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Comparative Effectiveness of Two Walking Interventions on Participation, Step Counts, and Health

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Abstract

Purpose: To (1) compare the effects of two worksite-based walking interventions on employee participation rates; (2) compare average daily step counts between conditions, and; (3) examine the effects of increases in average daily step counts on biometric and psychologic outcomes.

Design: We conducted a cluster-randomized trial in which six employer groups were randomly selected and randomly assigned to condition.

Setting: Four manufacturing worksites and two office-based worksite served as the setting.

Subjects: A total of 474 employees from six employer groups were included.

Intervention: A standard walking program was compared to an enhanced program that included incentives, feedback, competitive challenges, and monthly wellness workshops.

Measures: Walking was measured by self-reported daily step counts. Survey measures and biometric screenings were administered at baseline and 3, 6, and 9 months after baseline.

Analysis: Analysis used linear mixed models with repeated measures.

Results: During 9 months, participants in the enhanced condition averaged 726 more steps per day compared with those in the standard condition ($p < .001$). A 1000-step increase in average daily steps was associated with significant weight loss for both men (−3.8 lbs.) and women (−2.1 lbs.), and reductions in body mass index (−0.41 men, −0.31 women). Higher step counts were also associated with improvements in mood, having more energy, and higher ratings of overall health.

Conclusions: An enhanced walking program significantly increases participation rates and daily step counts, which were associated with weight loss and reductions in body mass index.

Keywords

walking, exercise, comparative effectiveness research, body mass index, workplace, prevention research

Purpose

Physical inactivity is a key risk factor for developing numerous serious health conditions, including increased risk of the onset of cardiovascular disease,[1,2] obesity,[3] diabetes mellitus,[4] hypertension,[5] colon and breast cancer,[6] and depression.[7] Fortunately, physical inactivity is a modifiable risk factor, and increasing the amount of walking people do on an average daily basis is a relatively easy way to increase routine physical activity. Walking interventions have been shown to be effective at getting people to increase their daily activity levels,[8-10] and they improve both physical[5,11] and mental[12] health. For example, a meta-analytic review of nine pedometer-based walking interventions lasting at least 4 weeks found that participants

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decreased weight by an average of 2.8 lbs.[11] Similar results were observed in a meta-analytic review of 24 randomized controlled trials examining the effects of walking on cardiovascular risk factors. Participants in walking interventions experienced greater weight loss, and greater decreases in body fat, body mass index (BMI), and diastolic blood pressure compared with controls.[5] Aerobic exercise has also been shown to have a significant and positive impact on several psychological outcomes, including mood[13] and self-esteem,[14] and is negatively associated with depression[15-17] and anxiety.[16,18,19]

Walking is a simple activity that can be performed virtually anywhere and is very effective for improving health. As such, interventions to increase daily walking are ideally suited for worksite wellness programs. For employers, the value of worksite wellness interventions is closely associated with the number of employees who participate, increase the number of steps taken daily, and experience positive outcomes. A walking program with a low participation rate or one that does not produce positive and measurable outcomes at the individual level is unlikely to improve the health of the employee population.

This study describes the results of a worksite walking intervention that had three specific aims. First, this study was designed to measure the impact of two levels of intervention on participation rates during 9 months. A second aim was to increase average daily step counts and to compare the effects of the two interventions on step counts. The third aim was to examine the effects of increasing daily step counts on biometric and psychological outcomes.

Methods

Design

This was a cluster-randomized trial with baseline measurements taken approximately 2 weeks before the intervention and follow-up measurements taken at 3, 6, and 9 months after baseline. The protocol was reviewed and approved by Chesapeake Research Review Institutional Review Board.

Sample

The sample frame consisted of all employers that met the following criteria: (1) had no more than two locations; (2) had 200 or fewer employees; (3) were in the Philadelphia, Pennsylvania, region; and (4) were a designated Independence Blue Cross Wellness Partner. Employers could elect to be a Wellness Partner by agreeing to work with Independence Blue Cross's Worksite Wellness to create a strategic wellness initiative for their employees. In all, there were 13 groups that met these criteria, each randomly assigned to condition. Then three groups were randomly selected for targeted recruitment from within each condition. The selected employer groups were then asked if they would be interested in participating in the study. Employer groups were informed that six groups would be participating but were blinded to the existence of the other intervention condition. One group that had been selected and assigned to the standard condition declined to participate and was replaced with a group that had more than the maximum number of employees in the original criteria. Enrollment for this replacement group was limited to 62, which was approximately the estimated voluntary enrollment of employees in the other five groups. The randomization produced relatively balanced groups with regard to industry and type of work, including one office and two manufacturing groups in each condition.

Approximately 1 week after employer groups agreed to participate, members of the research team conducted on-site informational sessions describing the nature of the study, requirements and expectations, and risks and benefits of participation, and stating that participation was voluntary. They were also informed that approximately 1 week later, the research team would be on site to enroll participants.

Intervention

Informed consent was obtained at the baseline screening before participants completed the baseline questionnaire or received baseline biometric screenings. Following the screenings, each participant was given an NL-800 accelerometer along with instructions and demonstrations on pedometer placement as well as use of the device and access and use of the Web site for logging daily step counts. Participants were instructed to wear the accelerometer during all waking hours 7 days a week. Validation studies have shown the NL-800 to be accurate and reliable in active daily living contexts[20] as well as in controlled step-counting validation experiments.[21,22] The NL-800 has a 7-day memory, so participants only had to log in and record steps online once a week.

In addition to receiving the accelerometer and training on its use, each participant also completed the baseline and follow-up screenings and survey measures. In the standard condition, a designated contact at each of the three employer groups was given a tool kit that is free and available to all employer groups via the WalkingWorks Web site. The tool kit includes instructions and resources for administering the program, flyers and posters to hang throughout the workplace, sample e-mail text that could be used to encourage and motivate employees, and information about the WalkingWorks Web site and how to have employees log steps online. Employer groups in the standard condition were allowed to do as much or as little promotion as they wanted throughout the program.

Groups in the enhanced condition received the tool kit plus several other enhancements. One enhancement was the addition of between-group walking challenges, whereby groups in the enhanced condition participated in walking challenges developed by the research staff (i.e., Race Around the Globe; Tour of US cities; World Tour) and received twice-monthly feedback regarding how many miles they walked (on average, per walker). Each group was compared with and could see the progress of the other five groups, although group names were masked. Also on a twice-monthly basis, participants in the enhanced groups received small tokens (plastic feet) for every 10,000 steps they walked. Participants collected the tokens on a lanyard and could trade them in for prizes, such as gym bags, backpacks, and cookbooks, at each of the follow-up screenings. Enhanced participants also received worksite-specific walking maps for walks of at least 1 mile in the vicinity of the worksite. Using the Walkability Audit Tool from the Centers for Disease Control and Prevention,[23] two researchers completed a walkability profile to determine a walkability rating for each walk based on the safety, accessibility, and aesthetics of a particular walk. Finally, the enhanced groups were offered monthly wellness seminars that dealt with setting walking goals, overcoming barriers to reaching walking goals, stress reduction, and developing healthy eating habits. For example, the first workshop was based on the Theory of Planned Behavior[24] and focused on setting specific and personal walking goals by having participants consider their average daily step count from the baseline period and then form an intention to increase their step count (e.g., "I intend to increase my daily walking by ___ steps each day in the next two weeks").

Participants were encouraged to set an achievable goal for the next 2 weeks and were informed that the ultimate goal was to average 10,000 steps per day as the program progressed. The remainder of the workshop focused on (1) identifying barriers to reaching their walking goals and developing strategies to overcome those barriers; (2) identifying sources of social support for reaching goals and developing strategies for using those resources; and (3) identifying the positive and negative outcomes they may experience if they were to reach their goal.

This was a 9-month program that began in mid-April and ran through mid-January. The length of the program periods differed slightly between employer groups and was dependent on scheduling the follow-up screenings at each worksite. Each screening marked the beginning of a new study period.

The baseline period began in mid-April and ran until April 25. The baseline period ranged from 5 to 13 days, averaging 9.7 days. The intervention period began on April 26, which was the National Walk@Lunch day. All six employer groups held company-wide walks to promote walking on this date. The first on-site wellness workshop was conducted at each enhanced group worksite during the week following the National Walk@Lunch day. The first study period began on April 26, ran through mid-July, and averaged 86.8 days (average of 12 weeks; range, 83–91 days). The second study period ran from mid-July through the end of October and averaged 98.0 days (average of 14 weeks; range, 97–99 days). The third and final study period ran from the end of October through the middle of January and averaged 85.2 days (average of 12 weeks; range, 82–92 days). The total length of the program averaged 279.7 days (average of 40 weeks; range, 278–282 days).

Measures

Participation. Program participation was measured as the percentage of total days that each participant logged steps within each study period (e.g., between baseline and first follow-up, or between first follow-up and second follow-up). The percentage of total days logged in each period was preferred over total days logged because the number of days within each study period varied slightly between groups.

Walking. Daily step counts as recorded on the WalkingWorks Web site were used as the primary measure of walking. A measure of lifestyle index was computed for each participant at each study period. The categories were defined as: active, $\geq$10,000 steps per day; somewhat active, 7500 to 9999 steps per day; low active, 5000 to 7499 steps per day; and sedentary, <5000 steps per day.[25]

Biometric Measures. At each screening, trained staff used a finger stick to measure both nonfasting blood glucose and total cholesterol. Waist and hip circumference were measured and used to compute waist-to-hip ratios. Height and weight were measured and used to compute BMI. Systolic and diastolic blood pressure was also measured.

Survey Measures. Surveys were administered at baseline and at the follow-up screenings at 3, 6, and 9 months after baseline. Measures of stress, mood, and overall health ratings were not included on the 9-month follow-up survey in order to make room for questions regarding program satisfaction.

Mood. Mood was measured using a 10-item scale assessing both positive and negative effects during the past 2 weeks.[26] Participants used a five-point scale ranging from "Very slightly or not at all" to "Extremely" to indicate how inspired, alert, determined, active, attentive, upset, nervous, hostile, ashamed, and afraid they typically felt in the past 2 weeks.

Stress. The 20-item Perceived Stress Questionnaire[27] was used to measure four dimensions of stress: worries, tension, joys, and demands. Questions asked about the frequency (always, often, sometimes, almost never) with which they "have many worries," "feel mentally exhausted," "are full of energy," and "have too many things to do."

Energy. We included an item from the SF-8 Health Survey reading, "During the past 4 weeks, how much energy did you have?" with response options "Very much," "Quite a lot," "Some," "A little," and "None."[28]

Health Status. Self-perceived health status was measured by a single item asking, "in general, would you say your health is . . . " with response options "Very good," "Good," "Fair," "Poor," and "Very poor."[29]

Analyses

Participation. A linear probability model was used to predict the probability of logging steps for at least 1 day within each program period using condition, gender, and age as predictor variables. Generalized Estimating Equations (GEE) as implemented in SAS PROC GENMOD (version 9.1, SAS Institute Inc., 2006) were used to conduct a repeated-measures analysis with the measure of whether or not a participant logged days during each of the four study periods as the dependent variable, and condition, age, and gender as predictor variables. PROC GENMOD was also used to model percent days of total days logged during each time period as a function of condition, age, gender, and lifestyle index. A mixed model with a random intercept was used to model the percent of days logged during each of the four study periods while accounting for the clustering of participants within employer group. These analyses were conducted using empirical standard error estimates to correct for dependence among observations.

Walking. Generalized estimating equations were used to model the average number of steps logged at each study period. A mixed model with random intercept was used to examine the effect of condition on daily step counts while accounting for the clustering of participants within employer group. A repeated-measures linear probability model was used to examine the effects of condition on the probability of logging 10,000 or more steps in a day. These models controlled for age and gender.

Biometric and Survey Measures. To examine the relationship between average number of steps walked in each period on each outcome a mixed model with empirical standard errors and a random intercept was used to model biometric screening results and survey results across the four study periods while accounting for the clustering of participants within employer groups. Analyses were conducted separately for each outcome and controlled for the percent of days logged during each period, age, gender, and condition.

Results

Participants

A total of 459 members enrolled in the program (234 in the enhanced condition and 225 in the standard condition). Participants ranged in age from 19 to 77 years, averaging 49.51 years (SD, 11.12) at baseline, and 56% were female. The enhanced condition had a higher percentage of female participants (61.5%; n = 144) compared with the standard condition (51.1%; n = 115), χ^2 (1) = 5.07, $p = .024$. The average age of participants in the enhanced condition was slightly but not significantly lower (mean, 48.6 years; SD, 11.4) than those in the standard condition (mean, 50.4 years; SD, 11.1), $t(457) = 1.73$, $p = .08$.

Participation

Figure 1 shows unadjusted participation rates by week as measured by the percent of employees who registered for the program that logged steps at least 1 day each week. As shown, participation declined at a greater rate in the standard condition compared with the enhanced condition. During the baseline period, 79% of participants in both conditions logged steps (enhance, n = 185; standard, n = 178). In the final week of the program 40% (n = 95) of those in the enhanced condition were still logging steps vs. only 24% (n = 53) of participants in the standard condition.

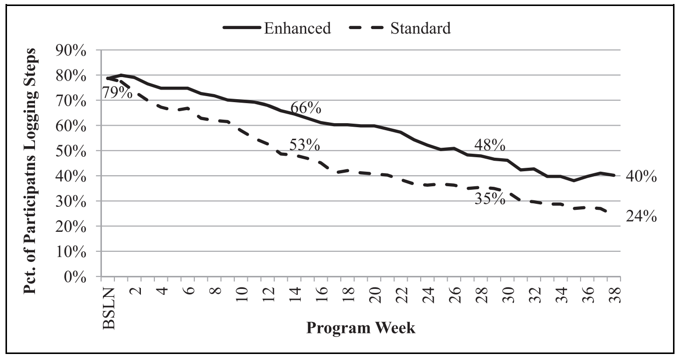

Figure 1. Percent of Participants Logging Steps by Program Week and Intervention Condition.

Logistic regression analyses predicting the probability of logging steps for at least 1 day during each of the program periods, controlling for age and gender, are presented in Table 1. At baseline, there was no difference in the likelihood of logging steps during the baseline period between participants in the standard and enhanced conditions (odds ratio [OR], 0.81; 95% confidence interval [95% CI], 0.50–1.31; $p = .39$). At the first follow-up period, enhanced participants were showing a slight but nonsignificant trend toward an increased likelihood of logging steps (OR, 1.44; 95% CI, 0.86–2.41; $p = .16$). At the second and third follow-up periods, enhanced participants were more likely to log steps than those in the standard condition (OR, 1.78; 95% CI, 1.20–2.64; and OR, 1.86; 95% CI, 1.26–2.74, respectively; $p < .05$).

Analyses of the percent of days logged in each period (Table 2) show that among those who logged steps at least 1 day during the baseline period, participants in the enhanced condition logged steps less often (mean = 87% of baseline days) than did those in the standard condition (mean = 92% of baseline days). The pattern of adjusted means suggests that those in the enhanced condition who were logging steps tended to log more frequently than those in the standard condition, showing statistical significance at the second follow-up period ($p < .023$).

Walking

Figure 2 shows unadjusted average daily step counts within each week of the program for both the standard and enhanced conditions. Participants in both conditions increased their step counts significantly during the first 10 weeks of the program. In the enhanced condition, average daily steps counts exceeded the 10,000 steps per day goal for 24 of the 26 weeks between weeks 5 and 31. There were several rainy days during the 2-week period when step counts averaged less than 10,000 steps. Participants in the standard condition showed a steady decline in step counts after week 10.

Table 1. Logistic Regression Predicting Likelihood of Logging Steps by Study Period.[†]

Parameter	Baseline OR (95% CI)	First Follow-up OR (95% CI)	Second Follow-up OR (95% CI)	Third Follow-up OR (95% CI)
Condition				
Enhanced	0.81 (0.50–1.31)	1.44 (0.86–2.41)	1.78* (1.20–2.64)*	1.86 (1.26–2.74)**
Standard	Ref.	Ref.	Ref.	Ref.
Gender				
Female	2.53 (1.57–4.07)***	2.92 (1.74–4.91)***	1.53 (1.03–2.27)**	1.58 (1.07–2.33)**
Male	Ref.			
Age				
19–29	3.31 (1.46–7.53)*	1.59 (0.64–3.89)	3.63 (1.58–8.35)*	2.32 (0.99–5.42)
30–39	0.46 (0.18–1.11)	0.50 (0.20–1.30)	1.37 (0.74–2.55)	1.65 (0.90–3.03)
40–49	1.00 (0.54–1.86)	0.90 (0.46–1.75)	1.58 (0.95–2.62)	2.17 (1.29–3.65)**
50–59	Ref.			
>60	1.09 (0.57–2.11)	0.98 (0.48–1.98)	1.05 (0.60–1.83)	1.10 (0.64–1.87)

[†]OR indicates odds ratio; CI, confidence interval; and Ref., reference. Odds ratios are adjusted.
*p<.10
**p<.05
***p<.01
****p<.001

Table 2. GEE Models Predicting Percent of Days Logged for Those Who Logged Any Days.*

	Baseline		First Follow-up		Second Follow-up		Third Follow-up	
Parameter	Est. (SE)	p	Est. (SE)	p	Est. (SE)	p	Est. (SE)	p
Constant	0.88 (0.05)	<0.001	0.32 (0.10)	0.001	0.43 (0.13)	<0.001	0.25 (0.13)	0.061
Condition								
Enhanced	−0.05 (0.02)	<0.01	0.04 (0.03)	0.163	0.09 (0.04)	0.023	0.05 (0.04)	0.284
Standard	Ref.							
Gender								
Female	0.03 (0.02)	0.196	0.02 (0.03)	0.587	−0.01 (0.04)	0.747	−0.00 (0.04)	0.995
Male	Ref.							
Lifestyle index								
Active	0.05 (0.03)	0.10	0.25 (0.07)	<0.001	0.16 (0.08)	0.052	0.13 (0.08)	0.124
Somewhat active	0.08 (0.03)	<0.01	0.23 (0.07)	<0.001	0.18 (0.09)	0.034	0.20 (0.87)	0.024
Low active	0.08 (0.03)	<0.01	0.15 (0.07)	0.032	0.06 (0.09)	0.455	0.20 (0.88)	0.024
Sedentary	Ref.							
Age	−0.00 (0.00)	0.651	0.01 (0.00)	0.004	0.00 (0.00)	0.077	0.01 (0.00)	0.005
Effect	**Adj. Mean (SE)**	**p**	**Adj. Mean (SE)**	**p**	**Adj. Mean (SE)**	**p**	**Adj. Mean (SE)**	**p**
Condition								
Enhanced	0.87 (0.01)	<0.001	0.74 (0.03)	<0.001	0.77 (0.03)	<0.001	0.71 (0.03)	<0.001
Standard	0.92 (0.01)	<0.001	0.69 (0.03)	<0.001	0.69 (0.03)	<0.001	0.66 (0.04)	<0.001

* Est. indicates Estimate; Ref., reference; and Adj., adjusted.

The results of a repeated-measures mixed model using four observations per participant show the adjusted mean number of steps by program period for participants in the enhanced vs. standard conditions (Table 3). Participants in the enhanced condition walked significantly more steps at every program period. The interaction between time period and condition was not significant, indicating that the difference in average number of steps remained constant across all program periods.

The results seen in Table 3 show trends by study period and condition, but they lose a lot of information by collapsing daily step counts into four observations per participant. A separate repeated-measures mixed model accounting for the nesting of participants within employer groups was used to examine the effect of condition on step counts recorded at the daily level. This model showed nonsignificant effects of age and gender but a significant effect of condition, $F_{(1, 376)} = 4.34, p = .038$. The least squared means produced by this model estimated that those in the enhanced condition averaged significantly more steps per day (mean, 9732; SE, 236) than those in the standard condition (mean, 9006; SE, 268), $p < .001$ throughout the course of the program.

A repeated-measures linear probability mixed model accounting for the nesting of participants within employer groups showed that the probability of logging 10,000 or more

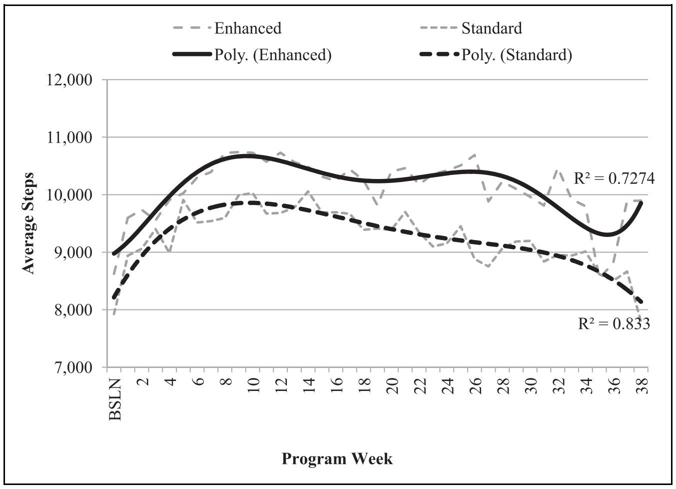

Figure 2. Average Steps by Program Week and Intervention Condition.

Table 3. Average Number of Steps Walked per Program Period Adjusted for Age and Gender.

	Enhanced		Standard			
Study Period	n	Mean (SE)	n	Mean (SE)	Difference	*p*
Baseline	184	8637 (234)	178	7957 (257)	973	0.003
First follow-up	202	10006 (252)	178	9353 (293)	845	0.031
Second follow-up	158	10266 (279)	120	9268 (364)	998	0.028
Third follow-up	123	9507 (277)	83	8531 (378)	976	0.036

steps in a day was 8% greater for participants in the enhanced condition (47.1%) than those in the standard condition (39.1%), $Z = 2.33$, $p = .020$

Biometric and Survey Outcomes

Table 4 shows the results of models examining the impact of average daily step counts, percent of days logged (as a measure of motivation or interest in the program), and condition on biometric and psychologic outcomes. Separate mixed models accounting for the clustering of participants within employer group were run for each outcome, including: weight, BMI, waist-to-hip ratio, systolic and diastolic blood pressure, glucose, total cholesterol, energy, stress, mood, and overall health. Regardless of condition, increased step counts were associated with weight reductions and improvements in waist-to-hip ratios in males, and improvements in BMI for both males and females. Increases in step counts were also associated with self-reports of having more energy, increased positive effect, and higher ratings of overall health.

Discussion

This paper describes the effects of two worksite walking interventions on program participation, average daily step counts, biometric outcomes, and psychologic outcomes. Results show that the enhanced intervention had a strong positive effect on participation rates and on average daily step counts. Those in the enhanced group averaged 726 more steps on a daily basis, were more likely to reach the 10,000 step-per-day threshold, and continued logging steps more frequently throughout the 9-month study period (40% of enhanced participants at the end of the study vs. 24% for the standard group). The observed changes in cholesterol during the final study period were not associated with walking but likely attributable to the measure being taken in early January, immediately following the holidays.

We demonstrated that regardless of condition, higher step counts were linked to positive changes in several health outcomes. On average throughout the study period, a 1000-step increase in average daily steps was associated with significant weight loss for both men (−3.8 lbs.) and women (−2.1 lbs.), along with reductions in BMI (−.41 for men, −.31 for women). Moreover, higher average step counts were also associated with having more energy, improved mood, and more positive ratings of overall health.

These findings are consistent with other walking-based studies reported in the literature, including a meta-analysis of nine pedometer-based randomized controlled trials and prospective cohort studies[11] that found that participants decreased weight by an average of 2.8 lbs. in these studies, with a median duration of 16 weeks. Similarly, in a study of pedometer-based activity of sedentary workers at five workplaces, Chan et al[30] reported that during a 12-week study period, participants increased their daily steps from 7029 at baseline to 10,480 by the fourth week of the intervention. Results showed a significant relationship between reductions in waist girth and heart rate and increase in steps per day.

Limitations

The enhanced condition included several elements intended to maintain high levels of participation and increase average daily step counts. One limitation of this study is that our design did not allow us to determine the relative impact of these interventions elements on participation rates and walking. A second limitation is that analyses rely on participant reports of daily step counts and there is no way to determine the validity of the steps that participants recorded, thereby increasing measurement error and reducing the likelihood of finding statistically reliable effects of step counts on outcome measures. In addition, we did not systematically measure the amount of program promotion at the worksites in the standard condition. Also, analyses examining changes in health outcomes over time use step counts as the only measure of physical activity and do not account for other types of

Table 4. Biometric and Survey Outcomes.[†]

Outcome	Intercept	Average Steps ×1000	Average % Days Logged	Enhanced Condition	Female	Age	First Follow-up	Second Follow-up	Third Follow-up
Biometric measures									
Weight									
Males	245.24*	−3.780*	−5.996	2.494	—	−0.005	−1.953**	−2.415**	0.635
Females	204.64*	−2.100**	11.040	−5.474**	—	−0.457	−1.016***	−0.941	−0.783
BMI									
Males	32.19*	−0.410*	0.176	0.398	—	0.030	−0.744*	−0.742*	−0.922*
Females	31.92*	−0.310***	0.210	−0.871	—	−0.003	−0.474**	−0.530*	−0.219
Waist-to-hip ratio									
Males	0.88*	−0.003****	−0.002	0.020****	—	0.002*	−0.011**	−0.015*	−0.017**
Females	0.78*	−0.002***	0.019	0.005	—	0.001**	−0.022*	−0.015*	−0.020*
Systolic BP	109.60*	−0.080	−2.150	−0.314	−6.070*	0.414*	−1.577****	−1.221	2.185**
Diastolic BP	74.62*	−0.190	−1.356	0.627	−3.156*	0.123*	−1.158*	1.139**	1.036**
Glucose	87.48*	0.070	−2.869	2.869	−8.070*	0.357*	−0.637	−1.680	1.518
Total cholesterol	158.40*	−0.400	3.832	3.410	12.822*	0.487*	−2.793	4.069****	15.860*
Survey measures									
Energy	3.07*	0.035**	−0.097	0.031	−0.141****	0.003	0.152	0.056*	—
Stress									
Joy	2.71*	0.017****	0.053	0.004	−0.105****	−0.004	0.024	0.023	—
Tension	2.15*	−0.001	0.012	0.017	0.083**	−0.002	−0.040****	−0.005	—
Worries	1.98*	0.007	−0.009	0.035	0.162**	−0.005****	−0.068**	−0.040	—
Demands	2.36*	0.008	0.059	−0.003	0.130**	−0.004***	−0.050****	−0.040	
Mood									
Negative effect	1.75*	0.009	−0.103	0.050	0.146**	−0.003	−0.096**	−0.110**	−0.137*
Positive effect	3.03*	0.025*	0.064	−0.002	−0.089***	0.003	0.131*	−0.009	−0.013
Overall health	3.42*	0.046*	−0.041	−0.001	−0.065	0.007	0.244*	0.172*	—

[†]BMI indicates body mass index; and BP, blood pressure.
*p<.10
**p<.05
***p<.01
****p<.001

physical activity that participants may have engaged in that would have contributed to health outcomes. Despite this limitation, we demonstrated meaningful relationships between step counts and improvements in physical health and psychologic well-being. Anecdotally, we know of one group in the standard condition that did a substantial amount of promotion, including regular raffles for top walkers, allowing shift managers to incorporate a preshift walk with their staff, and offering occasional weekend step challenges. Although this worked against finding an intervention effect, analyses still showed that participation rates and step counts were higher in the enhanced condition. Finally, although groups were randomly assigned to condition, participants in the enhanced condition had higher average step counts at baseline. Although all study participants were asked not to alter their daily walking behavior during the baseline period, it is possible that those in the enhanced condition may have increased steps more because of increased interest in the upcoming program, including anticipated feedback comparing them with other groups. Nevertheless, the baseline differences between the groups do not have an impact on the finding that the increase in steps regardless of group is associated with positive health outcomes.

Conclusions

To conclude, program enhancements were substantially robust to show strong positive effects on participation and walking behavior. It is informative that the group in the standard condition whose on-site program administrator introduced her own program enhancements elicited participation rates that were close to the participation rates observed in the enhanced condition. We interpret this as further evidence that higher levels of promotion and providing ongoing feedback and rewards produce high levels of engagement in worksite walking programs.

Future interventions might also include organized group walks on a regular basis, because this has been shown to increase physical activity in group settings.[31]

SO WHAT? Implications for Health Promotion Practitioners and Researchers

What is already known on this topic?

Walking interventions have been shown to be effective at getting people to increase their daily activity levels and improve physical and mental health. In particular, walking at least 10,000 steps daily is a marker for an active lifestyle and is linked to improvements in waist circumference, BMI, and mood.

What does this article add?

Although pedometer- and accelerometer-based walking intervention studies have been reported in the literature, generally they have included small populations, do not test different intervention characteristics, and have limited follow-up periods. This workplace study is of substantial size, tests two interventions across six worksites during a 9-month period, documents the value of adding incentives and extra encouragement to keep people committed to reaching the goal of walking 10,000 steps daily, and associates step counts with improvements in biometric and psychologic outcomes.

What are the implications for health promotion practice or research?

Program promotion coupled with ongoing feedback and rewards produce high levels of sustained participation and physical activity.

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