Research and Best Practice

Impact of a pedometer-based physical activity challenge on behavioral, biomedical, anthropometric and psychological outcomes in hospital employees: An interventional study

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Abstract

Background Health promotion programmes often incorporate the use of a pedometer to increase physical activity (PA). Although many studies have examined the influence of the pedometer on PA at the workplace, very few have directly targeted hospital employees and the anthropometric, biomedical, psychological, and behavioral benefits they could experience following a pedometer-based PA intervention. The aim of the present study was to examine the anthropometric, biomedical, psychological and behavioral benefits associated with the use of a pedometer in a PA challenge with a wide range of hospital employees.

Methods A total of 310 employees of a university-affiliated multi-site healthcare centre in Canada, from 24 to 70 years of age and of different types of jobs and work schedules, were voluntarily enrolled in an eight–week pedometer-based PA programme aimed at increasing PA as well as improving fruit and vegetable consumption. Data were collected at baseline and after the eight-week challenge using clinical measurements and questionnaires that were classified into five categories: socio-demographic, anthropometric, biomedical, psychological, and behavioral. Paired sample t-tests were conducted on the baseline and post-programme data to detect significant differences between the measurement points. Further analyses, including univariate analyses of covariance, were conducted on the post-programme scores to detect significant differences in the study variables between pedometer-determined PA groups.

Results Behavioral, biomedical, anthropometric and psychological benefits were associated with the PA intervention. Hospital employees also exhibited significant changes in anthropometric measures, such as lower weight and body mass index which is in line with previous studies. The present intervention also led to an increase in moderate PA and to a decrease in time spent sitting, to improvements in biomedical and psychological outcomes.

Conclusion The results highlight that the use of a pedometer is associated with significant increases in PA and significant decreases in weight, BMI, blood pressure and cholesterol as well as in stress, fatigue and sleep problems. This underscores the importance of such interventions in the hospital setting.

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Introduction

Physical activity (PA) is associated with many health benefits. Nonetheless, according to the World Health Organization (WHO), less than 40% of the world's population exercises (1). Physical inactivity is currently the fourth leading global risk factor for mortality and accounts for 6% of deaths and 2% of disability-adjusted life years worldwide (2).

There are many reasons why the workplace is the best setting for encouraging people to participate in PA. The workplace is available to all employees and a significant amount of time is spent there, making it an ideal environment with which to reach a large number of individuals and to modify employees' behavior (3;4). Also, workplace health promotion activities provide an opportunity to promote and advocate for the psychological and physical health benefits of PA (4).

When changes are made in the workplace, risk factors for chronic disease can be reduced and employees' health improved accordingly. There are also positive results for the employer, such as reduced absenteeism, lower accident rates,

Research and Best Practice

improved efficiency and productivity, increased job satisfaction, more staff interaction, and better workplace morale (4-6).

Health promotion programmes often incorporate the use of a pedometer to increase PA. The pedometer, or step counter, is a small, light, electronic device that is generally clipped to an individual's clothing at the hip. It is a measurement tool which estimates distance traveled by foot by recording the number of steps taken. Pedometers are ideal for health promotion interventions because they are inexpensive, costing US$20 to US$35 apiece. As pedometers provide an approximate calculation of distance travelled by an individual, they are a simple and efficient way to measure PA. Health promotion programmes often set a goal of 10,000 daily steps to encourage increased PA (6). Pedometer programmes are often combined with motivational reminders, such as internet-based motivational messages, motivational interviewing or challenges to encourage a successful increase in PA (6;7).

The aim of the present study was to examine the benefits associated with the use of a pedometer in a PA challenge with hospital employees from all job categories. It was hypothesised that hospital employees would experience anthropometric, biomedical, psychological and behavioral benefits following the intervention and that taking all these outcomes into account simultaneously would help to better justify resource allocation for similar preventive intervention programmes for employees in the healthcare setting.

Method

Study Design

A pre-test and post-test study design was used to examine changes in behavioral, biomedical, anthropometric and psychological outcome questionnaires (8-14).

Recruitment

Participants were recruited in a university-affiliated multi-site healthcare centre in Canada comprised of six hospitals and one administrative site with over 10,000 employees. Recruitment took place at each site in areas frequented by most employees - such as the main entrance or close to the cafeteria in order to recruit staff with different types of jobs and work schedules. Interested employees booked an appointment for a pre-screening evaluation. Inclusion criteria included being a hospital employee and successfully completing the Physical Activity Readiness Questionnaire (PAR-Q). Individuals who answered yes to any question on the PAR-Q were further screened by a health professional. Candidates who were pregnant, had a cardiovascular disease, or a serious orthopaedic problem that could be made worse with exercise, needed clearance from a physician.

Intervention

The "Wellness Challenge" intervention comprised a one-hour on-site lunch lecture, 30-minute one-on-one pre- and post-evaluations during work hours and the eight-week pedometer activity challenge (September 19 to November 13, 2011). The activity challenge involved tracking step counts, step equivalents of other physical activities, as well as tracking fruit and vegetable consumption on a website. The lunch-hour lecture provided information on PA and nutrition as well as instructions on proper pedometer use. A goal of 10,000 steps and a goal of being the first site to cross Canada virtually as a group was used as motivators. The website allowed participants to see their progress as individuals, as a team and as an entire group (measurement of how many times they walked around the world). The website developed by the CHIP (Complete Health Improvement Program) team (comprised of trained and licensed facilitators) also provided health risk assessments and educational modules on various health factors—including cardiovascular disease, blood pressure, cholesterol, smoking, sleep, stress, depression, exercise, weight loss, and nutrition. Participants were invited to register with partners or as small groups, with colleagues from their department, to enhance social support. All eligible participants received a pedometer at the lecture and a code to access the programme website.

Assessments

Data were collected at baseline and after the eight-week challenge using questionnaires completed by participants (by mail and in person) as well as clinical measurements collected by trained staff during the pre- and post-screening evaluations at the workplace. Clinical measurements and questionnaires were classified into five categories (15): socio-demographic, anthropometric, biomedical, psychological and behavioral.

Socio-demographic

Date of birth, gender, smoking status, presence of cardiovascular disease (CVD) and diabetes, family history of CVD and diabetes, and current medications were collected at the pre- and post-screening evaluations

Anthropometric

Trained staff measured weight, waist circumference and height at baseline and at the end of the programme.

Research and Best Practice

Biomedical
Blood pressure was measured by trained staff at both the pre- and post-screening. Two blood-pressure measurements were taken using an automatic blood-pressure monitor (Lifesource UA – 767) after five minutes of quietly sitting and the lower of the two blood-pressure values was used. Participants were given blood-test requisition forms six weeks prior to the start of the challenge and were invited to do a 12-hour fasting blood test at an MUHC hospital site prior to the baseline screening day. Two weeks before the end of the challenge, participants were given a second requisition form, to have the blood tests repeated. Blood measures included total cholesterol, LDL and HDL cholesterol, triglycerides and fasting glucose. Results were sent to a physician from the McGill Cardiovascular Health Improvement Program.

Psychological
Psychological questionnaires were completed by the subjects at the pre- and post-screening.

- Fatigue. Participants completed the four-item general fatigue subscale of the multidimensional fatigue inventory (8) on a five-point Likert scale. Cronbach's alpha was 0.80 at both baseline and post-programme.

- Insomnia. Participants completed the seven-item insomnia severity index (9). This questionnaire evaluates insomnia severity on the basis of difficulty falling asleep, difficulty staying asleep at night, difficulty waking up in the morning and daytime impairment. Items are scored on a four-point Likert scale. Cronbach's alpha was 0.89 at baseline and 0.85 at the end of the programme.

- Stress. Participants completed the 10-item perceived stress scale (10;11) at both measurement points. Sample item is "In the last month, how often have you been upset because of something that happened unexpectedly?". Cronbach's alpha was 0.88 at baseline and 0.89 at the end of the programme.

- Worklife. This questionnaire was completed both at baseline and at post-programme. Recently validated in both French and English (12), the Worklife Pulse survey is a 21-item questionnaire developed by Accreditation Canada and the Ontario Hospital Association. This survey provides a quick snapshot of a healthcare organisation's work environment and of employees' physical and psychological well-being. The survey is composed of four subscales: work environment, health, work adjustment, and absenteeism/health-related presenteeism. Cronbach's alpha varied between 0.64 and 0.92. All items are self-reported on Likert-type scales.

Behavioral (PA information)
Participants reported their daily steps on the website for the duration of the eight-week programme and were classified into pedometer-determined PA groups based on Tudor-Locke and Basett guidelines (13): sedentary participants were defined as those logging less than 5,000 steps per day, low active participants as those logging 5,000 to 7,499 steps per day, somewhat active participants as those logging 7,500 to 9,999 steps per day, active participants as those logging 10,000 to 12,499 steps per day and highly active participants as those logging more than 12,500 steps per day.

International Physical Activity Questionnaire (IPAQ)
Participants completed the short, self-administered format of the IPAQ for young and middle-aged adults (14) at both measurement points. This questionnaire is composed of questions assessing participants' physical activity level over the previous seven days. Participants are asked to indicate on how many days they did vigorous and moderate intensity PA and the number of days on which they walked for at least ten minutes at a time. Participants are further required to specify for how long they performed these activities on a typical day. Finally, participants are asked to report how much time they spent sitting on a typical week day. Continuous variables are created for each level of PA by weighting reported minutes per week within each activity category by a MET energy expenditure estimate assigned to each category of activity (for a detailed description of the origin of the MET levels (14)). A total MET variable is also created. The reliability and validity of the IPAQ is well documented (14).

To detect a medium effect size (Cohen's d of 0.5) with a statistical power of 0.80, it was estimated that a minimum total sample size of 130 participants was required. Given the longitudinal design of the study, the goal was to recruit at least twice this minimum total sample size at baseline (i.e., n=300).

Statistical analyses
Paired sample t-tests were conducted on the baseline and post-programme data to detect significant differences between the measurement points for the final sample. This analysis was preferred because it permits the detection of changes by comparing the exact same sample of participants at two measurement points. Furthermore, univariate analyses of covariance were conducted on the post-programme scores (while controlling for baseline scores) to detect significant differences in the study variables between pedometer-determined PA groups. All analyses were conducted with SPSS 20.0.

Research and Best Practice

Ethics
Participants gave written consent to participate. The study was approved by the healthcare organisation's research ethics committee (reference number 10-066-PSY).

Results
At baseline, 310 participants completed the pre-screening evaluation and 259 completed the blood test. During the pedometer programme, 76 participants were lost to attrition. At the end of the programme, 235 (75.5%) participants attended the post-screening; this sample size was large enough to confirm the statistical power of 0.80 (Table 1).

Table 1 Socio-demographics of final sample

Gender	92.3% female	
Age	Average = 47.6 (SD = 9.1), range from 24 to 70	
Job Title	Nurses	21.8%
	Technicians	12.7%
	Professionals *	16.2%
	Clerical services	25.8%
	Managers	10.5%
	Others **	13.1%
Experience	Average = 12.4 years (SD = 10.6)	
Work Full-time	87.4%	
Fixed daytime schedule	92.2%	
Takes blood-pressure medication	8%	
Familial history of cardiovascular disease	30%	
Familial history of diabetes	44.7%	

* e.g., advisors, staff consultants, staff officers, analysts
** e.g., research assistant, coordinators, personal support workers

It was found that a greater proportion of men failed to complete both measurements (38.7% of men and 20.2% of women completed only baseline measurements) and that participants who completed only the baseline measurements had higher stress scores (average = 16.1, SD = 7.0) than those who completed both measurements (average = 14.1, SD = 5.9, $t(1, 307) = 4.32$, $p = 0.038$).

Detailed paired-sample t-tests' results are shown in Table 2.

Anthropometric
A significant decrease in participants' weight and body mass index (BMI) was observed post-programme compared to baseline. Obese participants lost an average of 0.8 kg ($t(51) = 2.14$, $p = 0.037$).

Biomedical
A significant reduction in both systolic blood pressure and diastolic blood pressure was observed. Participants' total cholesterol also dropped significantly, which was primarily due to the significant decrease in low-density lipoprotein cholesterol. In addition, significant improvements were also noted in participants who had hypertension or abnormal blood lipids (total cholesterol) at baseline.

Psychological
Participants reported significantly lower levels of fatigue post-programme compared to baseline. Of the participants who had a baseline score indicating severe fatigue (higher than the 75th percentile), nearly 54% could be classified as normal post-programme. Similarly, a significant decrease in insomnia was also noted. At baseline, 13.3% of the sample were classified as having insomnia of moderate severity or worse while at post-programme only 6% were classified at this level. Stress levels were also found to be significantly lower post-programme compared to baseline. Paired sample t-tests did not show any significant differences between baseline and post-intervention values for work environment, self-reported health, work adjustment or absenteeism/health-related presenteeism.

Behavioral
Participants' total MET scores did not significantly change between baseline and post-programme. However, a significant decrease in time spent sitting was observed from baseline to post-programme. Furthermore, a significant increase was observed from baseline to post-programme in the number of days participants walked for at least ten minutes at a time.

On average, participants reported 12,428 steps per day (SD = 7,262). Table 3 shows the distribution of the participants in the pedometer-determined physical activity groups (13). Only 13.3% of participants were classified as low active or sedentary, and 54.5% were classified as either active or highly active.

ANCOVA showed significant differences in post-programme BMI between the pedometer-determined PA groups when controlling for baseline BMI ($F(4,227) = 2.84$, $p = 0.025$). BMI of the low active and the somewhat active groups were significantly higher than those of the active and highly active groups.

Similarly, significant differences in post-programme triglyceride were found ($F(4,166) = 2.44$, $p = 0.049$), where the post-programme triglyceride of the somewhat active group were significantly higher than those of the active

Research and Best Practice

Table 2 Clinical measurements & questionnaire variables at baseline and post-program (mean ± SD)

	Baseline		Post-program		t-value	p-value
Weight (kg)	72.40	± 15.30	72.01	± 15.04	3.09	0.002
Waist circumference (cm)	87.42	± 11.50	86.72	± 12.33	1.65	0.100
BMI (kg/m²)	26.80	± 4.92	26.65	± 4.81	3.09	0.002
Total cholesterol (mmol/L)	5.21	± 0.90	5.12	± 0.89	3.33	0.018
High-density lipoprotein cholesterol (mmol/L)	1.59	± 0.43	1.58	± 0.45	0.59	0.558
Low-density lipoprotein cholesterol (mmol/L)	3.15	± 0.76	3.08	± 0.74	2.20	0.029
Triglycerides (mmol/L)	1.08	± 0.78	1.02	± 0.62	1.27	0.207
Fasting glucose (mmol/L)	5.12	± 0.97	5.08	± 0.78	0.91	0.363
Systolic blood pressure (mmHg)	116.66	± 15.46	114.62	± 14.13	3.25	0.001
Diastolic blood pressure (mmHg)	76.77	± 10.43	75.81	± 9.41	1.87	0.063
Fatigue	11.70	± 3.84	10.39	± 3.64	6.04	0.001
Insomnia	7.70	± 5.46	5.82	± 4.48	7.37	0.001
Stress	20.56	± 2.99	19.84	± 3.03	3.69	0.001
Worklife Pulse: work environment	3.65	± 0.75	3.61	± 0.77	0.52	0.606
Worklife Pulse: health	3.46	± 0.64	3.51	± 0.67	-1.66	0.100
Worklife Pulse: work adjustment	3.78	± 0.61	3.74	± 0.64	0.99	0.326
Worklife Pulse: absenteeism/ presenteeism (total number of days)	6.59	± 22.64	5.88	± 18.00	0.63	0.531
Vigorous activity MET	930.72	± 1779.08	923.57	± 1855.35	0.05	0.957
Moderate activity MET	628.47	± 1716.29	600.63	± 1102.35	0.37	0.709
Walking MET	1407.50	± 1938.21	1567.48	± 1928.14	-0.60	0.548
Total MET score	2878.07	± 3474.30	3041.86	± 2914.56	-0.56	0.575
Days walking 10min	5.40	± 1.93	5.87	± 1.59	-3.08	0.002
Sitting (min/week day)	417.16	± 240.15	352.82	± 189.36	3.80	0.001

Table 3 Results of the ANCOVAs (mean ± SD)

	Sedentary		Low Active		Somewhat active		Active		Highly active	
	n = 6		n = 38		n = 63		n = 71		n = 109	
Post-program BMI	31.29	± 7.68	29.02	± 6.05	27.66	± 5.00	25.82	± 4.67	25.49	± 3.616
Post-program triglyceride	0.78	± 0.24	1.10	± 0.54	1.29	± 0.78	0.87	± 0.39	0.95	± 0.62
Post-program fatigue	13.30	± 2.08	11.63	± 3.82	11.40	± 3.51	9.91	± 3.94	9.54	± 3.25

and highly active groups when baseline triglyceride levels were accounted for.

Significant differences in post-programme fatigue scores were also found ($F(4,228) = 2.76$, $p = 0.03$). Specifically, fatigue scores of the low active group were significantly higher than those of the active and the highly active groups. See Table 3.

Discussion

This study shows that the pedometer-based physical activity challenge had multiple positive health outcomes for a wide range of hospital employees. Specifically, behavioral, biomedical, anthropometric and psychological benefits were associated with the PA intervention. Hospital employees also exhibited significant changes in anthropometric measures, such as lower weight and body mass index, which is in line with previous studies (9;23;24;26). The present intervention also led to an in-

Research and Best Practice

crease in moderate physical activity, a decrease in time spent sitting, improvements in biomedical outcomes (blood pressure and cholesterol levels), and psychological outcomes (lower stress level, less fatigue, and sleep problems). The present study was one of the few to look at the psychological impact of a pedometer-based PA challenge (27).

Over the last decade, a large number of studies in which a pedometer was used to assess PA in various populations (20-22) were published.

The pedometer has also been studied in workplace interventions for the promotion of PA (4). These studies demonstrate not only that a pedometer intervention can easily be incorporated into the workplace setting, but also that there are many benefits associated with such interventions, including behavioral, biomedical, psychological, and anthropometric benefits. For instance, some studies show that a greater number of daily steps correlates with a higher serum HDL cholesterol level and a lower ratio of total cholesterol to HDL cholesterol (21), with lower blood pressure (9) as well as with a decrease in BMI and waist circumference (9;23;26). However, there is little research that examines the impact of the pedometer on all these aspects simultaneously and few studies have investigated the psychological outcomes of a pedometer intervention. Furthermore very few have directly targeted hospital employees.

In a recent study (25), healthcare providers wore a pedometer and recorded their daily steps for 12 weeks which led to a reported increase of up to 200 minutes walked and up to 85 minutes in vigorous PA. Unfortunately, no psychological variables other than stress, which was shown to be lower post-intervention, were evaluated and no biomedical outcomes were measured.
In a study focusing exclusively on physicians, it was found that that physicians walked on average 6,010 steps daily at work (28). Two other studies (27;29) also revealed that physicians do not meet current guidelines for PA in the workplace and therefore need to incorporate exercise after work. These studies only measured the number of steps walked daily and no other outcomes were evaluated.

In the hospital employee pedometer studies mentioned above, the participants were almost exclusively physicians and very few variables were assessed.

Strengths and limitations of the study
A strength of this study is the high participation rate (75.5%). The study is also among the few that looks at the benefits of a pedometer-based intervention for various categories of hospital employees and takes into consideration behavioral, biomedical, anthropometric, and psychological outcomes.

The study has few limitations as well. The most important being the absence of a control group. Another limitation is the length of the intervention: the programme only lasted eight weeks. Also, the majority of the participants are women. Further, more dropouts are men, who were also more stressed at baseline, which may influence the generalisation of the results. Social desirability biases may have led to exaggerated reports of physical activity. However, the study also includes objective data (e.g., blood pressure measurements and blood tests). Furthermore, selection bias may have led to a sample of already highly motivated participants. However, the positive outcomes observed were influenced by the programme and not by changes in work environments as none were detected between pre- and post-programme.

Practical implications
This study indicates that implementing a pedometer-based intervention within a hospital setting is an excellent initiative for improving the physical and psychological health of hospital employees at a low cost. Furthermore, motivation and satisfaction with the programme were very high. Considering the positive impact on stress, fatigue, and insomnia demonstrated, this study is also relevant for workplace mental health prevention and management strategies to improve employee well-being. In addition, patients, relatives and the community can also benefit from such programmes that encourage self-management, self-care, and a better quality of life.

This study supports the concept of building health promotion capacity in hospitals and health services as outlined by the WHO International Network of Health Promoting Hospitals and Health Services (30).

Future studies
Future studies should be carried out with subsamples of hospital employees, with a control group, and with longer longitudinal designs.

Results of the analysis conducted for drop-outs show that the drop-outs were more often men than women and also more stressed at baseline. Future research is needed in order to determine if the same changes could be observed in a sample of male with high levels of stress.

Conclusion
In sum, this study substantiates the positive effect of a

pedometer-based PA challenge in many spheres such as behavioral, biomedical, anthropometric, and psychological. The study results underscore the importance of such interventions in the hospital setting and should provide incentive for other hospitals to introduce similar pedometer-based interventions to help keep their employees in good health physically and psychologically.

Contribution Details

Conception and design: CS, MLT, GL, JT, KM
Acquisition of data: KM, IL, SG, MLT, CS
Analysis and interpretation of data: GL, MLT, CS, JL, KM, IL, SG
Drafting the article: CS, MLT, JT, GL
Revising the article critically for important intellectual content: CS, GL, MLT
Final approval of the version to be published: CS, GL, MLT, IL, SG

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References
(1) World Health Organization: Physical Inactivity: A global Public Health Problem 2010. Available from www.who.int
(2) World Health Organization (WHO): Global health risks: mortality and burden of disease attributable to selected major risks. Global health risks: mortality and burden of disease attributable to selected major risks. Geneva: WHO Press; 2009.
(3) Atlantis E, Chow CM, Kirby A, Fiatarone Singh MA: Worksite intervention effects on physical health: A randomized controlled trial. Health Promot Int 2006; 21:191-200.
(4) Thomas L, Williams M: Promoting physical activity in the workplace: Using pedometers to increase daily activity levels. Health Promot J Austr 2006; 17:97-102.
(5) Chan CB, Ryan DAJ, Tudor-Locke C: Health benefits of a pedometer-based physical activity intervention in sedentary workers. Prev Med 2004; 39:1215-22.
(6) Freak-Poli RLA, Cumpston M, Peeters A, Clemes SA (2011): Workplace pedometer interventions for increasing physical activity (Protocol). The Cochrane Collaboration. John Wiley & Sons, Ltd.
(7) Strath SJ, Swart AM, Parker SJ, Miller NE, Grimm EK, Cashin SE: A pilot randomized controlled trial evaluating motivationally matched pedometer feedback to increase physical activity behavior in older adults. J Phys Act Health 2011; 8(Suppl 2):267-74.
(8) Freak-Poli R, Wolfe R, Backholer K, de Courten M, Peeters A: Impact of a pedometer-based workplace health program on cardiovascular and diabetes risk profile. Prev Med 2011; 53:162-71.
(9) Lin JM, Brimmer DJ, Maloney EM, Nyarko E, BeLue R, Reeves WC (2009): Further validation of the Multidimensional Fatigue Inventory in a US adult population sample. Popul Health Metr 2009; 15:7-18.
(10) Morin CM: Insomnia: Psychological Assessment and Management. New York: the Guilford Press; 1993.
(11) Cohen S, Kamarck T, Mermelstein R: A global measure of perceived stress. J Health Soc Behav 1983; 24:385-96.
(12) Cohen S, Williamson G: Perceived stress in a probability sample of the United States. In The social psychology of health: Claremont Symposium on applied social psychology. Edited by Spacapam S, Oskamp S. Newbury Park, CA: Sage; 1988; 31-67.
(13) Lavigne GL, Sounan C, Lavoie-Tremblay M, Mitchell J, MacDonald B: Validation of the French & English versions of the Worklife Pulse survey. Health Care Manager, in press.
(14) Tudor-Locke C, Bassett D: How many steps /day are enough? Preliminary pedometer indices for public health. Sport Med 2004; 34:1-8.
(15) Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, Ainsworth BE, et al: International Physical Activity Questionnaire: 12-Country Reliability and Validity. Med Sci Sports Exercise 2003; 35:1381–95.
(16) Beets MW, Huberty J, Beighle A: Physical activity of children attending afterschool programs: Research and practice-based implications. Am J Prev Med 2012; 42:180-4.
(17) Dollman J, Maher C, Olds TS, Ridley K: Physical activity and screen time behavior in metropolitan, regional and rural adolescents: A cross-sectional study of Australians aged 9-16 years. J Sci Med Sport 2012; 15:32-7.
(18) Peterson JC, Charlson ME, Hoffman Z, Wells MT, Wong S-C, Hollenberg JP, et al: A randomized controlled trial of positive-affect induction to promote physical activity after percutaneous coronary intervention. Arch Intern Med 2012; 172:329-36.
(19) De Cocker KA, De Bourdeaudhuij IM, Cardon GM: The effect of a multi-strategy workplace physical activity intervention promoting pedometer use and step count increase. Health Educ Res 2010; 25:608-19.
(20) Wyatt HR, Peters JC, Reed GW, Grunwald GK, Barry M, Thompson H, et al: Using electronic step counters to increase lifestyle physical activity: Colorado on the Move. J Phys Act Health 2004; 1:181-90.
(21) Bravata DM, Smith-Spangler C, Sundaram V, Gienger AL, Lin N, Lewis R, et al: Using pedometers to increase physical activity and improve health. JAMA 2007; 298(19):2296-304.
(22) Kelley GA, Kelley KS, Tran ZV: Walking and resting blood pressure in adults: A meta-analysis. Prev Med 2001; 33:120-7.
(23) Murphy MH, Nevill AM, Murtagh EM, Holder RL: The effect of walking on fitness, fatness and resting blood pressure: A meta-analysis of randomized, controlled trials. Prev Med 2007; 44:377-85.
(24) LA Freak, Poli R, Wolfe R, Walls H, Backholer K, Peeters A (2011): Par)ticipants characteristics associated with greater reductions in waist circumference during a four-month, pedometer-based, workplace health program. http://www.biomedcentral.com/1471-2458/11/824.
(25) Hess I, Borg J, Rissel C: Workplace nutrition and physical activity promotion at Liverpool Hospital. Health Promot J Austr 2011; 22:44-50.
(26) Abd T, Kobylivker A, Perry A, Miller III, J, Sperling L: Work-related physical activity among cardiovascular specialists. Clin. Cardiol 2012; 35:78-82.
(27) Conzett-Baumann K, Jaggi GP, Husler A, Husler J, Beer JH: The daily walking distance of young doctors and their body mass index. Eur J Intern Med 2009; 20:622-4.
(28) Jatkinson J, Goody RB, Walker CA: Walking at work: A pedometer study assessing the activity levels of doctors. Scott Med J 2005; 50:73-4.
(29) James I, Smith A, Smith T, Kirby E, Press P, Doherty P: Randomized controlled trial of effectiveness of pedometers on general practitioners' attitudes to engagement in and promotion of physical activity. J Sports Sci 2009; 27:753-8.
(30) Sounan C, Lavoie-Tremblay M, Martin K: Promoting healthy employees in health promoting workplaces: The MUHC wellness challenge program [abstract]. Abstract book of the 20th International Conference on Health Promoting Hospitals and Health Services 2012; 2(Suppl):35.