JOURNAL OF BEHAVIORAL HEALTH, 2018
VOL 7, NO. 3, PAGE 131–139
10.5455/jbh.20180207013410

ORIGINAL RESEARCH

Open Access

An exercise and sedentary break intervention on mood profile and dietary behavior in young adults: Pilot study

Hannah Dau, Paul D. Loprinzi
University of Mississippi, Oxford, MS

ABSTRACT

The purpose of this pilot intervention was to examine whether changes in physical activity (PA) and sedentary behavior influence mood profile and dietary behavior. Three intervention (exercise, sedentary break, and control) groups were evaluated over a 4-week period. The exercise intervention consisted of progressively increasing vigorous intensity PA over a 4-week period among an inactive population. The sedentary break group was asked not to exercise, but instead, refrain from prolonged sitting (<45 minutes at a time). The control group was asked to remain inactive over the 4-week period. Compared to the exercise group and sedentary break groups, hostility levels increased in the control group over time. Also, improved dietary behaviors were observed in both the exercise and sedentary break groups. The sedentary break group, in particular, improved their dietary score consistently over time, whereas the exercise group improved mostly from baseline to midpoint. These results suggest that participating in vigorous activity and breaking up time spent in sedentary behaviors may potentially have an influence on mood profile and dietary behaviors.

ARTICLE HISTORY

Received February 07, 2018
Accepted May 27, 2018
Published June 09, 2018

KEYWORDS

Behavior change; diet; exercise; hostility; mental health; mood; sedentary behavior

Background

Psychological distress is common among college students [1], and as such, identification of effective strategies to minimize this distress is critical. Encouragingly, experimental research demonstrates favorable effects of exercise on psychological outcomes [2], including depression and anger [3]. For example, in a 2016 meta-analysis, Schuch et al. [4] identified 25 randomized controlled trials comparing exercise *versus* control conditions. Overall, exercise had a large and significant effect on reducing depression symptoms among those with and without major depressive disorder. Previous work has suggested various mechanisms to help explain this effect, including exercise-related changes in psychological constructs (e.g., distraction hypothesis, in that exercise may reduce rumination of negative thoughts and stress via the necessary focus on the exercise stimulus and distress distraction via social interaction) as well as physiological alterations, such as changes in core body temperature (thermogenic effect), endorphins, and monoamines [5]. In addition to depression, emerging work suggests that certain forms of exercise (e.g., individual exercises *vs.* group combative exercise) can also help to reduce anger feelings [6]. Inverse correlations have also been observed between exercise and anger levels specifically among college students [7] and younger populations [8].

Additionally, emerging experimental work demonstrates that extended periods of sedentary behavior are associated with negative psychological outcomes [9,10]. Mechanisms of this effect are not clear, but may, in part, be a result of inactivity-related alterations in sleep quality, mood, and social parameters (e.g., distraction hypothesis) [9,10]. Recent work also demonstrates physiological changes from sedentary break interventions. Mailey et al. [11] conducted a randomized controlled trial comparing a short-break sedentary

Contact Paul D. Loprinzi pdloprin@olemiss.edu University of Mississippi, Oxford, MS.

intervention (1–2 minutes break from sitting every half-hour) to a long-break intervention (two 15-minutes breaks per workday). The short-break intervention was more effective in reducing sedentary time during the workday and was more effective in lowering total cholesterol, triglycerides, and fasting blood glucose. A recent meta-analysis also shows that when interventions incorporate a sedentary break component, the intervention is more likely to be effective in reducing sedentary time among adults [12]. To our knowledge, however, there are no experimental studies that have conducted a side-by-side comparison of an exercise *versus* sedentary-break intervention on psychological health. Such an investigation is warranted to provide information as to which behavior (sedentary or exercise) is more strongly associated with psychological health.

Theoretical evidence suggests that changing exercise behavior may help to foster changes in dietary behavior [13–15]. Mechanisms for this potential effect are likely multifold [16], including exercise-induced modulation of executive function [17]. That is, executive function is responsible for higher order cognition involved in goal setting and response inhibition [18,19]. To our knowledge, no experimental study has evaluated whether, indeed, changes in exercise behavior and sedentary behavior are associated with changes in dietary behavior. This has important implications in multi-behavior interventions as it may prove challenging to change multiple health behaviors concurrently.

To address the above gaps in the literature, and within an inactive young adult population, this pilot experiment evaluated the effects of increasing exercise behavior, reducing prolonged sitting, and a control group on changes in mood profile and changes in dietary behavior.

Methods

Study design and participants

A three-arm parallel group randomized control pilot intervention was employed. Participants were randomized into one of the three groups: 1) exercise intervention (N = 10); 2) sedentary break intervention (N = 10); or 3) control group (N = 9).

The recruitment process for the study included using a convenience sampling approach at the authors' university. In order to take part in the study, participants needed to fit the following criteria. They were required to be in the age range of 18–35 years, considered "ready" to participate in physical activity (PA) as determined by the PA readiness questionnaire [20], able to speak English, and provide written consent. Furthermore, as determined by the international PA questionnaire (IPAQ; short form), participants were only eligible for inclusion in this study if they self-reported engagement in <75 minutes/week of vigorous PA; this was employed as the exercise intervention involved engaging in jogging exercise. Notably, based on self-report, none of the enrolled participants indicated a diagnosis of depression, anxiety, or panic disorder. The study was approved by the authors' institutional review board and the participants provided written consent prior to participation.

Intervention groups

The intervention lasted 4 weeks, with assessments occurring at baseline, mid-point (2-weeks) and immediately post-intervention (4-week period). This shorter duration period (4-weeks) was chosen as other related interventions using a 4-week exercise intervention period have shown reductions in depression [21]. For the exercise intervention group, participants were instructed to gradually increase their structured exercise to 75 minutes/week by week 4, with their structured exercise (e.g., jogging) to occur on their own in an environment of their choosing. This was done by starting off with a 10 minute jog twice a week the first week, to a 10 minute jog three times a week the second week and so forth.

Unlike the exercise group, the sedentary break intervention group was not instructed to increase their moderate-to-vigorous PA (MVPA), but instead, was instructed to minimize prolonged sitting during the 4-week intervention period. They were told that after every 45 minutes during the day, they should get up and walk briefly for a few minutes. To maximize generalizability of this intervention, they were not given a device to remind them to get up and move every 45 minutes, but rather, at the beginning of the study, they were instructed to be mindful of the clock and do their best to adhere to the instructed protocol. At the mid-point and post-intervention assessments, those in the sedentary break group were asked the following four questions:

1) Implementing the sedentary break intervention (every 45 minutes) was relatively easy to do over the past 2 weeks.
2) Implementing the sedentary break intervention (every 45 minutes) was relatively easy to maintain over the past 2 weeks.

3) Implementing the sedentary break intervention (every 45 minutes) did not negatively affect my ability to accomplish my normal activities over the past 2 weeks.
4) Over the course of the past 2 weeks, the intervention did not negatively influence my ability to engage in social interactions.

For these four questions, response options ranged from 1 to 7, in the order of strongly disagree, disagree, somewhat disagree, neutral, somewhat agree, agree, and strongly agree.

Measurement of mood profile

Identical to previous work [2,22], the profile of moods states (POMS) questionnaire was used to evaluate mood profile, which was assessed at baseline, mid-point, and post-intervention. The *depression–dejection* (13 items) and *anger–hostility* (11 items) subscales were used for the present study.

The POMS survey has demonstrated adequate levels of internal consistency (α = 0.779–0.926), as well as criterion validity and construct validity [23]. In the present study, internal consistency, as measured by Cronbach's alpha (α), was 0.94, 0.87, and 0.88, respectively, for *depression–dejection* for the exercise, sedentary break, and control groups at baseline. For these respective groups for anger/hostility, Cronbach's alpha (α) at baseline was 0.81 for all the three groups.

Measurement of dietary behavior

Participants also completed an eight-item starting the conversation (STC) dietary questionnaire, which assesses food patterns (nutrient or fat intake) and has been used as a tailored approach for dietary counseling. This was assessed at baseline, mid-point, and post-intervention. An example item is, "In the past week, how many times did you eat fast food meals or snacks?" For each of the eight items, there are three response options, which varies based on the item. As an example, response options included "<1 time, 1–3 times, and 4+" for "How many times a week did you eat fast food meals or snacks?" For the item, "How many servings of fruits did you eat each day?" response options included "5+, 3–4, or 2 or less." Ultimately, the summed dietary score ranged from 8 to 24, with higher scores reflecting a better dietary behavior. Some items were reverse coded to reflect this, i.e., eating 5+ servings of fruits and vegetables constituted the same numerical score as eating fast food or snacks <1 time. Thus, a higher score (better score) is reflective of, for example, eating more fruits/vegetables and eating less fast food. The STC has demonstrated evidence of feasibility, validity, and sensitivity to change in dietary behavior [24].

Measurement of physical activity

At each of the three time points, PA was self-reported using the IPAQ short form. The IPAQ form asked participants about the time they spent being physically active in the last 7 days. For example, questions on the form include "How many days did you participate in vigorous PA over the last 7 days?" followed by "How much time did you usually spend on one of those days doing vigorous PAs?" Participants can report their answers in hours per day or minutes per day. Previous studies show the IPAQ to demonstrate some evidence of being reliable and valid [25].

In addition to the self-reported IPAQ short-form assessment, all participants were instructed to wear an ActiGraph GT3X accelerometer (ActiGraph Corporation, Pensacola, FL) during all waking hours over the 4-week assessment period. The monitor was affixed to an elastic belt and worn at the waist near the right iliac crest. Sedentary behavior was defined as activity counts per minute of 0–99 [26], with MVPA defined as counts per minute of 2,020 or greater [27]. The number of breaks in sedentary behavior was calculated as the number of times/day the individual transitioned from a sedentary bout to a non-sedentary bout. Non-wear time was defined as a string of 60 minutes of 0 counts with a 1–2 minute interruption interval [27]. Only days with at least 600 minutes of wear time was included in the analysis. Across the 4-week intervention period, the mean standard error (SE) wear time per day for the control, sedentary break, and exercise group, respectively, was 802.4 (44.7), 775.7 (19.1), and 766.0 minutes (29.4). Across these respective groups, the mean number of valid days for each 2-week period was 5.1 (0.6), 6.8 (1.3), and 7.7 (1.7).

Statistical analyses

All analyses were computed in SPSS (v. 12). To examine the effects of the different interventions on the outcome parameters, a repeated measures 3 (group) × 3 (time) analysis of variance (ANOVA) was employed. Condition (three-arm intervention groups) served as the between-subject variable and time (baseline, mid-point, and post-intervention) served as the within-subject variable. Results were unchanged when considering analysis of covariance (ANCOVA) analyses, including covariates such as

Table 1. Estimates [mean (SE)] in the study variables across the intervention periods.

	Baseline	Mid-intervention	Post-intervention
POMS depression			
Exercise intervention	14.5 (0.8)	14.0 (0.3)	13.7 (0.3)
Sedentary break intervention	16.6 (1.5)	15.9 (1.1)	16.2 (1.9)
Control group	16.4 (2.1)	16.6 (1.9)	16.6 (2.3)
POMS hostility			
Exercise intervention	11.3 (0.1)	12.6 (0.8)	11.8 (0.4)
Sedentary break intervention	12.0 (0.5)	11.6 (0.3)	12.9 (1.1)
Control group	12.3 (0.7)	12.2 (0.4)	15.3 (2.6)
Dietary behavior			
Exercise intervention	15.4 (1.2)	17.3 (0.7)	17.0 (0.6)
Sedentary break intervention	16.7 (0.8)	17.2 (0.8)	17.9 (0.4)
Control group	16.0 (0.7)	16.2 (0.6)	15.1 (0.9)

age and gender; that is, when adjusting for age and gender, the results were similar to the unadjusted models. Thus, only the results for the repeated measures ANOVA are reported herein. Statistical significance was established as $P < 0.05$.

Results

The mean age of the sample was 21.3 years (SE = 0.5); 75.8% were female; and 69% were non-Hispanic white. Mood profile and dietary behavior scores, across the three groups and three time points, are shown in Table 1. The accelerometer-determined estimates for the exercise, sedentary break, and control groups, respectively, are 37.5 (6.2), 25.2 (2.6), and 24.4 minute/day (4.1) (see Fig. 1). The mean number of sedentary breaks per day for the exercise, sedentary break, and control groups, respectively, was 20.8 (4.6), 24.8 (7.1), and 16.9 breaks/day (0.9) (see Fig. 2).

With regard to the main findings, the 3 × 3 repeated measures ANOVA was significant for anger/hostility ($F = 3.48$, $P = 0.04$, and partial-eta squared = 0.23) but not depression/dejection ($F = 0.19$, $P = 0.94$, and partial-eta squared = 0.01). For anger/hostility, as shown in Figure 3, the exercise

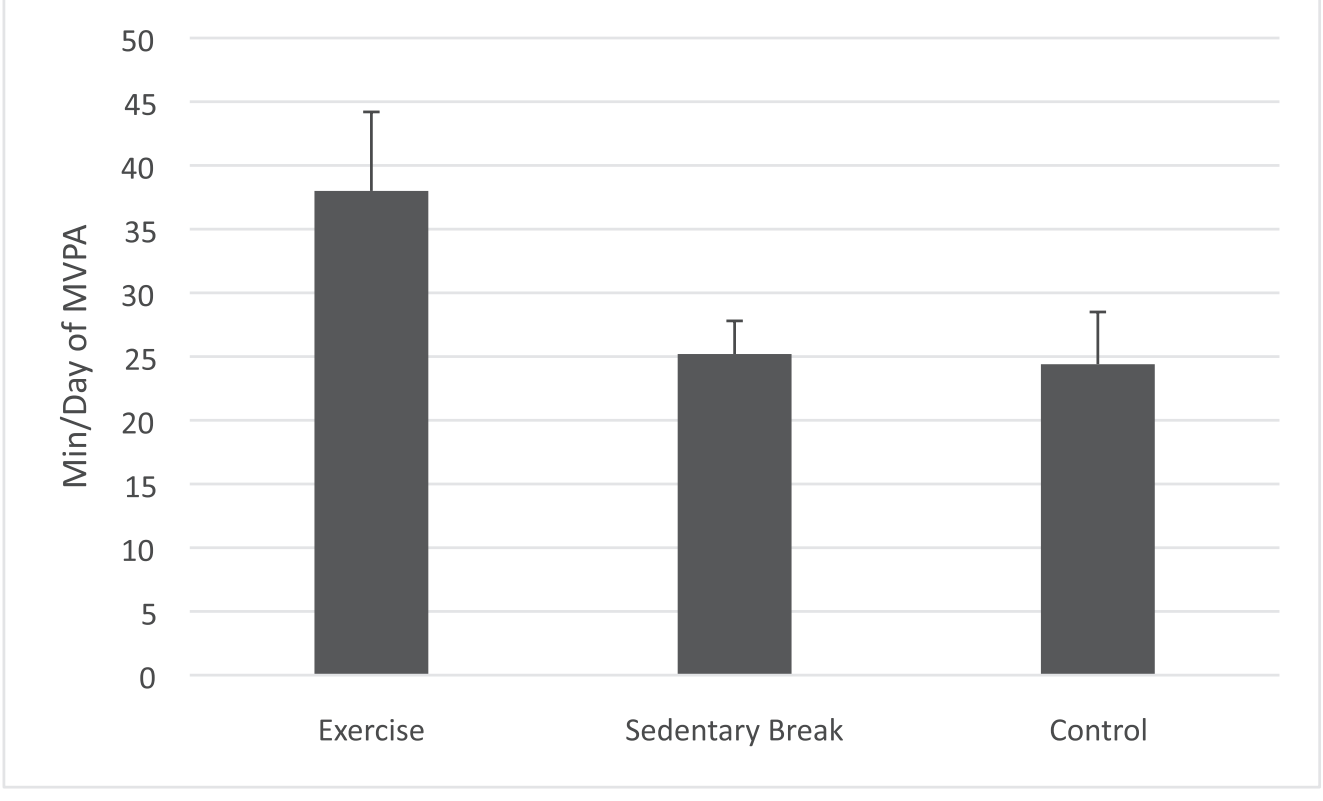

Figure 1. Four-week accelerometer-determined mean (SE) daily minutes of MVPA across the three intervention arms.

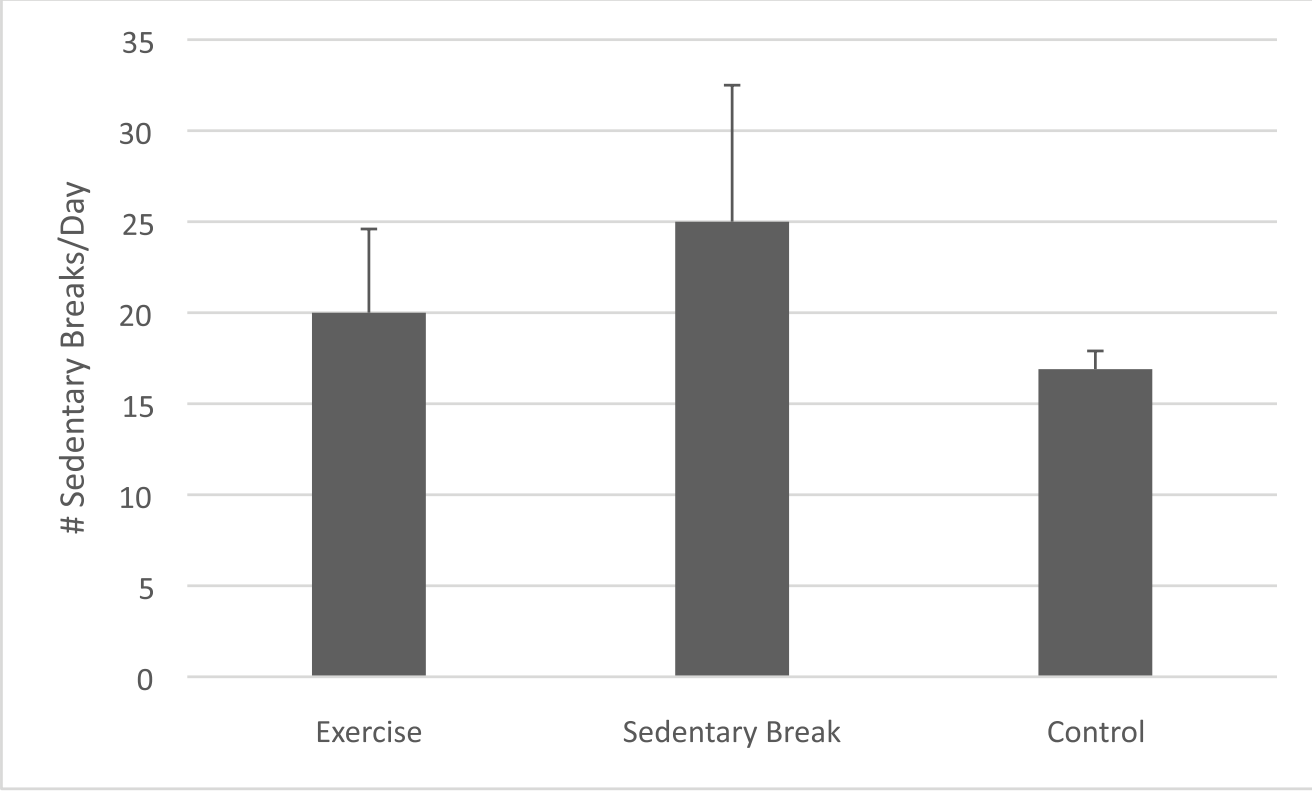

Figure 2. Over the 4-week intervention period, the mean (SE) number of accelerometer-determined daily sedentary breaks/day across the three intervention arms.

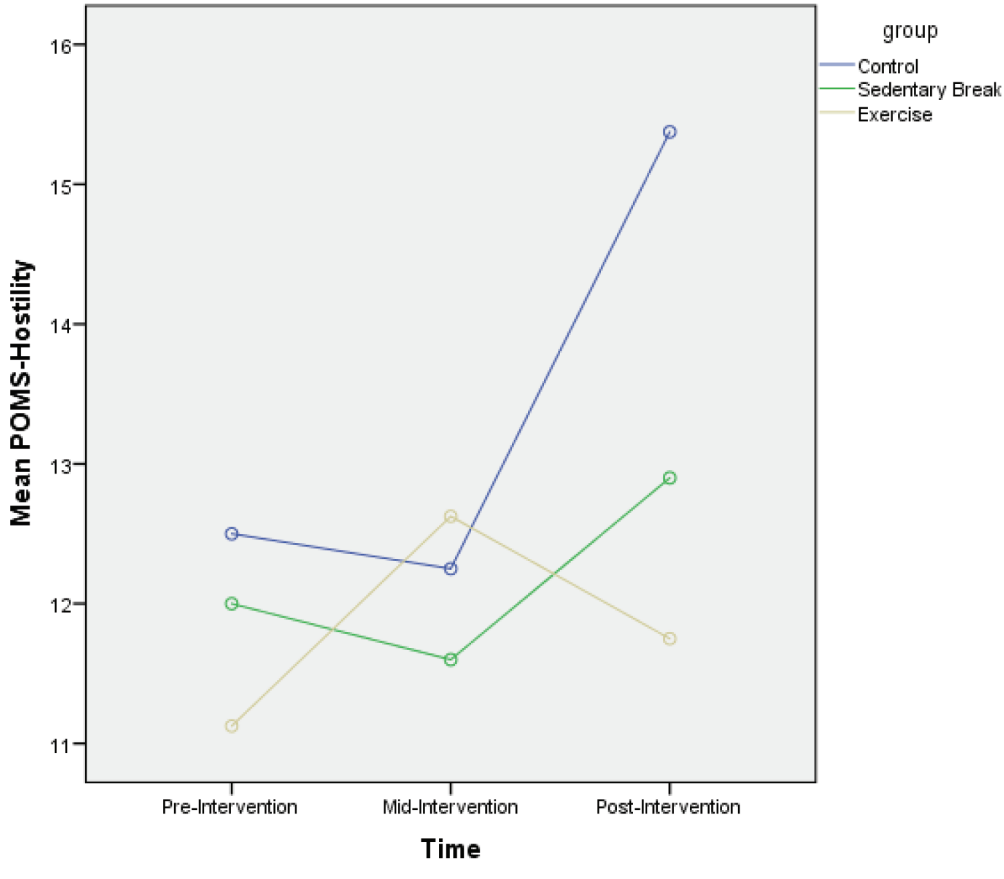

Figure 3. Mean POMS-hostility scores for the three groups across the three time points.

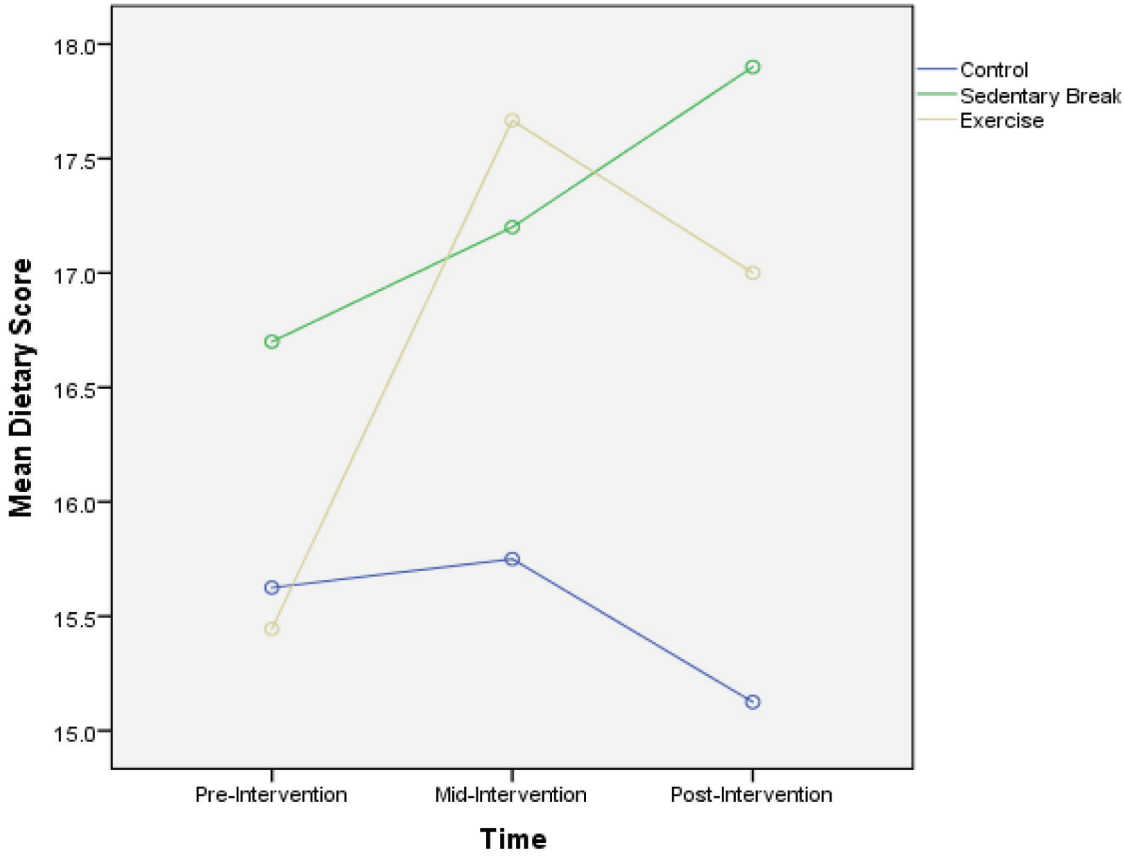

Figure 4. Mean dietary behavior scores (higher is better) for the three groups across the three time points.

group, compared to the sedentary break or control groups, had an attenuated increase in anger/hostility over the 4-week intervention. This is in contrast to the control group, which resulted in an increase in hostility over time.

The 3 × 3 repeated measures ANOVA was significant for dietary behavior (F = 3.44, P = 0.04, and partial eta-squared = 0.22). As shown in Figure 4, the exercise group and the sedentary break groups had an increase in dietary behavior over the 4-week intervention. An increase in the dietary behavior measure represents an improvement in dietary behavior (e.g., an increase in fruits/vegetables). This is in contrast to the control group, which showed a stable diet the first two time points, followed by a slight drop for the last time point.

With regard to the feasibility assessment of the sedentary break intervention, results are shown in Table 2. On a scale between 1 and 7, all group responses were between 4 and 7. For example, the sedentary break intervention group had an average score of 5.7 for their perception on how easy it was to implement the sedentary break intervention. A score of 5 indicates that they agree that this intervention was easy to implement. Overall, these findings demonstrate that the sedentary break intervention was perceived as fairly easy to comply with and that it did not negatively impact their daily activities.

Discussion

The purpose of this pilot experiment was to compare the effectiveness of an exercise intervention and a sedentary behavior break intervention on changes in mood profile and dietary behavior. The findings of this pilot study provide some suggestive evidence that mood profile and dietary behavior may be influenced by not only an exercise intervention but also a sedentary break intervention.

Our non-significant effects for the depression subscale may be a result of several factors. Our main speculation for this non-significant finding is due to the non-clinically diagnosed sample in the present study. If depressed individuals at baseline were included, it is possible that significant changes in this parameter may have been more likely to be observable (due to a greater room for change). However, though mood profile did not change as

Table 2. Feasibility assessment of the sedentary break intervention [mean (SE)].

Question	Mid-intervention score	Post-intervention score
Implementing the sedentary break intervention (every 45 minutes) was relatively easy to do over the past 2 weeks	5.77 (0.40); 5.7 equates to between "somewhat agree" and "agree."	5.77 (0.54); 5.7 equates to between "somewhat agree" and "agree."
Implementing the sedentary break intervention (every 45 minutes) was relatively easy to maintain over the past 2 weeks	4.22 (0.61); 4.2 equates to between "neutral" and "somewhat agree."	5.77 (0.54); 4.88 equates to between "neutral" and "somewhat agree."
Implementing the sedentary break intervention (every 45 minutes) did not negatively affect my ability to accomplish my normal activities over the past 2 weeks	6.22 (0.32); 6.2 equates to between "agree" and "strongly agree."	6.33 (0.16); 6.3 equates to between "agree" and "strongly agree."
Over the course of the past two weeks, the intervention did not negatively influence my ability to engage in social interactions	6.44 (0.24); 6.4 equates to between "agree" and "strongly agree."	6.33 (0.17); 6.3 equates to between "agree" and "strongly agree."

far as depression, our results did indicate that both the exercise and sedentary behavior break groups' behaviors had a more favorable effect on anger/hostility as compared with the control group. Additionally, anger and depression are conceptually different, as anger is an emotional state, whereas depression is considered a mental health disorder consisting of several symptom clusters. Our relatively short intervention period may not have been long enough to alter changes in the depression disorder. Furthermore, a more robust assessment of depression may have increased the likelihood of observing a statistically significant effect on this disorder.

In addition to changes to mood profile, positive changes in dietary behavior were also observed. Both the exercise and sedentary behavior break groups showed improvement in dietary behaviors compared with the control group. In fact, the sedentary behavior break group improved more consistently throughout the intervention than the exercise group. The sedentary behavior break group showed a linear relationship with dietary behaviors, as seen in Figure 4. That is, those who engaged in the sedentary break intervention had improved dietary behavior over the intervention period. Though the exercise group improved to a higher degree from the first visit to the last visit, their average scores at the mid-point were higher than scores at the end. We speculate that this may have been a result of a compensatory effect. Because participants in the exercise group may have felt "healthier" after exercising regularly for 2 weeks, they may have thought (either subconsciously or consciously) it was okay to eat something unhealthy as long as they were being active. This assertion is, of course, speculative. Another explanation, which is likely to be more plausible, is that this very slight drop during the final week is a result of individual differences within the sample. A future experiment employing a larger sample size will be useful in clarifying this potential dietary trajectory.

The link between the eating and exercise behaviors is critical in the study of health. As discussed previously [13], similar executive functions influence both eating habits and exercise. These neurocognitive underpinnings may help to explain the improved dietary behavior seen in the present study in the sedentary behavior break group, and especially the exercise group, as previous studies demonstrate exercise-induced changes in neurocognition [17].

Strengths of this study include the novel topic, experimental approach, assessment of multiple outcomes (mood and diet), utilization of an inactive population, inclusion of an objective measure of PA and sedentary behavior, and feasibility assessment of the sedentary break intervention. Limitations of this study include the relatively short intervention period, small sample size, limited generalizability, and use of a self-report measure of dietary behavior. Given these limitations, the results of this study should be interpreted cautiously. If anything, these pilot data suggest that future, larger scale, and more robust studies on this topic are needed to provide any conclusive evidence as to the potential effects of a sedentary break and exercise intervention on mood and dietary behavior.

In conclusion, in our pilot experimental study, we demonstrated some evidence to suggest that changes in exercise and minimizing prolonged sedentary behavior may potentially influence mood

profile and dietary behavior. We also provide some preliminary support for the feasibility of this sedentary break intervention. Future replicative work is needed to confirm our pilot findings. It would be useful for future work to consider adding in a fourth intervention arm that has individuals both exercise and minimize prolong sedentary behavior, given the beneficial effects of both of these behaviors. Additional work should also consider other psychological outcomes, such as anxiety, and evaluate whether any observed effects are moderated by weight status.

Acknowledgments

No funding was used to prepare this manuscript and no conflicts of interest are disclosed.

References

[1] Rosenthal BS, Schreiner AC. Prevalence of psychological symptoms among undergraduate students in an ethnically diverse urban public college. J Am Coll Health 2000; 49:12–8.

[2] Jaffery A, Edwards MK, Loprinzi PD. Randomized control intervention evaluating the effects of acute exercise on depression and mood profile: solomon experimental design. Mayo Clin Proc 2017; 92:480–1.

[3] Crush EA, Frith E, Loprinzi PD. Experimental effects of acute exercise duration and exercise recovery on mood state. J Affect Disord 2018; 229:282–7.

[4] Schuch FB, Vancampfort D, Richards J, Rosenbaum S, Ward PB, Stubbs B. Exercise as a treatment for depression: a meta-analysis adjusting for publication bias. J Psychiatr Res 2016; 77:42–51.

[5] Craft LL, Perna FM. The benefits of exercise for the clinically depressed. Prim Care Companion J Clin Psychiatry 2004; 6:104–11.

[6] Pels F, Kleinert J. Does exercise reduce aggressive feelings? An experiment examining the influence of movement type and social task conditions on testiness and anger reduction. Percept Mot Skills 2016; 122:971–87.

[7] Washburn CR, Pritchard ME, Book P, Clark C. Correlations between exercise and anger in college students. Percept Mot Skills 2007; 104:1310–2.

[8] Tkacz J, Young-Hyman D, Boyle CA, Davis CL. Aerobic exercise program reduces anger expression among overweight children. Pediatr Exerc Sci 2008; 20:390–401.

[9] Edwards MK, Loprinzi PD. Experimentally increasing sedentary behavior results in decreased life satisfaction. Health Promot Perspect 2017; 7:88–94.

[10] Edwards MK, Loprinzi PD. Effects of a sedentary behavior-inducing randomized controlled intervention on depression and mood profile in active young adults. Mayo Clin Proc 2016; 91:984–98.

[11] Mailey EL, Rosenkranz SK, Casey K, Swank A. Comparing the effects of two different break strategies on occupational sedentary behavior in a real world setting: a randomized trial. Prev Med Rep 2016; 4:423–8.

[12] Prince SA, Saunders TJ, Gresty K, Reid RD. A comparison of the effectiveness of physical activity and sedentary behaviour interventions in reducing sedentary time in adults: a systematic review and meta-analysis of controlled trials. Obes Rev 2014; 15:905–19.

[13] Joseph RJ, Alonso-Alonso M, Bond DS, Pascual-Leone A, Blackburn GL. The neurocognitive connection between physical activity and eating behaviour. Obes Rev 2011; 12:800–12.

[14] Oh H, Taylor AH. Self-regulating smoking and snacking through physical activity. Health Psychol 2014; 33:349–59.

[15] Oh H, Taylor AH. A brisk walk, compared with being sedentary, reduces attentional bias and chocolate cravings among regular chocolate eaters with different body mass. Appetite 2013; 71:144–9.

[16] Loprinzi PD, Wolfe CD, Walker JF. Exercise facilitates smoking cessation indirectly via improvements in smoking-specific self-efficacy: prospective cohort study among a national sample of young smokers. Prev Med 2015; 81:63–6.

[17] Loprinzi PD. Physical activity is the best buy in medicine, but perhaps for less obvious reasons. Prev Med 2015; 75:23–4.

[18] Loprinzi PD, Herod SM, Walker JF, Cardinal BJ, Mahoney SE, Kane C. Development of a conceptual model for smoking cessation: physical activity, neurocognition, and executive functioning. Res Q Exerc Sport 2015; 86:338–46.

[19] Edwards MK, Addoh O, Herod SM, Rhodes RE, Loprinzi PD. A conceptual neurocognitive affect-related model for the promotion of exercise among obese adults. Curr Obes Rep 2017; 6:86–92.

[20] Warburton DE, Bredin SD, Jamnik VK, Gledhill N. Validation of the PAR-Q+ and EPARMED-X+. Health Fit J Canada 2011; 4:38–46.

[21] Zarshenas S, Houshvar P, Tahmasebi A. The effect of short-term aerobic exercise on depression and body image in Iranian women. Depress Res Treat 2013; 2013:132684.

[22] Loprinzi PD, Kane CJ. Exercise and cognitive function: a randomized controlled trial examining acute exercise and free-living physical activity and sedentary effects. Mayo Clin Proc 2015; 90:450–60.

[23] Norcross JC, Guadagnoli E, Prochaska JO. Factor structure of the Profile of Mood States (POMS): two partial replications. J Clin Psychol 1984; 40:1270–7.

[24] Paxton AE, Strycker LA, Toobert DJ, Ammerman AS, Glasgow RE. Starting the conversation performance of a brief dietary assessment and intervention tool for health professionals. Am J Prev Med 2011; 40:67–71.

[25] Craig CL, Marshall AL, Sjostrom M, Bauman AE, Booth ML, Ainsworth BE, et al. International physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc 2003; 35:1381–95.
[26] Matthews CE, Chen KY, Freedson PS, Buchowski MS, Beech BM, Pate RR, et al. Amount of time spent in sedentary behaviors in the United States, 2003–2004. Am J Epidemiol 2008; 167:875–81.
[27] Troiano RP, Berrigan D, Dodd KW, Masse LC, Tilert T, McDowell M. Physical activity in the United States measured by accelerometer. Med Sci Sports Exerc 2008; 40:181–8.