

The Efficacy of Stage-Matched and Standard Public Health Materials for Promoting Physical Activity in the Workplace: The Physical Activity Workplace Study (PAWS)

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Abstract

Purpose. To compare the effects of stage-matched and standard print materials for physical activity (PA) change.

Design. Participants were randomized into (1) a stage-matched intervention group ($n = 165$), (2) a standard intervention group ($n = 176$), or (3) a no-contact control group ($n = 166$). The stage-matched and standard intervention groups both received materials at baseline, 3 months, and 6 months. Assessments of all three groups were conducted at baseline, 6, and 12 months.

Setting. Canadian worksites.

Subjects. Employees ($N = 507$).

Interventions. Five motivationally targeted booklets were developed for the stage-matched group. The standard group received Canada's Physical Activity Guide and handbook.

Measures. The main dependent variable was PA, expressed as metabolic equivalent (MET) minutes and measured using the Godin Leisure-Time Exercise Questionnaire. Demographic characteristics and stages of change for PA were also assessed.

Results. At 12 months mean weekly MET minutes for combined moderate and vigorous activity increased from baseline by 223, 67, and 78 for the stage-matched, standard, and control groups, respectively; however, differences were not significant ($p > .05$). Women in the stage-matched group over the 12-month period significantly increased their activity by 327 weekly MET minutes whereas the standard and control groups declined their activity ($F = 3.01$, $p < .05$).

Conclusion. PA stage-matched materials delivered in the workplace are efficacious for women but not men. Future interventions should explore the use of these intervention materials in conjunction with multilevel strategies, and particular attention should be paid to possible gender differences. (*Am J Health Promot* 2007;21[6]:501–509.)

Key Words: Physical Activity, Worksite, Stage-matched, Print-based Intervention, Population Health Material, Prevention Research. Format: research; Research purpose: intervention testing/program evaluation; Study design: randomized trial; Outcome measure: behavioral; Setting: workplace; Health focus: fitness/physical activity; Strategy: skill building/behavior change; Target population age: adults, seniors; Target population circumstances: geographic location

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INTRODUCTION

Despite strong evidence supporting the adoption of physical activity (PA) for optimal health, the majority of Canadians (57%) are insufficiently active to achieve health benefits.¹ Moreover, the workplace has been identified as a pivotal setting for promoting PA adoption and maintenance among adults by several expert groups.^{2–5} The workplace setting offers a potentially attentive audience, established communication channels, existing support networks, and the opportunity to reach a significant proportion of the population.^{3,6} A recent needs assessment of Canadian work-sites and stakeholders identified an urgent need for greater development of workplace PA programs.^{7,8} Research to date is supportive: a meta-analysis concluded that workplace PA interventions can reduce the risk of cardiovascular morbidity and overall mortality to a “meaningful degree.”⁹

Traditional approaches to PA promotion include the use of written material. As an example, in response to the low levels of PA among Canadian adults, Health Canada developed Canada's Physical Activity Guide to Healthy Active Living (CPAG), a two-page guide providing targets and advice to increase PA, as well as a 24-page handbook that contains the guide as a pullout.¹⁰ Although information currently exists on the population's awareness and use of the CPAG,¹¹ research to date has not

examined its efficacy or effectiveness as a tool to increase and maintain regular PA. In general, concern has been expressed that generic written materials have low impact on PA levels.¹¹

The most efficacious workplace PA interventions are based on social-cognitive theories.⁹ The Transtheoretical Model (TTM) has frequently been applied as it addresses both the *adoption* of regular PA (in inactive people) as well as *maintenance* and *relapse* prevention among those already engaged in regular PA. Briefly, the TTM hypothesizes that the way people differ in their readiness to adopt new behaviors and readiness to change can be understood in terms of four key constructs: (1) stage of change, (2) processes of change, (3) decisional balance, and (4) self-efficacy. Individuals adopting a new behavior move through a series of five stages: (1) *precontemplation*—not thinking of making changes, (2) *contemplation*—considering change, (3) *preparation* for change, (4) *action*—making the change, and (5) *maintenance* of the desired change. Movement through these stages does not always occur in a linear fashion, as individuals may make several attempts before achieving maintenance, and even then relapses still occur.

Interventions based on the TTM have yielded significant changes in the adoption and maintenance of PA in community settings,^{12,13} primary care settings,¹⁴ and workplace settings.^{15,16} Results from a meta-analysis support, in part, the application of the TTM in the exercise domain, as there are sufficient data suggesting that constructs differ across the stages in the direction predicted by the theory.¹⁷ However, the results of this meta-analysis,¹⁷ along with a longitudinal test of the TTM on exercise behavior in a large population sample,¹⁸ revealed a number of limitations to this model in its application to PA.

While workplace interventions have yielded positive results, their overall efficacy is nevertheless modest. Better theoretically driven interventions are needed to increase PA.^{9,19} One approach that has received attention is the development of more efficacious, stage-specific intervention materials.²⁰ Plotnikoff et al.^{18,21–24} conducted a

randomized, community-based longitudinal study (Physical Activity Community Study [PACS]) to examine the value of several social-cognitive constructs and items selected from several behavioral theories (TTM, Theory of Planned Behavior, Health Belief Model, Protection Motivation Theory, and Social-cognitive Theory) to predict transitions in the stages of PA behavior. The constructs and items from the PACS study found to be predictive of PA change,^{18,21–24} along with theoretically supported social-cognitive constructs, were operationalized in the present study into print-based messages designed to promote behavioral changes specific to each stage.

The purpose of this project was to examine the efficacy of PA promotion in the workplace using two strategies: (1) stage-matched print materials and (2) *CPAG* and handbook. It was hypothesized that participants receiving the stage-matched materials would have greater increases in PA compared with the group receiving the *CPAG* and handbook (standard materials) and the controls. However, no hypothesis was developed for the efficacy of the *CPAG* due to the lack of literature evaluating these materials.

METHODS

Design

This study was conducted to compare: (1) a stage-matched intervention (i.e., print-based materials matched for PA stage of readiness), (2) a standard intervention (i.e., *CPAG* and handbook), and (3) a control group. The study received ethical approval from a university ethics board. Three large Canadian worksites were enrolled in the study. To avoid study contamination within the worksites, each worksite was divided into geographically based subsites (ranging from 3 to 12 subsites per worksite). (Subsites within organizations were unique departments with distances between subsites ranging from locations within the same building to sites 30 km apart.) Further, as part of the study protocol, study cocordinators and employee managers in each of the three organizations were instructed only to communicate and disseminate PA materials related to the designed intervention

arms; employees were not told what type of materials the other intervention arms were receiving. Each of the subsites (within each worksite) was then randomized to one of the three study arms. The stage-matched arm received booklets matched to their stage of readiness following the baseline, 3-month, and 6-month assessment points. The standard arm received the 24-page *CPAG* handbook following the baseline assessment and a 2-page pullout from the handbook after the 3- and 6-month assessments. The control group did not receive any materials during the 1-year study period. Full assessments (demographic characteristics, health factors, PA levels, and core social-cognitive constructs from major social cognitive theories [i.e., Social Cognitive Theory, TTM, Theory of Planned Behavior, and Protection Motivation Theory]) were performed on all participants at baseline, 6 months, and 12 months using self-administered questionnaires. Stage of PA level change and PA were assessed by telephone at 3 and 6 months.

Sample

Study participants were employees from three large organizations in the province of Alberta, Canada. Participants were initially notified by flyers and posters they would be approached for their consent to take part in the Physical Activity Workplace Study. Employees across the three workplaces were sent the baseline survey through their employers' internal mail system. All future communications were sent to their workplace address, unless another preferred address was indicated. The study recruited 887 employees: 409 from a regional health authority, 170 from a post-secondary institution, and 318 from a municipal government. Self-reported questionnaires collected information about demographic and medical backgrounds, PA levels, stage of change, and social-cognitive constructs. Questionnaires were distributed to employees in June 2002 (baseline), December 2002 (6 months), and June 2003 (12 months). All analyses were restricted to the subset of the study participants who completed question-

naires at all three-time periods (n = 507).

Measures

Demographic Characteristics. Demographic characteristics were measured using questions based on Statistics Canada Census of Population Questionnaire²⁵ and included age, gender, marital status, educational level, gross annual family income, employment status, height, and weight.

Physical Activity Assessments. Respondents indicated the frequency and average duration of their PA sessions for three listed intensity levels (i.e., light, moderate, strenuous). The questionnaire was based on the Godin Leisure-Time Exercise Questionnaire (GLTEQ) modified to include PA duration.²⁶ To calculate the main PA-dependent measure, the frequency of PA sessions per week within each intensity category was multiplied by the average reported duration, weighted by a standard estimate of the metabolic equivalents (MET), summed across the moderate and strenuous intensities and expressed as an average (light activity was not included). The standard MET weightings derived from the literature²⁷ were 7.5 MET for strenuous activities and 4 MET for moderate activities.

Participants also completed the National Health Interview Survey (NHIS) Instrument, a comprehensive questionnaire which includes a list of leisure and occupational activities.²⁸ MET minute scores were computed for each of these activities^{29–31} and were then summed to provide an overall activity estimate. The MET minute method was chosen because it is independent of body weight and is less likely to underestimate the prevalence of PA in women.²⁷ Analyses were conducted only on reported leisure-type activities.

Employees were classified as having achieved a PA standard adequate to achieve a health benefit if their score met or exceeded 480 weekly MET minutes. This criterion reflects 30 minutes of moderate activity on 4 days each week, which corresponds to the Canadian public health guidelines.¹⁰

The Modified Canadian Aerobic Fitness Test (MCAFT) was completed by 10% of the employees in each of the three intervention arms at baseline and 12 months to assist in the validation of this self-report measure. This test, recommended by the Canadian Society of Exercise Physiology,³² consists of a step-test at a predetermined cadence, which assesses $\text{VO}_{2\text{max}}$. The correlation between the MCAFT and Godin measure was 0.30 ($p < .05$).

Stages of Change. To assess current stage of PA motivational readiness, a modification of the Marcus et al.³³ staging question was employed.¹⁸ The stages of change categories were *precontemplation* (not currently physically active and not intending to start in the next 6 months), *contemplation* (not currently physically active but intending to start in the next 6 months), *preparation* (not currently physically active but intending to start in the next 30 days), *action* (currently regularly physically active for <6 months), and *maintenance* (currently regularly physically active for >6 months). For purposes of presenting this scale to participants, regular PA was defined as undertaking leisure activities at a minimum of moderate intensity on at least 4 days per week for 30 minutes.¹⁰ Moderate activity was defined as equivalent to the pace of a brisk walk. Participants were allowed to accumulate PA in three 10-minute periods.

Intervention materials. Participants in the standard and stage-matched groups were asked if they recalled reading the intervention materials with a yes/no response item.

Intervention

Stage-matched Materials. Five motivationally targeted PA *stage-matched printed materials* were developed³⁴ based on (1) modification of existing PA stage-matched materials (i.e., *Jump Start to Health Program* developed by Marcus et al.¹⁵ and materials developed by Plotnikoff and Hotz for the Heart and Stroke Foundation of Canada's Community Trial on PA and TTM³⁵) and (2) the findings from PACS.^{18,21–24} Each stage-matched booklet incorporated and operationalized the key social-cognitive constructs and/or

belief items (from the TTM, Theory of Planned Behavior, Protection Motivation Theory, and Social-cognitive Theory) that theoretically supported and/or empirically predicted forward stage transition for each of the TTM's stages in the PACS sample. These features (i.e., integrating constructs across key social-cognitive theories and selectively operationalizing at the construct item level²²) are novel to existing PA stage-matched materials.¹⁵ The booklets encouraged employees to achieve Canadian public health PA guidelines by participating in activities that were at least at a moderate intensity for at least 4 days per week for 30 minutes.¹⁰

Cognitive interviewing³⁶ and readability checks of the draft intervention materials were undertaken with both inactive and active groups of men (n = 10) and women (n = 10) from both professional and nonprofessional backgrounds. (The pilot sample reasonably reflected the demographic and PA behavior characteristics of the study proper.) An expert panel (n = 11) of five practitioners and six researchers with expertise in PA promotion also provided iterative feedback throughout all phases of material development. The first booklet, *Not for Me?*, was written for those who were not thinking about being regularly active (*precontemplation*) and focused on a discussion of the pros of PA. For employees who indicated that they were thinking about being regularly active (i.e., *contemplation*), the booklet entitled *Just a Thought* reviewed self-efficacy, advantages, severity, and vulnerability. *Here I Go* was written for employees who indicated that they had decided to be regularly physically active in the next 30 days (i.e., *preparation*) and emphasized self-efficacy and vulnerability. For employees who indicated they had been regularly physically active for less than 6 months (i.e., *action*), the booklet entitled *I'm Doing It* reviewed self-efficacy, attitude, perceived behavioral control, helping relations, and fear. Finally, the booklet entitled *I've Got It!* outlined self-efficacy, self-liberation, self-management, stimulus control, and helping relationships for those who had been regularly active for 6 months

or more (i.e., *maintenance*). The materials were developed and tested to reflect age, occupation, and gender diversity.

Standard Intervention. The standard intervention involved distributing two Health Canada publications, *CPAG* and *Handbook for Canada's Physical Activity Guide to Healthy Living*.¹⁰ The *CPAG* is a two-page document that lists a varied range of physical activities with information regarding the amount of PA for which Canadians should strive and how to get started. The *Guide* specifies that Canadians should engage in endurance activities at least 4 days per week.¹⁰ The *Guide* also lists benefits attributed to regular PA and the health risks of inactivity. The 24-page handbook is a more detailed document designed to encourage people to start being physically active. It provides information on the benefits of active living, the problems with inactivity, examples to help individuals choose physical activities that are right for them, and how to build PA into their routines.

Analyses

Chi-square analyses and analyses of variance (ANOVA) were conducted to compare demographic variables and initial PA of the study's three arms. To detect changes in PA within and between the three arms, a repeated measures analysis of covariance (ANCOVA) was conducted on MET minute²⁶ scores from the GLTEQ (similar results on all main analyses were achieved using the NHIS instrument and therefore are not presented). The covariates were age and gender, which were significantly correlated with baseline PA. Subsidiary analyses (repeated measures ANOVA and ANCOVA) explored potential moderators of PA,³⁷ including age (<45 years versus ≥ 45 years), level of activity at baseline (meeting versus not meeting public health guidelines of >480 weekly MET minutes), and gender (men versus women) adjusted for age.

The proportion of participants classified as "meeting public health guidelines" was further analyzed with χ^2 analysis to detect changes within and between the three study arms. A Spearman correlation was performed

to assess the internal validity between the stages of PA classification (treated as an ordinal variable) with self-reported PA.

RESULTS

Comparisons at Baseline

Response rates were 69% ($n = 616$) at 6 months and 69% ($n = 617$) at 12 months. Five hundred and seven employees (56.7% of the original sample; 53.2% of the stage-matched group, 59.8% of the standard group, and 59.3% of the control group) completed all three survey periods. Small but statistically significant differences ($p < .05$) were noted in three demographic characteristics of those completing the questionnaire at all three time periods ($n = 507$) versus those who did not complete all three assessments ($n = 380$) (data not shown). Completers were more likely to have a university degree (80.1% versus 74.1%), have a family income higher than \$60,000 (69.7% versus 63.5%), and be older (43.4 [SD = 9.1] versus 40.7 [SD = 10.8] years). However, significant differences were not noted for baseline PA ($M = 1153$ [SD = 1089] MET minutes for completers versus $M = 1236$ [SD = 1157] MET minutes for noncompleters).

Across the three arms, respondents were compared on the demographic characteristics and PA levels (Table 1). Analyses indicated significant differences in gender proportions among the three arms at baseline. At baseline the proportions of employees in each arm who were categorized as meeting the public health guidelines of 480 weekly MET minutes (stage-matched intervention group, 66.0%; standard intervention group, 73.3%; control group, 67.7%) were not significantly different ($\chi^2 = 2.21$; $p = .33$, $df = 2$). Baseline MET minute scores among the stage-matched intervention ($M = 1059$, $SD = 1034$), standard intervention ($M = 1262$, $SD = 1144$), and control group ($M = 1118$, $SD = 1083$) were not significantly different ($F = 1.50$, $p = .23$). Baseline stages of PA classification (precontemplation, contemplation, and preparation classified as inactive, and action and maintenance classified as active) and

self-reported PA were highly correlated ($r = .61$, $p = .01$).

Change in Physical Activity

At the 12-month follow-up mean weekly MET minutes increased from baseline by 222, 67, and 78 for the stage-matched, standard, and control groups, respectively (Figures 1 and 2). This corresponds to a weekly increase of 56 minutes of moderate activity for the stage-matched group, 17 minutes for the standard group, and 20 minutes for the control group. These changes in mean weekly MET minutes were not statistically different among groups ($F = .44$, $p = .65$, $df = 2$).

Moderating Effects

Analysis revealed no significant interactions ($F = .66$, $p = .63$, $\eta^2 = .003$) for Age $\times$ Group $\times$ Time and Baseline Activity $\times$ Group $\times$ Time ($F = .46$, $p = .77$, $\eta^2 = .002$). However, the interaction among Gender $\times$ Group $\times$ Time was borderline significant ($F [2.27]$, $p = .06$, $\eta^2 = .011$). ANCOVA (adjusted for age) for women and men on change scores (changes between baseline and 12 months) revealed significant differences ($F = 3.01$, $p < .05$) in the women's change scores, with women in the stage-matched group ($M = 327$, $SD = 1782$) increasing PA significantly more than women in the standard ($M = -73$, $SD = 1279$) and control groups ($M = -75$, $SD = 918$). (Figure 3a.) Significant differences ($F = 0.91$, $p = .41$) were not reported for men among the three groups (Figure 3b).

Stages of Change Transition

There were no significant differences in the proportion of PA transition (i.e., inactive progressing to active, inactive remaining inactive, active regressing to inactive, active remaining active) among the three arms from baseline to 1 year ($\chi^2 = 5.72$, $p > .05$, $df = 6$) (Table 2). There was evidence for a trend toward a greater proportion of people shifting from inactive to active in the stage-matched group (23.9%) compared with the standard (17.4%) and control (18.9%) groups.

Table 1
Comparison of Participants of the Physical Activity Workplace Study (PAWS)*

Variables	Stage-matched Materials Intervention (n = 165)		Standard Intervention (CPAG) (n = 176)		Control (n = 166)		χ^2	p
	%	n	%	n	%	n		
Sex							7.00	0.03
Male	23.0	38	23.4	41	34.3	57		
Female	77.0	127	76.6	134	65.7	109		
Education							1.97	0.37
No university degree	18.2	30	23.4	41	18.2	30		
University degree	81.8	135	76.6	134	81.8	135		
Partner status							0.09	0.96
Currently partnered	75.2	124	76.1	134	76.5	127		
Currently single	24.8	41	23.9	42	23.5	39		
Income							11.22	0.34
<\$20,000	0.6	1	1.8	3	1.2	2		
\$20,000–\$39,999	9.4	15	8.4	14	6.6	11		
\$40,000–\$59,999	20.6	33	24.6	41	17.5	29		
\$60,000–\$79,999	23.8	38	18.0	30	31.3	52		
\$80,000–\$99,999	17.5	28	21.6	36	19.9	33		
>\$100,000	28.1	45	25.7	43	23.5	39		
	Mean	(SD)	Mean	(SD)	Mean	(SD)	F	p
Age	44.16	(8.81)	43.38	(9.74)	42.67	(8.47)	1.12	0.33
Baseline MET minutes	1059	(1034)	1262	(1144)	1118	(1083)	1.50	0.23
6 months MET minutes	1047	(1197)	1190	(1190)	1139	(1290)	0.56	0.58
12 months MET minutes	1297	(1551)	1354	(1693)	1200	(1475)	0.39	0.68

* These demographic analyses were conducted on participants who completed the three time points (n = 507). The sample sizes reported in the tables of this article may not add up to the same value given missing data.

CPAG indicates Canada's Physical Activity Guide to Healthy Active Living; MET, metabolic equivalents.

Change of Proportions of Meeting Canadian Public Health Guidelines

There were no significant differences in stages of behavior transition (i.e., regressed, maintained, and progressed) among the three arms from baseline to 1 year (Table 3). Although not statistically significant ($\chi^2 = 4.97$, $p > .05$), a greater percentage of individuals in the stage-matched group (19.3%) progressed in their behavior from inactive to active between baseline to 12 months compared with the standard (11.7%) and control (15.4%) groups.

Intervention Materials

Among those in the standard group, 42.4% reported reading the CPAG guide and 77.4% reported reading the

CPAG handbook. Among those in the stage-matched group, 76.7% reported reading the printed materials.

DISCUSSION

This study set out to test the efficacy of two PA interventions that employed (1) stage-matched print materials based on a modified stage model and (2) CPAG materials. We hypothesized that the arm receiving the tailored intervention materials would have a greater increase in PA participation than the standard and control arms. Although there were no significant statistic differences in PA changes among the three groups, the stage-matched materials appear to have had some impact. The stage-matched

group displayed a larger increase (19.3%) in the proportion of participants that progressed from being inactive to active compared with the standard (11.7%) and control (15.4%) groups.

The stage-matched group reported a 223 weekly MET minute increase, which was greater than both the standard (78 MET minutes) and control (67 MET minutes) groups' increases. Further, these changes in behavior over the 12-month period for this group corresponded to a clinically meaningful increase in moderate PA of 56 minutes per week, which may lead to several health benefits compared with the 17-minute increase for the standard group and 20-minute increase for the control group. The relatively modest positive changes noted in the stage-matched group are of similar magnitude to most workplace PA interventions. Indeed, a meta-analysis⁹ concluded that worksite PA interventions have yielded, at best, small effects ($r = 0.11$).

Of particular importance is the finding that over the course of the study women in the stage-matched group reported significant increases in PA levels. These results demonstrate the efficacy of stage-matched print materials for women's PA levels. This is a noteworthy finding, as research has consistently found women to have lower activity levels than men.³⁸ An explanation for our findings may be that women, more than men, actively use available information sources³⁹; 79% of women compared with 68.6% of men in our study reported reading the stage-matched materials. Further, the PA increase found for women receiving the stage-matched intervention compared with the CPAG intervention may be attributed to the gender appropriateness of the stage-matched materials (e.g., the inclusiveness of women's issues). Previous studies have demonstrated support for tailoring PA interventions for women.^{15,40–42} However, although our study reported that the stage-matched materials were more efficacious for women, this finding does not necessarily mean such approaches are not appropriate for men. Certain aspects of our stage-based messages may have been salient for men but not powerful enough to

Figure 1

Physical Activity Scores as a Function of Time and Group Expressed as Unadjusted Weekly MET Minutes. MET indicates metabolic equivalents

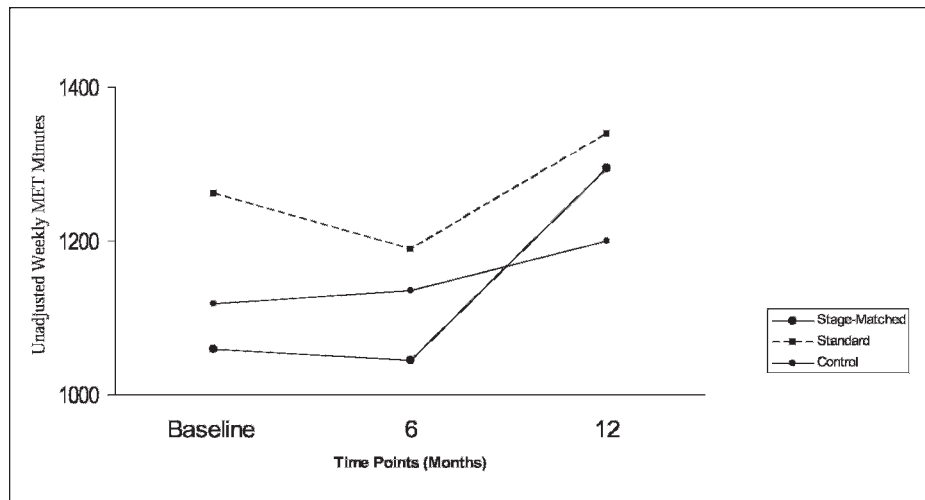


Figure 2

Mean Weekly MET Minute Change Scores and Confidence Intervals from Baseline to 12 Months. MET indicates metabolic equivalents

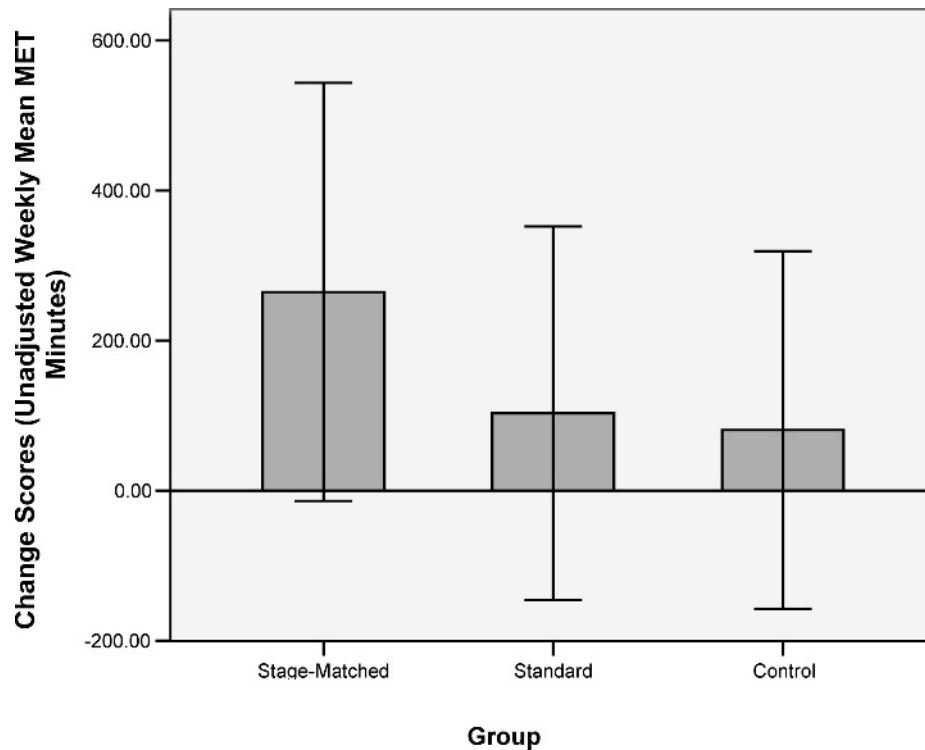
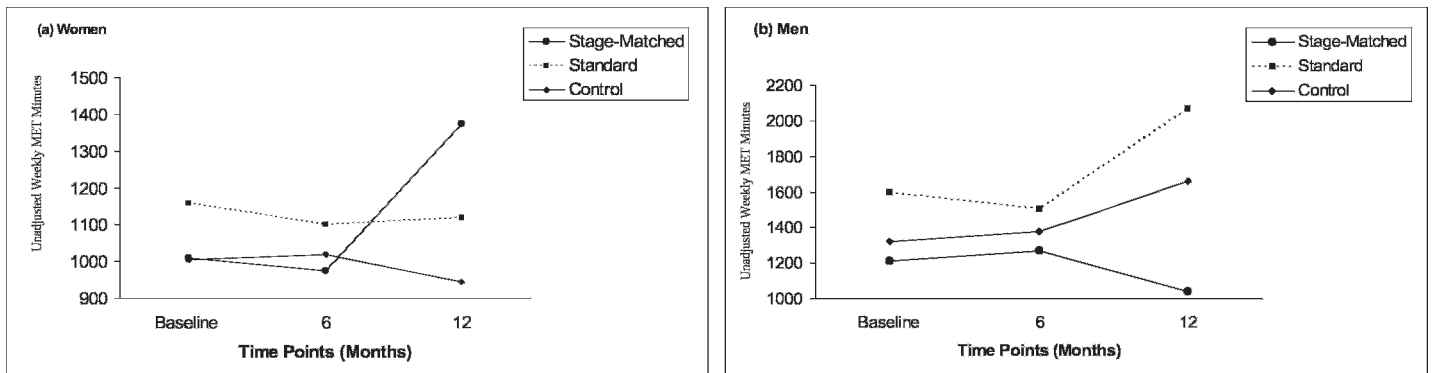


Figure 3

Physical Activity Scores as a Function of Time and Group for (a) Women and (b) Men. MET indicates metabolic equivalents



promote significant behavior change. Further development of messages related to men may be warranted.

There have been few, if any, studies of the efficacy of standard PA public health materials for Canadians or tests of national public health guidelines subjected to a randomized, controlled trial. The CPAG and handbook had marginal impact on behavior change in our study, which is not surprising, as generic public health written materials/guidelines have limited impact on PA levels. For example, despite the wide dissemination of the Health Canada CPAG commencing in 1998, only 5.5% of Canadian adults reported using the guideline materials in a large, randomized population survey conducted 4 years after the launch of the CPAG.¹¹ It is important to note these Health Canada materials were developed and launched to provide general awareness of PA public health guidelines and suggested strategies for both

inactive and active individuals as a “stand-alone” initiative.

Participants in the two intervention arms reported a slight decline in PA levels at 6 months and an increase in PA at 12 months. These changes may be explained by (1) seasonal variability and (2) exposure frequency. First, earlier studies showed that Canadians exercise less in winter than summer months, most likely due to the extreme temperature variations and outdoor winter conditions of ice and snow.^{18,21,43} The results from the present trial parallel these findings; decreases in PA were noted in our study at 6 months (corresponding to the Canadian winter months), while the baseline and 12-month assessments corresponded to the summer season. Second, the higher scores at 12 months may be due to a longer exposure to the intervention materials—increased exposure to an intervention is reportedly associated with

higher levels of recommended behavior changes.⁴⁴ These findings suggest that more frequent distribution of intervention materials may lead to a greater increase in PA level.

There are a number of possible explanations that limited the potential efficacy of these two interventions. First, individuals self-select for participation in research studies, with more active people tending to participate in PA studies.^{45,46} A greater proportion of this study’s participants were in the action and maintenance stages of PA compared with national activity prevalence rates. Using the MET minutes criterion, 69.3% of employees were meeting public health guidelines at baseline while other studies have found lower activity participation levels (i.e., 44% of Canadian adults and 53% of adults in the province of Alberta).^{1,47} These high baseline activity rates may reflect a selection bias and potential ceiling effects (especially for men) that may have limited the potential for behavior changes. Second, the large standard deviations reported for the dependent measure may have limited, in part, the staged intervention to achieve statistical significance. Third, because participants received the intervention materials at work, they may not have been as attentive as if they had received the materials during their personal time.

Distribution of stage-matched, print-based materials alone may not be optimal in increasing PA for some individuals. Perhaps the material would be more useful for such sub-

Table 2

Behavior Stage Transition Patterns Between Baseline and 12 Months Based on MET Minute Cut Points

Physical Activity Status at Baseline/12 Months	Stage-matched Materials (%)	Standard Intervention (%)	Control (%)
Active/inactive	10.4	9.3	11.0
Active/active	47.2	54.1	45.1
Inactive/inactive	18.4	19.2	25.0
Inactive/active	23.9	17.4	18.9

MET indicates metabolic equivalents.

Table 3

Behavior Transition Patterns Between Baseline and 12 Months Based on MET Minute Cut Points

Physical Activity Status at Baseline/12 Months	Stage-matched Materials (%)	Standard Intervention (%)	Control (%)
Active/inactive	10.3	15.4	12.8
Active/active	55.9	59.3	55.7
Inactive/inactive	14.5	13.6	16.1
Inactive/active	19.3	11.7	15.4

MET indicates metabolic equivalents.

groups if applied with other strategies. Within a workplace setting, an organizational culture that supports health promotion needs to be in place for PA interventions to be effective. An integrated approach involving the collaboration of employers, policy makers, and other key personnel such as employees, unions, and healthcare professionals may prove more effective in producing significant and long-lasting intervention results⁴⁸ The lack of consistent and strong empiric findings within the workplace PA literature strengthens the fact that PA efforts within workplaces need to look at more comprehensive strategies. Interventions operationalizing social-cognitive theories at the individual level for the promotion of PA at best have limited impact.⁹

Other strategies may also be required to ensure permanent or at least long-term behavior change. In addition to the need for advancing social-cognitive theories and approaches, an increasing body of literature is beginning to provide support for the use of ecologic approaches in promoting PA.⁴⁹⁻⁵² In workplace PA interventions, a multilevel ecologic perspective is now advocated. For example, Heirich et al.⁵³ compared the effectiveness of (1) a multilevel approach to individualized counseling, encouraging peer support and employing mutual physical activities; (2) a staffed fitness facility; and (3) individualized counseling. The participants receiving the multilevel intervention had the greatest increase in PA. In response, a recent Workplace Physical Activity Assessment Tool^{19,54} with accompanying standard of best practice guidelines has been developed based on a multilevel ecologic frame-

work of the workplace environment. Such tools and strategies are valuable contributions for the successful implementation of PA in the workplace. Additional research is therefore required to investigate the effectiveness of supplementing print-based materials with strategies aimed at the various levels of the environment.

The present trial has limitations that need to be considered when interpreting the results and planning future research. First, similar to many previously published studies, this study relied on self-reported PA measures (although significantly correlated to step-test means). Second, the sample's PA may not be generalizable to the workplace population because it was limited to employees from three large organizations in Alberta. It is important that the sample's PA be as diverse and representative as the population's PA. Future studies may want to implement proactive recruitment strategies to eliminate the response bias typically occurring in reactively recruited samples. Although our design attempted to limit the threat to the internal validity of the study by randomizing geographic subsites within each worksite to each of the three study arms, we acknowledge the possibility of respondents sharing the print materials across intervention groups. A further limitation is the worksites in the study were primarily used as a mechanism to recruit people; the worksites were not exploited to support the intervention, limiting the justification of terming this a true "workplace study."

Despite these limitations, there are several strengths of the design and implementation of this study that need to be acknowledged. First, the study

used a randomized, controlled trial design, which provides the most rigorous test of an intervention. Second, the study assigned individuals to conditions and not worksites, thus making the individual the unit of statistic observation and allowing for an estimate of variance of the efficacy of the intervention in a population. Third, the study relied on established validated and reliable measures of PA.

The importance of PA interventions as a strategy to increase activity has long been recognized. Combined with other research, there is moderate support for the implementation of stage-matched interventions to promote PA in the workplace. The efficacy of the stage-based intervention materials developed and tested in this study show promise and may be increased when supplemented with ecologic-based strategies that include multilevel, environmental components. Further, processes of uptake⁵⁵ reach, impact, and cost-benefit assessment of such interventions must also be examined from both individual- and population-level perspectives.⁵⁶ Further work in this area is encouraged in both workplace and community-based settings.

SO WHAT? Implications for Practitioners and Researchers

PA stage-matched materials delivered in the workplace appear to be efficacious for women but not men. Results had limited support for the use of Canada's *Physical Activity Guide to Healthy Active Living* in promoting PA in either sex. Future interventions should explore the use of these intervention materials in conjunction with multilevel strategies, and particular attention should be paid to possible gender differences.

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