essential step in understanding and promoting their health behaviours.

Many studies have shown that breast cancer survivors report a variety of barriers to health behaviours (Blaney, Lowe-Strong, Rankin-Watt, Campbell, & Gracey, 2013; Brunet, Taran, Burke, & Sabiston, 2013; Ottenbacher et al., 2011; Oyekanmi & Paxton, 2014; Ventura et al., 2013), but only a few have explicitly considered multiple levels of influence when investigating health behaviour barriers. For physical activity, FRESH START (Demark-Wahnefried et al., 2007), a mail-based lifestyle intervention that successfully enhanced survivors' physical activity and healthy diets, found that breast cancer survivors reported higher-level physical activity barriers (e.g., 'having responsibilities at home', 'no one to exercise with', and 'bad weather') along with individual-level barriers (e.g., 'lacking will power'; Ottenbacher et al., 2011). Likewise, two qualitative studies identified barriers to physical activity across multiple levels including individual (e.g., 'lack of motivation/will power'), social (e.g., 'low social support', 'fatigue'), and contextual/environmental levels (e.g., 'employment', 'lack of equipment/facilities', 'seasonal/bad weather') among breast cancer survivors (Brunet et al., 2013; Hefferon, Murphy, McLeod, Mutrie, & Campbell, 2013).

Far fewer studies have taken a multilevel perspective on barriers to healthy diet, but these few studies show that breast cancer survivors perceive diverse barriers to healthy diet across different levels. Although not specifically examining eating behaviours, one study of breast cancer survivors' weight loss intervention experience found that survivors reported family- and social-level barriers (e.g., 'lack of support and understanding from family members' and 'conflicting advice from health professionals'; Terranova et al., 2017). Another study found that contextual-level (e.g., 'special occasions and holidays') as well as individual-level (e.g., 'personal preference', 'the taste of high fat foods') barriers to healthy eating among breast cancer survivors (Ventura et al., 2013); however, other higher-level barriers (e.g., 'availability or accessibility of healthy foods', 'lack of support from family') were rarely identified as barriers to a healthy diet in the study.

Relationships between barriers to health behaviours and actual health behaviours in cancer survivors

Although survivors seem to perceive barriers to health behaviours across multiple levels, only a handful of studies have sought to examine whether the existence of barriers at a specific level influences survivors' actual health behaviours (Ottenbacher et al., 2011; Jones & Paxton, 2015; Oyekanmi & Paxton, 2014; the latter two studies used the same sample). For example, breast cancer survivors perceiving barriers at the social- or environmental-level (e.g., 'no one to exercise with', 'nowhere to do it'), as well as those at the individual-level (e.g., 'not sure what to do', 'don't want to get sore', 'no willpower') reported fewer minutes of self-reported physical activity (occupational and leisure physical activity/week) than did those who did not report these barriers (Ottenbacher et al., 2011). Also, besides 'lack of interest', 'lack of facilities/space' was associated with fewer minutes of self-reported physical activity (combined mild, moderate, and vigorous/week) among African American breast cancer survivors (Jones & Paxton, 2015). These results imply that not only individual- but also higher-level barriers should be considered when designing an intervention that aims to promote breast cancer survivors' physical activity.

We have very limited knowledge regarding the association between multiple levels of barriers and diet behaviours among breast cancer survivors. However, given that breast cancer survivors with higher barriers (a mean score across different levels of influence) to healthy eating reported higher BMI (Ventura et al., 2013), it is likely that barriers to healthy diet will be associated with actual eating behaviours.

The present study

This is a secondary analysis of an existing dataset (Park, Cho, Salner, & Dornelas, 2016), with the primary aim of exploring barriers to physical activity and healthy diet among breast cancer survivors from a multilevel perspective. Our secondary aim is to explore the association between perceived barriers at different levels and health behaviour engagement. To achieve these aims, we employed a mixed-method approach by combining qualitative and quantitative methods (Morgan, 1998; Sandelowski, 2000). Although the number and characterization of levels can vary, we categorized barriers to physical activity and healthy diet into three levels (individual, social, and organizational/environmental) based on previous studies (Ottenbacher et al., 2011; Ventura et al., 2013). We further investigated whether actual health behaviours differed regarding the presence of barriers at each level among breast cancer survivors. We expected that survivors would report multiple barriers across different levels. Also, we hypothesized that at each level, those who perceived barriers would report poorer health behaviours (i.e., lower consumption of fruits & vegetables, less physical activity) than those who did not perceive barriers.

Method

Participants and procedure

Participants were breast cancer survivors who participated in a mail-based lifestyle intervention, a randomized controlled trial, aiming at promoting physical activity and healthy diet. Detailed research design and procedure can be found elsewhere (Park et al.,

2016). Briefly, we recruited 173 breast cancer survivors living in the Northeastern US from 2011 to 2014. Eligible participants were a) women; b) first diagnosed with breast cancer in the past 1.5 years; and c) staged 0–II. Further, we included survivors able to read/write English, not participating in other health behaviour research, and without apparent serious mental disturbance (e.g., psychosis). The majority of participants (85%) were recruited through Hartford Hospital, comprehensive regional cancer center in the Northeastern US. The remaining participants were recruited several ways. First, they were recruited through ClinicalTrials.gov (4%), a website in which researchers publicly register their clinical studies, so that potential participants can contact researchers to take part in the research. Second, a small number of participants (3.5%) were recruited through another small regional cancer center in the Northeastern US (Eastern Connecticut Health Network). Third, we obtained mailing lists of randomly selected women in major cities in the research area aged 40–60 years from a direct mail marketing company and sent 1,400 invitations via postal mail (6.4% of our sample were recruited this way after ensuring eligibility). Finally, the remaining participants (1.2%) were those who saw our widely distributed research flyers posted throughout the community (e.g., in libraries, grocery stores) and directly contacted us.

After completing baseline demographics and health behaviours, participants were randomly assigned to one of three groups: 1) Targeting the Teachable Moment Intervention (TTMI; n=57), 2) Standardized Lifestyle Management (SLM; n=58), and 3) Usual Care (n=58). In the present study, we used data from the two intervention groups (n=115) because barriers to health behaviours were not assessed in usual care participants. Participants in TTMI and SLM received a mail-based program of biweekly treatment materials focused on cancer survivors' health behaviours for four months (i.e., a total of 8 mailings). Each mailing included a brief section that participants were asked to complete and return in a self-addressed, stamped envelope corresponding to that mailing's topic (experiential writing exercises) as well as their goals and goal progress in the past two weeks. Barriers to health behaviours were reported in the second mailing.

Informed consent was obtained from all individual participants included in the study. This research was approved by the Hartford Hospital and University of Connecticut IRBs.

Measures

Demographics and cancer-related variables at baseline—Age, race/ethnicity, level of education and household income, marital status, prior cancer diagnosis (*yes*/*no*), and weight and height to calculate body mass index (BMI) were assessed.

Barriers to health behaviours—At the second mailing (of the 8 mailings), participants were asked to respond to an open-ended question: *What barriers make it difficult for you to eat healthily? To get exercise?* The analytic approach to these responses is described below.

Physical activity—Physical activity was assessed with a widely-used, validated measure, the Paffenbarger Activity Questionnaire (PAQ; Paffenbarger, Wing, & Hyde, 1978) at baseline. The PAQ asked participants to report the number of flights of stairs they climbed and number of city blocks they walked, on average, each day in the past week. Also,

participants reported any sports, recreation, or physical activities in which they engaged and their frequency and length (minutes) during the past week. By multiplying frequency and length of moderate and vigorous physical activities, we computed weekly minutes of moderate-to-vigorous physical activity. For participants (n=52) who marked their answers on other items on the scale (i.e., number of flights of stairs and number of city blocks), but left blank the frequency and length of exercise questions on the PAQ, which were used to calculate moderate-to-vigorous physical activity, we imputed their moderate-to-vigorous physical activity as zero. All physical activity variables were positively skewed; thus, they were $\log_{10}$ transformed.

Fruits and vegetables intake—Daily servings of fruits and vegetables consumed were assessed and scored according to the US National Institute of Health fruit and vegetable screener (2000) at baseline. Participants reported their frequency (i.e., from never to 5 or more times per day) and amount (e.g., from less than ½ cup to more than 1 cup) of various kinds of fruit and vegetable intakes such as 100% juice, fruits, lettuce salad, vegetable soups, and so on over the last month. Because fruit and vegetable intake was positively skewed, it was $\log_{10}$ transformed.

Analytic strategies

We conducted mixed-method research by combining qualitative and quantitative methods. The analytic plan was twofold. First, qualitative analysis was conducted regarding barriers to health behaviours. Each response was thoroughly read several times and independently coded by two raters (first author and a trained research assistant) with respect to the existence of barriers at each level (individual, social, organizational/environmental) (*no=0; yes=1*) for each health behaviour (i.e., physical activity and healthy diet). Individual-level barriers included personal reasons such as lack of motivation and physical symptoms/injuries/fatigue. Unless participants specified the reason for time constraints, lack of time was categorized at the individual level; social-level barriers included those regarding interpersonal issues, such as social commitments and lack of support from household; organizational/environmental-level barriers were those other than individual- and social-level barriers, mainly related to organizational demands and built or natural environments including job demand/stressful job, cost of fruits and vegetables, and weather. If participants reported multiple barriers across different levels, they were coded 1 for each level (e.g., 1=individual-level, 1=social-level, 0=environmental/organizational-level). If participants' reported barriers were unclear regarding their level (e.g., 'I do not always cook'; 'Exercise just is not part of my routine because it is so easy not to do') or possibly related to more than one level (e.g., 'I do not get fresh veggies'), we coded them as *did not specify*. Kappa across barriers at each level was moderate to substantial (from .59 to .73) based on Landis and Koch's (1977) criteria of 0–.20 as no agreement; .21–.40 as fair; .41–.60 as moderate; .61–.80 as substantial; .81–1.00 as almost perfect agreement.

Second, we conducted quantitative analyses of these coded responses. A correlational analysis was used to examine whether demographics and cancer-related variables were associated (at p<.05 level) with health behaviours to examine covariates. Several demographic variables were associated with some health behaviours. For physical activity,

younger age (r=−.24, p=.009), having at least a bachelor's degree (r=.37, p<.001), higher household income (r=.33, p<.001), and lower BMI (r=−.34, p<.001) were related to higher minutes of moderate-to-vigorous physical activity/week. For dietary behaviour, higher income (r=.23, p=.017) and being married/cohabitating (r=.25, p=.008) were related to higher servings of fruit and vegetable intake/day. Thus, for physical activity, age (mean centered), education, household income, and BMI (mean centered) were controlled for in the analysis. For F&V intake, household income and marital status were controlled for in the analysis.

Then, a univariate Analysis of Covariance (ANCOVA) controlling these covariates was conducted to determine whether participants who perceived barriers (*yes*/*no*) at each specific level showed lower amounts of health behaviours than those who did not perceive barriers at that level. Note that participants reported their barriers two weeks after reporting their baseline health behaviours. However, given that participants received only one mailing before reporting the barriers, in addition to the short time gap, we assumed that barriers reported at two weeks would approximate those at baseline. We did not conduct analysis separately by TTMI and SLM group due to lack of sufficient sample size in each group and lack of differential intervention effects between the two groups (see Park et al., 2016). Missing data were listwise deleted. All analyses were conducted with SPSS 22.

Results

Participants' characteristics

Mean age of participants was 56.74 years (SD=10.80; range=34–86). The majority was White/Caucasian (95.7%), married or in a long-term partnered relationship (71.9%), and had at least a 4-year college degree (60.9%) and a household income ≥ $50,000 (80.0%) (see Table 1). Of the 115 participants, 97 (84%) responded to the open-ended question regarding barriers. The two intervention groups did not differ in baseline health behaviours. Further, there were no differences between participants who did not report any physical activity barriers and those who reported physical activity barriers in terms of demographics, BMI, intervention group, or prior diagnosis. However, participants who reported barriers to healthy diet were younger (M age=55.26 years, SD=9.37) than those who did not report barriers to healthy diet (M age=63.08 years, SD=13.48), t(22.98)=−2.44, p=.022.

Descriptive statistics for barriers to healthy behaviours across different levels

Table 2 shows specific barriers reported for each health behaviour at each level with their frequency and percentage. A majority of participants perceived at least one barrier to either physical activity (68.0%) or diet (79.4%). Also, most participants reported at least one barrier at the individual level: 72.7% for physical activity and 64.9% for healthy diet. Frequently perceived physical activity barriers at this level were physical injury/symptoms (n=22; e.g., fibromyalgia, broken ankle, knee pain, and fatigue) and lack of time (n=13) and motivation (n=10). For example, a participant clearly reported, *"Lack of time or motivation can make it difficult to exercise regularly"*. Another participant reported, *"Not enough time to do for ME! Motivation is low when there is time."* Likewise, commonly perceived dietary barriers were lack of time (n=41) and physical symptoms such as pain and fatigue (n=32).

Only 15.2% and 15.6% of participants reported at least one barrier to physical activity and healthy diet, respectively, at the social level (see Table 2). Perceived barriers at this level were similar for physical activity and healthy diet, including family obligations (n=5; e.g., *"It is hard to do when I am taking care of a household"*) and social commitments (n=4; e.g., *"Family obligations that include being away from home and a regular routine"*) for physical activity; social commitments (n=5; e.g., 'social events such as wedding', 'get invited out') and family obligations (n=4; 'very busy with kids') for healthy diet.

More than a quarter of participants reported at least one barrier to physical activity (28.8%) and healthy diet (29.9%) at the organizational/environmental level. Job demand/stress was the predominant barrier to both physical activity (n=15) and healthy diet (n=12). A participant reported, "*My job is very busy and stressful. I work long hours and have little time for exercise and food prep. I spend a good amount of my day on the road and have to eat in the car.*" The remaining barriers were infrequently reported, but there were health behaviour-specific barriers such as cost of fresh fruits and vegetables (e.g., "*Fresh veggies/ fruits are expensive*"; "*I found over the last 2 weeks that eating healthy is very expensive"*) and neighbourhood environments (e.g., 'hills in the neighborhood'; "*I do not live in an area where I can buy healthy food*").

Differences in health behaviours regarding the existence of barriers

Univariate ANCOVAs controlling for appropriate covariates (see Table 3) showed that participants perceiving individual-level barriers showed lower fruit and vegetable intake (−. 65 servings/day) than those not perceiving healthy diet barriers at this level, $F(1)=8.29$, $p=.005$. In addition, those perceiving social-level dietary barriers reported lower fruit and vegetable intake (−.66 servings/day) than their counterparts, which was significant at $p<.10$: $F(1)=2.91$, $p=.092$. Finally, participants perceiving physical activity barriers at the organizational/environmental level reported fewer minutes of moderate-to-vigorous physical activity (−44.30 minutes/week) than those not perceiving physical activity barriers at this level, which was marginally significant at $p<.10$: $F(1)=3.09$, $p=.082$.

Discussion

Based on socio-ecological models and empirical studies that support the notion of targeting barriers at multiple levels, the present study examined barriers to physical activity and healthy diet among breast cancer survivors at the individual, social, and organizational/ environmental levels. The majority of survivors reported the existence of at least one barrier (across all levels of influence) to physical activity (68.0%) and healthy diet (79.4%), and most survivors perceived at least one barrier to physical activity (72.7%) and healthy diet (64.9%) at the individual level.

Consistent with previous studies, physical injury/symptoms (e.g., pain, fatigue), lack of time, and motivation were the top three barriers to physical activity (Blaney et al., 2013; Brunet et al., 2013; Ottenbacher et al., 2011; Ventura et al., 2013), which were also those most commonly reported with regard to healthy diet. Especially because the present sample comprised survivors who had been recently diagnosed with breast cancer (in the past 1.5 years), the high percentage of physical injury/symptoms as barriers to health behaviours is

understandable. This result implies that lifestyle interventions should be carefully tailored to survivors' physical conditions. Health care providers might encourage survivors to begin by setting up an affordable and safe health behaviour goal based on their physical health status. Further, given recent research showing that survivors would welcome guidance from health care providers and that they are keenly interested in lifestyle information (Beeken, Williams, & Crocker, 2016), it might be helpful for health care providers to routinely provide resources (e.g., on- and off-line support groups listservs or Facebook groups in which survivors motivate and support each other, physical activity and healthy diet information booklets) to survivors at the time of discharge or at the end of their primary treatment as a standard of cancer care.

Although the percentage was smaller than that for individual-level barriers, nearly half of participants reported higher-level barriers to physical activity (44.0%) or healthy diet (45.5%) including those at the social- and organizational/environmental-levels. This result (especially regarding physical activity) is similar to those of previous studies in which approximately 20–40% of surveyed breast cancer survivors reported social/environmental-level barriers such as 'lack of facilities/spaces' and 'lack of company' as physical activity barriers (Blaney et al., 2013; Oyekanmi & Paxton, 2014). However, inconsistent with previous studies (Blaney et al., 2013; Ottenbacher et al., 2011), 'bad weather' was rarely identified as a physical activity barrier in the present study. Given the recruitment period (> 2 years), we assume that this result was not due to seasonal effects. Notably, the most frequently reported barriers at these levels were 'job demands/stress'. This finding suggests that interventions may need to include additional components for employed breast cancer survivors to help them with their time and stress management.

Despite the relatively small percentage of barriers reported at the social- and organizational/environmental levels, we highlight the importance of assessing barriers at multiple levels. Participants who perceived dietary barriers at the individual level reported lower fruit and vegetable intake (.65 servings/day) than did those who did not perceive dietary barriers at this level. Also, those who perceived dietary barriers at the social level reported a trend of consuming fewer fruits and vegetables (significant at $p<.10$) than their counterparts. These results suggest that barriers at both the individual and social levels should be seriously considered as factors influencing breast cancer survivors' actual dietary behaviours. In terms of physical activity, survivors who perceived barriers at the organizational/environmental level reported a trend of fewer minutes (approximately 44 minutes/week) of moderate-to-vigorous physical activity (significant at $p<.10$) than their counterparts. Given that many participants reported individual-level physical activity barriers, it is surprising that the perceived individual-level barriers did not relate to actual physical activity. This lack of association might be because the existence of individual-level barriers itself is not enough to hinder physical activity. Or, if they exist, higher-level barriers might have stronger effects on physical activity efforts than do individual-level barriers. For example, perhaps individual-level barriers are easier to problem-solve than are higher-level barriers. Thus, future studies developing lifestyle interventions for breast cancer survivors should consider addressing health behaviour barriers at multiple levels.

The percentage of higher-level barriers may be underestimated, given that participants were not prompted to think about barriers at multiple levels. If we had given a specific instruction asking participants to report barriers at each level or interviewed them, more reports of barriers at each level may have been given. Further, even though lack of time may result from different reasons across different levels (e.g., lack of time due to family obligations, work, etc.), many participants did not specify the reasons, and we thus categorized it as an individual-level barrier. This coding decision probably influenced the relatively lower percentage of higher-level barriers reported. Finally, the reported level of education and income in the present sample was high. Thus, our participants may be less likely to experience specific higher-level barriers such as the cost of fruits and vegetables and access to physical activity facilities than would survivors from relatively disadvantaged backgrounds.

This research has several limitations. We did not use a measure assessing barriers to health behaviours at multiple levels. Participants were not prompted to report barriers at multiple levels, and barriers were assessed binarily (i.e., yes or no). Self-report measures of health behaviours were another limitation. In addition, participants in this study were enrolled in a behaviour change intervention. Thus, they might be relatively motivated to change and thus less likely to experience barriers such as motivation than those who did not elect to enroll. Further, our analysis lacked statistical power, which may have contributed to the non-significant (or only marginally significant) results. Note that socio-ecological models distinguish the organizational level from the environmental level. Given only a small number of participants (<10) reported environmental-level barriers (especially regarding physical activity), we combined these two levels and analyzed them as the highest level in order to avoid misleading results. However, we do not mean to suggest that higher levels should be combined together. Separating these levels will inform which specific contexts should be prioritized and targeted for improvements. Finally, the majority of participants were White, with high education and income, recruited from a regional cancer center. Results could differ for non-White, lower education and income, and community participants.

Nevertheless, this study advances our understanding of barriers to healthy lifestyles in breast cancer survivors in ways that can be applied in future (multilevel) intervention development. To date, many health behaviour interventions for cancer survivors have been developed and their efficacy demonstrated (Demark-Wahnefried et al., 2015), but many of them are individual-focused and yield small effects. The present study supports an expanded focus that incorporates multiple levels of influence by assessing barriers across multiple levels. Future studies should more comprehensively and thoroughly investigate multilevel barriers to health behaviours, especially among diverse and underserved cancer populations (e.g., non-White, low income, low education).

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Table 1

Participant Characteristics

	Total(n=115)	Intervention Group		Difference
		TTMI (n=57)	SLM (n=58)	
Age (SD)	56.74(10.80)	55.73 (10.91)	57.74 (10.70)	$t(113)=1.0$
Race/Ethnicity n (%)				$\chi^2(4)=3.03$
White	110 (95.7)	54 (94.7)	56 (96.6)	
African American	2 (1.7)	1 (1.8)	1 (1.7)	
Hispanics	2 (1.7)	1 (1.8)	1 (1.7)	
Other	1 (.9)	1 (1.8)	0	
Marital status n (%)				χ^2 (1)=.09
Single/Divorced/separated/widowed	32 (28.1)	15 (26.8)	17 (29.3)	
Married/other long-term partnered relationship	82 (71.9)	41 (73.2)	41 (70.7)	
Education n (%)				$\chi^2(1)=.42$
Less than college degree	45 (39.1)	24 (42.1)	21 (36.2)	
At least college degree (BA/BS)	70 (60.9)	33 (57.9)	37 (63.8)	
Household income n (%)				$\chi^2(1)=.34$
< $50,000	22 (20.0)	9 (16.4)	13 (23.6)	
≥ $50,000	88 (80.0)	46 (83.6)	42 (76.4)	
Prior diagnosis				$\chi^2(1)=6.89^{**}$
No	89 (77.4)	50 (87.7)	39 (67.2)	
Yes	26 (22.6)	7 (12.3)	19 (32.8)	

Note. TTMI=Targeting the Teachable Moment Intervention; SLM=Standard Lifestyle Management. $^{**}p < .01$.

Table 2

Perceived Barriers to Physical Activity and Healthy Diet

Level	Barriers to Physical Activity	*n* (%)
	None	31 (32.0)
	Did not specify	2 (2.1)
Individual	Total[a] (yes)	48 (72.7)
	Physical injury and symptoms (e.g., broken arm and ankle, knee injury, pain, and fatigue)	22 (45.8)
	Lack of time	13 (27.1)
	Lack of motivation/self-control	10 (20.8)
	Old habits	3 (6.3)
	Laziness	2 (4.2)
	Don't like exercise	1 (2.1)
	Emotional problems (e.g., don't feel good)	1 (2.1)
Social	Total[a] (yes)	10 (15.2)
	Family obligations (e.g., taking care of kids; kids activities conflict with workout times)	5 (50.0)
	Social commitments (e.g., vacation, being away home, get invited out)	4 (40.0)
	Lack of help around the house	1 (10.0)
Organizational/Environmental	Total[a] (yes)	19 (28.8)
	Job demand/stress	15 (78.9)
	Special occasions changing in normal daily activity (e.g., moving, away on a trip)	3 (15.8)
	Weather	1 (5.3)
	Unfavorable neighborhood environment (e.g., driving to gym, hills in the neighbourhood)	1 (5.3)
	Transportation unavailability	1 (5.3)
Level	**Barriers to Healthy Diet**	***n* (%)**
	None was reported	20 (20.6)
	Did not specify	4 (4.1)
Individual	Total[a]	50 (64.9)
	Lack of time	41 (82.0)
	Physical symptoms (e.g., pain and fatigue)	32 (64.0)
	Lack of motivation	7 (14.0)
	Craving for certain foods (e.g., sweet, cream)	6 (12.0)
	Old habits	5 (10.0)
	Laziness	1 (2.0)
	Taste of F&V	1 (2.0)
Social	Total[a]	12 (15.6)
	Social commitments (e.g., vacation, invitation for eating out)	5 (41.7)
	Family obligations (e.g., taking care of kids)	4 (33.3)

Level	Barriers to Physical Activity	*n* (%)
	Lack of support (e.g., 'nobody in the house wants to eat more fruits and veggies and cut back on sweets')	3 (25.0)
Organizational/Environmental	Total[a]	23 (29.9)
	Stressful job/Job demands	12 (52.2)
	Cost of fresh F&V	5 (21.7)
	Availability at home and neighborhood (e.g., difficulties of buying healthy foods in the neighbourhood)	4 (17.4)
	Difficulty in control choosing healthy foods (e.g., portion size, choice of meals)	2 (8.7)
	Lack of transportation	1 (4.3)

Note. F&V=fruit and vegetable;

[a]Sum may exceed total, because a participant could report more than one barrier even within a specific level.

Table 3

Mean Differences in Health Behaviours with respect to the Presence of Barriers

Variable	Level of barriers		Mean difference(95% CIs)	*p*	*F* (1)
	Presence of barriers				
	No	Yes			
F&V intake (serving/day)	1.96(1.49)	1.49 (1.32)	−.49 (−1.19, .21)	.097	2.81†
MVPA (minutes/week)	162.00 (195.23)	90.84 (119.33)	−67.74(−128.95, −6.53)	.212	1.58
	Individual-level				
	No	Yes			
F&V intake (serving/day)	1.98 (1.35)	1.35 (1.31)	−.65 (−1.22, −.08)	.005	8.29**
MVPA (minutes/week)	140.48 (175.13)	84.43 (115.33)	−45.72(−103.68, 12.24)	.423	.65
	Social-level				
	No	Yes			
F&V intake (serving/day)	1.73 (1.40)	1.12 (.93)	−.66 (−1.50, .19)	.092	2.91†
MVPA (minutes/week)	115.03 (157.36)	97.50 (84.27)	−33.61(−126.01, 58.79)	.571	.32
	Organizational/Environmental-level				
	No	Yes			
F&V intake (serving/day)	1.54 (1.38)	1.97 (1.27)	.43 (−.26, 1.11)	.111	2.60
MVPA (minutes/week)	121.03 (156.02)	78.96 (123.92)	−44.30 (−110.15, 29.55)	.082	3.09†

Note. F&V = fruit and vegetable; MVPA=moderate-to-vigorous physical activity. For ease of interpretation, raw M and SD of F&V intake and MVPA are presented. However, P and F values are based on log10 transformed scores. For F&V intake, household income and marital status were controlled; for MVPA, age (centered), education, household income, and BMI (centered) were controlled.

$^{\dagger}p < .10$;

$^{*}p < .05$;

$^{**}p < .01$.