

Effects of a Print-mediated Intervention on Physical Activity during Transition to the First Year of University

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Transition to the first year of university is linked to steep declines in moderate–vigorous physical activity (MVPA). The purpose of this study was to investigate the effects of a targeted, theory-driven, print-based intervention on MVPA during transition to university. Volunteer participants from five Canadian universities ($n = 255$) completed measures of MVPA at the start of their first semester at university and were randomly assigned to conditions receiving a first-year-student physical activity and action-planning brochure, Canada's Physical Activity Guide (CPAG), or a no-intervention control group. Six weeks later, a follow-up measure of MVPA was obtained as well as retrospective accounts of physical activity action-planning strategies and self-efficacy for scheduling physical activity. At the follow-up, students who received the targeted first-year student physical activity brochure reported significantly higher levels of MVPA compared to controls ($p < .05$) and a trend towards higher MVPA compared to the CPAG group ($p = .06$). However, there were no differences between groups on action planning or self-efficacy. A theory-driven and targeted print media intervention can offer low-cost and broad-reaching effects that may help students stay more active or curb declining levels of MVPA that occur during transition to university.

Moderate to vigorous intensity cardiovascular activity (MVPA) performed for at least 150 minutes per week is

linked to numerous positive health effects and is encouraged as a preventive measure for chronic diseases such as cancer and diabetes, treatment for conditions such as heart disease, and as an integral behavioral element in promoting better physical and mental health.^{1–5} Despite strong evidence supporting the health benefits of regular physical activity

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and many national and regional efforts to promote physical activity, the most recently available population data show disturbing trends of inactivity with fewer than half of the populations of Canada or the US engaging in levels of physical activity that are sufficient to achieve significant health benefits.^{6,7}

While the majority of North American adults are not physically active, data suggest that many adults were significantly more active as children and adolescents.^{8–20} For example, although not indicative of within-person change, cross-sectional data from large behavioral surveillance studies show children and youth are the most active segment of the population in North American and other industrialized nations, with evidence of a decelerating trend in the proportion of the population that is physically active with advancing age.^{1,6,8,10,18} This trend is not linear, however, as there is an accelerated decline in population physical activity that begins in early adolescence and levels off between ages 30–40.^{14,15} Evidence reflecting changes within persons over time is available from smaller-scale studies that have tracked physical activity from youth to young adulthood that also show significant declines in physical activity over time.^{9,11,12,13,17,19}

Several studies have noted the developmental and social transition from adolescence to young adulthood coincides with this period of rapid physical activity decline as well as other indicators of chronic disease and health risk behaviors (e.g., tobacco use, binge drinking, poor diet, risky sexual practices).^{21,22} One sub-population that has been the focus of numerous investigations of physical activity decline during this transitional period is first-year or freshman university students.^{23–28} Those studies have shown that young adults who attend university are far less active during their first year at university compared to the year prior, or months leading up to, their arrival at university. Other data indicate a continuing decline in physical activity levels as students progress from first year through to their later university years²⁹ and the stabilization or further decline in physical activity patterns following graduation (i.e., inactivity persists).³⁰ Collectively, this evidence suggests that the transition to first year university may be a critical window in which to initiate intervention efforts to promote physical activity, or curb physical activity decline, in a large segment of the young adult population that appears highly vulnerable to these effects.

Efforts to understand why the decline in physical activity occurs during first year university have uncovered numerous barriers to physical activity experienced by students. For example, Gyurcsik et al.²⁶ found that students reported school course-load demands, studying, and not feeling motivated to be active were common barriers that frequently interfered with being physically active during their first semester at university. When compared to high school students, first year university students have also reported experiencing a greater number and variety of barriers to being physically active.³¹

Building on descriptive evidence identifying physical activity barriers experienced by first year university students

and applying a social cognitive perspective that has shown strong validity in the physical activity domain, Bray²³ investigated student's self-efficacy for managing or coping with barriers they were likely to experience during first year university. That study showed students who reported greater confidence in their abilities to overcome barriers such as having little time to exercise, high coursework demands, and feeling tired when the first semester began were more active during their first year at university compared to students who reported lower levels of self-efficacy at the start of the first semester. In further efforts to understand potential psychosocial predictors of physical activity during transition to university Kwan and Bray²⁷ investigated students' perceptions about physical activity using the theory of planned behavior. In that study, students' attitudes and perceived control toward being physically active at the start of their first semester were positively associated with their intentions to be physically active during the semester. When their activity levels were assessed later in the semester, students who had reported stronger intentions to be physically active and greater perceived control were more likely to be active; however, it was also evident that the students who were active had also been more active prior to coming to university. Considered together, these initial findings are in alignment with larger bodies of literature showing social cognitions such as self-efficacy, perceived control and intentions are moderate to strong predictors of physical activity behavior.^{32–34}

As noted earlier, the period of transition to university may offer a distinct window of opportunity for intervention efforts to assist students and curb the decline that might otherwise be expected in their physical activity levels. The present study represents an evaluation of an attempt to alter the decline in physical activity that is typically seen in first year university by providing first year students with a targeted, theory-driven print-based resource intervention. Specifically, drawing from past work examining social cognitive predictors of physical activity during first year university^{23,27} and intervention research on physical activity action planning,^{35,36} we developed and provided students with an interactive physical activity brochure designed to reinforce positive self-perceptions about physical activity and stimulate behavioral plans for staying active during the first semester of their transition to university. As noted above, evidence indicates that many first year students are physically active prior to university. Accordingly, the self-perception content of the brochure was based on suggestions by Rothman and colleagues^{37,38} who argue that perceptions underlying the maintenance of health behaviors differ in form and function than those that determine adoption of new health behaviors.

Print-based mediated interventions have several positive features including: low cost, rapid dispersion, and reuse/reference potential and have shown positive effects on physical activity in several studies.^{39–41} As described in greater detail below, the intervention consisted of a two-page brochure that provided prescriptive information on

appropriate doses and modes of physical activity for young adult students and was designed to target students' self-perceptions regarding physical activity by stimulating greater self-efficacy to be physically active as well as positive outcome expectations towards maintaining or increasing their physical activity levels. It also included an interactive exercise that prompted students to plan and implement a physical activity action plan for one week and offered a 28-day calendar to allow further planning of their activities for the forthcoming month as well. The effect of the first-year student physical activity and action planning brochure was compared to a control condition that did not receive a printed intervention as well as a group that received a copy of Canada's Physical Activity Guide (CPAG).⁴² The CPAG is also a brochure about physical activity; but designed for a broader adult demographic (ages 18–55) and is more comprehensive in its focus on increasing cardiovascular, resistance and range of motion activities as well as decreasing sedentary activities.⁴³

It was hypothesized that students in the group that received the first year student brochure would exhibit higher levels of physical activity during a six-week intervention follow-up period during their first semester at university compared to the other two conditions. We also predicted the group that received the targeted first-year-student brochure would report greater self-efficacy for physical activity as well as more elaborate action planning activities compared to the other groups.

METHOD

Participants

Participant flow through the study is detailed in Figure 1. Baseline data were obtained from 1526 potential participants from five Canadian universities during the initial recruitment

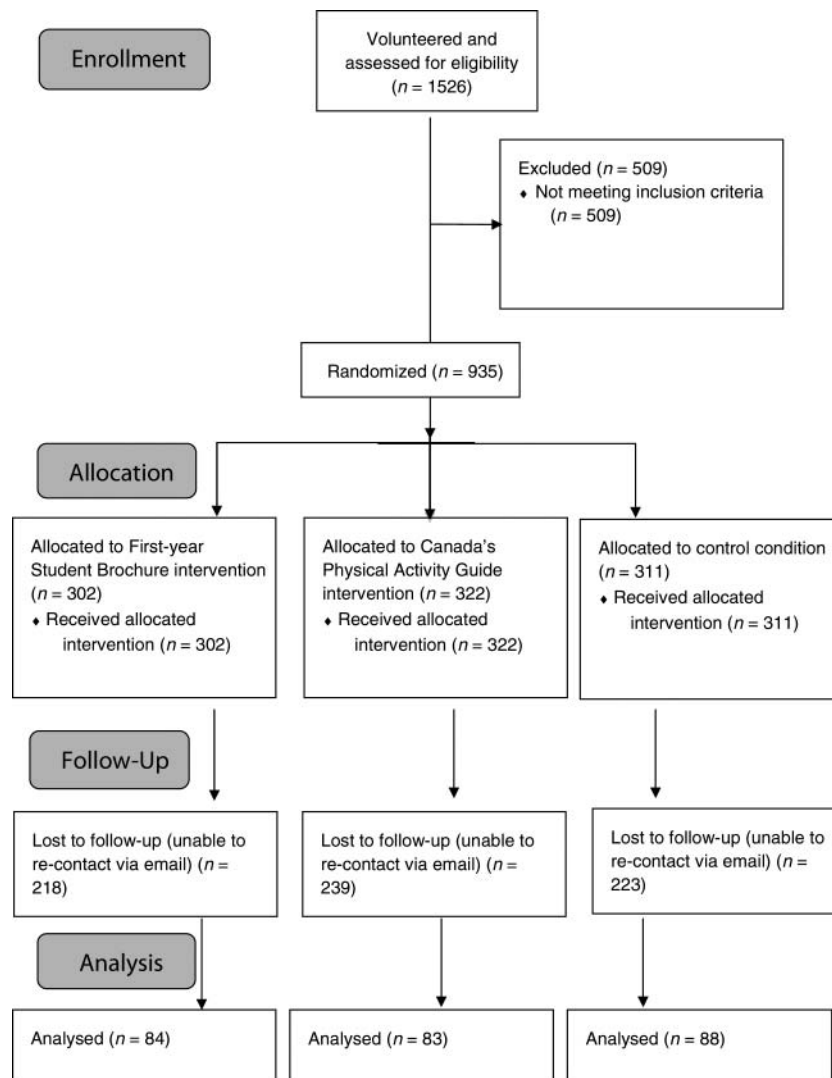


FIGURE 1 Flow of participants through study.

phase of the study. Of these, 591 were excluded because they were not registered as a first-year university student (i.e., were upper year students), had graduated from high school more than one year prior to the study, or were not living in on-campus housing residence. Prior research has shown that university transition experiences differ for first year students living in residence compared to living off-campus.^{44–46} Thus, 935 participants were randomly assigned to one of the three study conditions. Follow-up data were available for 27 percent of the original sample ($n = 255$). Thus, two hundred and fifty-five first-year students ($n = 155$ women) voluntarily participated in this prospective study. The final study sample was generally reflective of the original participant pool, with similar gender proportionalities (58%–60% women) and study adherers not differing from dropouts in terms of age, coursework time commitments (hours of class per week), pre-transition MVPA levels, or intentions towards physical activity at baseline (MANOVA; Wilks' $\lambda = .998$), $F(4, 919) = 0.31$, $p = .96$, $\eta^2 < .01$. Inclusion criteria limited participants to students who were living in on-campus residence and who had entered university in the autumn following high school graduation the previous summer.

Measures

Moderate–Vigorous Physical Activity. We utilized the moderate and vigorous activity sections of the 2003 Behavior Risk Factor Surveillance System (BRFSS)⁴⁷ interview schedule to assess moderate and vigorous physical activity. Participants reported the *average number of sessions* of moderate and vigorous physical activity engaged in per week as well as the *average duration* of each moderate and vigorous activity session in response to the following questions:

1. In a usual week, how many DAYS do you do vigorous activities (such as running, aerobics, hockey, squash) for at least 10 minutes at a time that cause large increases in breathing or heart rate?
2. On days that you do vigorous activities for at least 10 minutes at a time, how much total time per day do you spend doing these activities?
3. In a usual week, how many DAYS do you do moderate intensity activities (such as brisk walking, bicycling, easy swimming, volleyball) for at least 10 minutes at a time that cause moderate increases in breathing or heart rate?
4. On days that you do moderate activities for at least 10 minutes at a time, how much total time per day do you spend doing these activities?

For the *pre-transition* measure, they completed the measure by indicating the average number of days per week they performed moderate-intensity activities and vigorous-intensity activities and for how long, on average, they performed the activities on those days with specific reference to

the 8-months prior to coming to university. For example, a student might have engaged in vigorous-intensity activities on an average of 2 days per week for 40 minutes on each occasion and moderate-intensity activities on 3 days per week for 20 minutes on each occasion. A total score representing moderate–vigorous activity was computed by adding the products of the average weekly frequency and duration for each of the moderate and vigorous intensity activities. In the example above, the total score for moderate–vigorous activity would be 140 minutes. For the *first semester* follow-up activity measure, students completed an identical set of BRFSS questions with specific reference to the previous 6 weeks.

Physical activity intentions. Consistent with recommendations for assessing physical activity intentions,^{48–50} three questions were used to measure respondents' intentions to engage in 30 or more minutes of physical activity 4 or more days per week over the six weeks comprising the intervention follow-up period. The wording of the individual items was: (1) "I intend to engage in ≥ 30 minutes of moderate or vigorous activity 4 or more times per week," (2) I will try to engage in ≥ 30 minutes of moderate or vigorous activity 4 or more times per week," and (3) My intention is to engage in ≥ 30 minutes of moderate or vigorous activity on ---- days per week. The first two items were assessed using a 7-point Likert scale anchored by 1 = *completely agree* and 7 = *completely disagree*. The third item was scored as the frequency indicated in the space provided to indicate how often participants intended to engage in activity. The three items were averaged to form an internally-consistent scale (Cronbach $\alpha = .89$).

MVPA action planning. To gain a sense of the amount of action planning participants engaged in during the 6-week intervention follow-up period, they completed a scale taken from a previous study by Scholz and colleagues³⁶ consisting of four questions. The questions were prefaced with the statement: Over the past six weeks, I made detailed plans about. . . (a) what types of activities I was going to do, (b) where I was going to do activities, (c) when I was going to do activities, and (d) how long I was going to do activities for. Each item was rated on a 6-point Likert-type scale anchored at 1 = strongly disagree to 6 = strongly agree. The items were averaged and formed an internally consistent scale (Cronbach $\alpha = .95$).

Exercise scheduling self-efficacy. This measure was adapted from a scheduling self-efficacy measure that has been employed in previous research.^{51,52} The original measure was developed for the context of structured exercise classes (e.g., aerobics), therefore, the items referring to exercise classes were dropped from the scale, which left 5 items reflecting participants' confidence in their abilities to regularly complete planning behaviors to schedule physical

activities during the subsequent six weeks. Participants indicated their confidence in their abilities to: come up with a strategy for doing moderate or vigorous physical activity each week, organize time and responsibilities to fit in moderate or vigorous physical activities, arrange a schedule to do moderate or vigorous physical activity no matter what comes up, make a plan of action to doing moderate or vigorous physical activity each week, maintain a definite plan to restart or rearrange my schedule if I should miss any planned session of moderate or vigorous physical activity. For each item, participants rated their confidence on an 11-point, 0 (not at all confident) to 10 (completely confident) scale that showed good internal consistency (Cronbach $\alpha = .95$).

Intervention manipulation check. The follow-up survey also included three questions to serve as checks that participants who were given the first year student brochure or the CPAG recalled the intervention. The first was a yes/no question that inquired whether the student recalled receiving a brochure about physical activity at the start of the study. The second question asked whether students had read through the brochure material completely, which was answered using a 7-point Likert-type scale ranging from 1 = strongly disagree to 7 = strongly agree. The third question was a yes/no question that inquired whether the student had saved the brochure.

Materials

First-year student physical activity and action planning brochure. The two-page (folded 11" \times 17" double-sided) student activity brochure was intended to provide basic information on exercise prescription for young adults along with strategies to facilitate self-perceptions and motivation to be physically active, and was drawn from social cognitive theory. Specifically, the brochure provided information that healthcare practitioners and scientists recommend young adults accumulate 30–60 minutes of physical activity each day of the week. Specific examples of activities that corresponded to vigorous (e.g., basketball, aerobics, ultimate Frisbee), moderate (e.g., brisk walking, bicycling, skating, rollerblading), and light (e.g., walking, bowling, golf) intensities were outlined. Self-efficacy for making lifestyle adaptations incorporating physical activity while at home, at university, and for active transportation to, from, and around campus was targeted by providing guided mastery in the form of specific strategies to incorporate physical activity into common student routines. Suggestions such as: trying to establish a regular morning or evening routine of exercise such as taking a light jog while at home or at the dorm; taking a brisk walk between classes to explore campus and talk to new people; walking across campus to the furthest café to get a morning coffee; and getting off the bus a few blocks prior to one's intended stop in order to have a walk, were presented. The brochure also included a section focused on outcome expectations aimed to appeal specifically

to young adults. Following suggestions from Williams and colleagues,⁵³ this section targeted a variety of outcome expectations including: health (reduced chronic disease risk) as well as affective (mood enhancement, stress reduction), and appearance-related (weight and social impression management) outcomes linked to physical activity. In order to help capture the attention and imagination of the students, the brochure was printed in bright colors with the backdrop of a concert stage, and accentuated with graphic depictions of young adult characters playing Frisbee, mountain biking, and rollerblading, as well as walking and jogging outdoors, and taking part in an aerobics exercise class.

The first-year student brochure also included an interactive action planning exercise in which students were instructed to plan one week of physical activities specifying what activities they would do, where they would do them, when they would do them, and how long they would do them for. Students were provided with a model example of a completed one-week action plan and encouraged to complete the one-week planning exercise themselves. They were also prompted to recognize and use the reverse side of the page that offered a detachable one-month calendar upon which they could extend the action planning exercise.

CPAG. Information describing the extensive scientific basis underlying the content and delivery of the CPAG is summarized in considerable detail elsewhere.⁴³ In brief, the CPAG consists of a single-page (8.5" \times 11") double-sided color-printed brochure containing informative and engaging text and cartoon depictions of young and middle-age adult characters engaging in physical activities such as cutting grass, riding bicycles, stretching, practicing martial arts, performing calisthenics, lifting weights, wheeling a wheelchair, walking and cross-country skiing. The CPAG provides exercise prescription information pertaining to aerobic, resistance and range of motion exercises as well as general information about health benefits of physical activity. According to the Public Health Agency of Canada⁵⁴: "The Guide provides a rainbow of physical activities that can help you have more energy, move more easily, and get stronger. It tells you how much activity you should strive for and how to get started. It also lists the many benefits of physical activity and the health risks of inactivity."

Procedures

At the start of the autumn semester during September 2007, undergraduate students were invited to take part in this randomized field trial, which was promoted during introductory classes or at study recruitment booths set up at on-campus housing facilities at five Canadian universities in the Provinces of Nova Scotia, Ontario, Alberta, and British Columbia. Participants completed an informed-consent package and questionnaires assessing demographic characteristics as well as baseline measures of their

physical activity histories (past 8 months MVPA) and exercise intentions.

Following questionnaire completion, participants were provided with one of the following: First-year student physical activity and action planning brochure; CPAG; or no intervention. At three of the five sites, where participants were recruited from introductory classes or dormitory residence cafeterias, dispersal of the intervention materials involved serial allocation to each study condition based on order of completing the baseline survey. At two sites, where first-year students were recruited from separate dormitories, cluster randomization was used and students were assigned to study conditions and received materials based on which dormitory they resided in. These procedures resulted in roughly equal distribution of the sample across the three conditions, with 32%, 35%, and 33% receiving the first-year brochure, CPAG, and no intervention, respectively.

Follow-up measures were obtained using an internet-based survey protocol six weeks later. Students were sent an email message which contained a link to a secure website where they completed and submitted a brief survey consisting of the manipulation check items, BRFSS MVPA questions, the action planning measure, as well as the scheduling self-efficacy scale. The study was approved by an institutional research ethics review panel at each university and all participants provided informed consent prior to completion of the baseline survey. Participants were given a healthy snack (granola bar) as a token of appreciation for their participation in the study at the baseline data collection and were entered in a draw for a prize (iPod) contingent upon their completion of the follow-up survey.

RESULTS

Demographic characteristics of the overall sample, segmented by study condition are presented in Table 1. As

these data show, the randomization procedure resulted in similar proportions of young men and women in each study condition. Differences in mean values for age and coursework time commitments (hours of class per week), as well as pre-transition MVPA levels and intentions towards MVPA during the six-week follow-up period were examined using MANOVA and found to be equivalent across the study conditions (Wilks' $\lambda = .99$), $F(8, 498) = .40$, $p = .81$, $\eta^2 < .01$. Responses to the manipulation check items revealed 92% and 88% of students recalled getting the first year student brochure and CPAG, respectively. On average, students who received the first year student brochure and the CPAG reported they had read through the materials (first year brochure: $M = 4.20 \pm 1.92$; CPAG: $M = 4.46 \pm 1.96$). Approximately half the students who were given intervention materials indicated they had saved them and still had them in their possession (57% of first-year student brochures and 54% of CPAG).

MVPA levels are displayed graphically by time and study condition in Figure 2. As shown in the figure, participants in the three groups were roughly equivalent, engaging in an average of ~ 600 min of MVPA per week prior to coming to university. All groups showed drastic declines in MVPA from pre-transition scores to those obtained at mid-semester (Full sample), $F(1, 254) = 123.32$, $p < .001$, $\eta^2 = .33$. Between group differences in total volume of MVPA at the 6-week follow-up were evaluated using univariate ANCOVA, treating baseline MVPA as a covariate and pair-wise simple contrasts between the first-year student physical activity and action planning brochure condition and the other two conditions. The overall ANCOVA was significant, $F(2, 251) = 2.88$, $p = .05$, $\eta^2 = .02$, with the paired contrasts revealing a significant difference between the targeted first-year print brochure condition and the control condition (Contrast estimate = -83.20 [S.E. = 37.24]; 95% C. I. = -156.54 to -9.86, $p = .03$) and a non-significant trend in the expected direction between the first-year brochure condition and the CPAG

TABLE 1
Descriptive Statistics of Sample Demographic and Physical Activity Characteristics Overall and by Study Condition

Variable	Full Sample(N = 255)	Study Condition		
		First-year Student Brochure (n = 84)	CPAG (n = 83)	Control (n = 88)
Age	17.94 ± .66	17.91 ± .55	17.95 ± .66	17.96 ± .74
Class hours per week	19.52 ± 5.00	19.23 ± 5.39	19.30 ± 4.35	20.02 ± 5.11
Intentions to exercise at start of semester	4.87 ± 1.42	4.96 ± 1.36	4.85 ± 1.42	4.81 ± 1.48
Pre-transition MVPA	596.82 ± 452.64	593.16 ± 463.77	578.80 ± 426.06	617.33 ± 470.25
Self-efficacy	6.30 ± 2.53	6.57 ± 2.37	6.41 ± 2.39	5.93 ± 2.78
Action planning	3.56 ± 1.54	3.67 ± 1.40	3.56 ± 1.55	3.45 ± 1.67
Gender	M = 100 F = 155	M = 34 F = 50	M = 35 F = 48	M = 31 F = 57
Ethnicity	White = 196 Asian = 37 Other = 22	White = 66 Asian = 12 Other = 6	White = 65 Asian = 9 Other = 9	White = 65 Asian = 16 Other = 7

Note. CPAG = Canada's Physical Activity Guide. Continuous data variables: age, class hours, intentions, MVPA, self-efficacy, action planning represented by $M \pm SD$; Categorical data variables: gender, ethnicity represented by counts.

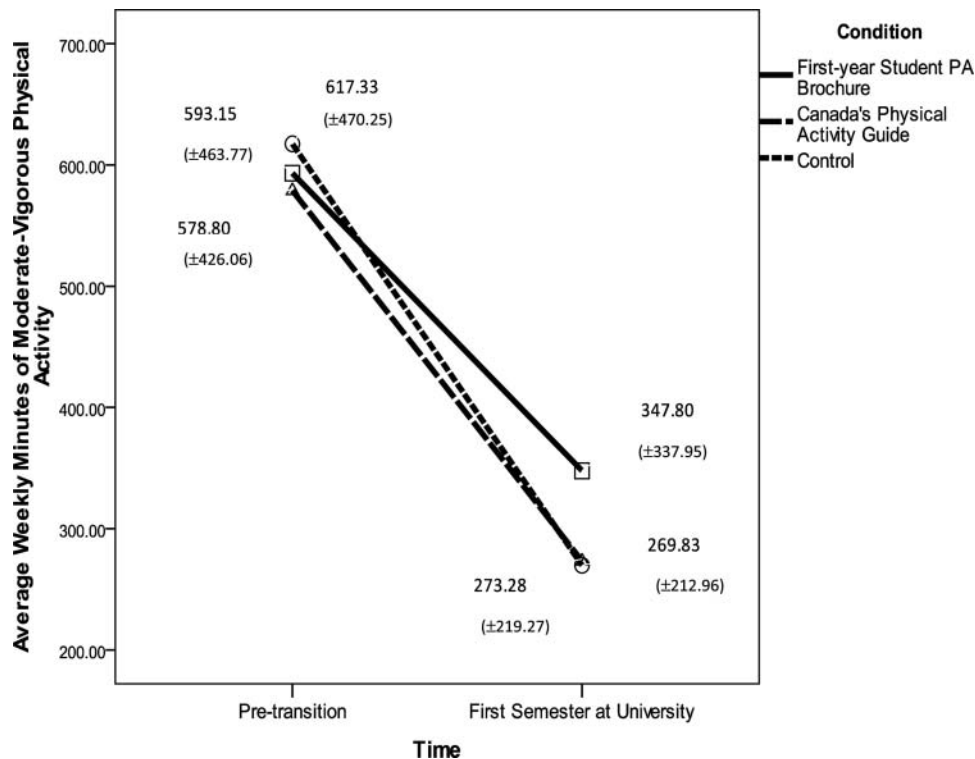


FIGURE 2 Changes in moderate-vigorous physical activity (MVPA) from pre-transition to first semester at university by study condition.

condition (Contrast estimate = -71.42 [S.E. = 37.78]; 95% C. I. = -145.81 to 2.99 , $p = .06$). There was no difference between the CPAG condition and the control condition (Contrast estimate = 11.37 [S.E. = 37.37]; 95% C. I. = -61.81 to 85.37 , $p = .75$). Thus, during the follow-up measurement period, participants in the first-year student physical activity and action planning brochure condition were engaging in 71 to 83 more minutes of MVPA per week than students in the other two conditions during the 6-week intervention follow-up period.

Descriptive statistics for the action planning and scheduling self-efficacy variables are presented in Table 1. Between group differences in these variables at the follow-up assessment were evaluated using one-way ANOVA. Contrary to predictions, the group means were not significantly different for either action planning, $F(2, 246) = 1.35$, $p = .26$, or scheduling self-efficacy, $F(2, 249) = .51$, $p = .60$.

DISCUSSION

The purpose of the present study was to examine the effect of a theory-driven physical activity and action planning intervention on students' MVPA behavior during their first semester at university. Students that received the first-year student physical activity and action planning brochure at the start of the semester exhibited significantly higher levels of

MVPA over a 6-week follow-up period compared a control group and a trend toward greater activity levels compared to a group that received a copy of Canada's Physical Activity Guide (CPAG).⁴² Students in all three conditions reported similar levels of scheduling self-efficacy for exercise and similar histories of action planning over the 6-week intervention period.

The main finding in the present study was the between-condition effect showing students who had been given a copy of the first year student activity brochure reported engaging in greater levels of MVPA per week than students who were given a copy of the CPAG or students in the control group. As can be seen in Figure 2, MVPA levels for students in all of the conditions declined markedly during the six week intervention follow-up period. Those data are consistent with previous research showing dramatic declines in physical activity among samples of students during their first year at university.²³⁻²⁸ However, it is also clear from the pattern of findings that providing students with a theory-driven, targeted first year student physical activity and action planning brochure resulted in a less-dramatic physical activity decline and preserved levels of MVPA that met or exceeded current recommendations for achieving health benefits.⁴

One thing that sets the present study apart from many intervention studies that target physical activity behavior change is the objective of the intervention was not necessarily to promote participants to be more physically active than they had been previously. That is, physical activity interventions are

commonly aimed at sedentary or insufficiently active people in order to stimulate adoption of greater levels of physical activity. In contrast, our study sample was expected to be (and was) very active prior to the study and, due to an extreme environmental perturbation (transition to university), was likely to become less active during the study's intervention follow-up period. Thus, rather than promoting adoption, our intervention drew from theorizing about health behavior maintenance that targeted psychosocial characteristics of our defined population in the context of their transitional environment as well as MVPA activities aimed to help accommodate adaptation to active lifestyles during university transition. We believe the focus on adaptation and the design of the information and delivery of the intervention was a key factor contributing to the success of the intervention.

The printed materials included in the intervention focused on reinforcing self-efficacy and stimulating action plans for MVPA. Contrary to our expectations, there were no differences in scores between the study groups for either of these variables. Thus, we cannot conclude that the difference in MVPA in the intervention group was attributable to what we measured as self-efficacy or action planning. However, it is also important to put these findings in the perspective of the MVPA levels observed, which show that, on average, students in all three groups reported engaging in over 260 minutes of MVPA per week throughout the 6-week post-intervention window. Given these moderately high levels of activity, it is not surprising that students had similar levels of self-efficacy to be physically active. The high levels of action planning that were seen in the non-intervention conditions (Table 1) were not expected, but provide an indication that this was also a factor contributing generally healthy levels of physical activity in the sample. A more detailed follow-up analysis of students' use of the action planning exercise would have been informative; however, on the basis of these findings, we can only speculate that the action planning exercise could have helped students in the intervention group make plans that included more MVPA or make plans that they were better enabled to follow through on.

Limitations

Although the present study offers some promising evidence that a theory-driven, targeted first-year student physical activity and action planning print media intervention can assist students in adapting MVPA during transition to university, there are several limitations to acknowledge. One limitation is the data obtained were all based on self-report and are therefore susceptible to memory and social desirability biases. However, the BRFSS measures have good evidence of reliability,^{55,56} and measurement error should have been equally distributed between the study groups, which allows for greater confidence in the relative differences between groups in MVPA scores. Another limitation is the high degree of attrition over a relatively short follow-up interval.

The high dropout rate may have been influenced by technical factors, as students may have changed their primary email addresses once they settled in at university. Also, given the challenges, distractions and demands of first-year university, many of the original participants may have given their continued participation in the study low priority among other pressing commitments. Nonetheless, despite high attrition, the final sample was reflective of the original sample on all demographic, social cognitive and behavioral measures. A further limitation relates to the relatively brief (i.e., 6-week) intervention follow-up period. Although the findings indicate the intervention may be effective in the short-term, whether or not the higher levels of MVPA seen in the intervention group could be sustained longer than six weeks is not known.

Balanced against these limitations are several strengths. One major strength of this study is our evidence of a modest effect on MVPA using a simple print-based intervention. Similar to several other print media interventions,^{39,40} the first year student activity and action plan brochure provided targeted messaging and interactive planning tasks at low cost with easy delivery. Because the print media brochure can also be reused and referenced at the convenience of the user, it also has an advantage over more comprehensive and time-consuming interventions involving face-to-face delivery. Although further research should be undertaken, we are optimistic that a print media intervention such as the one examined in the present study might offer an inexpensive and effective method to curb MVPA decline during transition to first year university that could easily be adopted by post-secondary institutions. Another strength of the study is the integration of social cognitive theory elements (self-efficacy and outcome expectations)^{37,38,53} and population targeting⁴² in the design of the intervention materials. Because first-year university students living in dormitory residence have many characteristics in common (e.g., young adults, recent move to university, experiencing greater independence, developing new behavioral routines) we were able to manipulate the content of the messaging and activities in the student brochure to highlight those shared characteristics. Also, based on theorizing by Rothman and colleagues^{37,38} the intervention content was designed to reinforce perceptions and activities aimed at adaptation and maintenance, which are not typical of most physical activity interventions that focus on perceptions about adoption. In this regard, it seems appropriate to contrast results between the first year student brochure and the CPAG. The CPAG was developed and designed to target inactive Canadian adults aged 18–55, who had moderately positive attitudes towards being physically active.⁴³ It seems reasonable to suggest that this lack of direct correspondence between the focus of the material included in the CPAG and the characteristics of the students in this sample led to the finding that students in the CPAG condition showed similar MVPA declines as those in the no-treatment control group.

CONCLUSIONS

To conclude, this study demonstrated that providing first-year university students with a theory-driven, targeted first-year student physical activity and action planning brochure resulted in greater levels of MVPA during a six-week intervention follow-up compared to the CPAG and a control group. Previous research has shown a dramatic decline in physical activity among students entering their first year at university.^{23–28} Although students generally report strong intentions to be physically active when they arrive at university,²⁷ they also report many barriers to physical activity that they experience during their first semester at university.^{26,31} Future studies should continue to examine modifiable factors that are implicated in post-secondary students' physical activity levels and effective methods that will help students maintain healthy levels of physical activity through university and into later adulthood.

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