International Journal of Medical, Medicine and Health Sciences
ISSN: 2517-9969
Vol:10, No:10, 2016

Effectiveness of a Malaysian Workplace Intervention Study on Physical Activity Levels

M. Z. Bin Mohd Ghazali, N. C. Wilson, A. F. Bin Ahmad Fuad, M. A. H. B. Musa, M. U. Mohamad Sani, F. Zulkifli, M. S. Zainal Abidin

***Abstract*—**Physical activity levels are low in Malaysia and this study was undertaken to determine if a four week work-based intervention program would be effective in changing physical activity levels. The study was conducted in a Malaysian Government Department and had three stages: baseline data collection, four-week intervention and two-month post intervention data collection. During the intervention and two-month post intervention phases, physical activity levels (determined by a pedometer) and basic health profiles (BMI, abdominal obesity, blood pressure) were measured. Staff (58 males, 47 females) with an average age of 33 years completed baseline data collection. Pedometer steps averaged 7,102 steps/day at baseline, although male step counts were significantly higher than females (7,861 vs. 6114). Health profiles were poor: over 50% were overweight/obese (males 66%, females 40%); hypertension (males 23%, females 6%); excess waist circumference (males 52%, females 17%). While 86 staff participated in the intervention, only 49 regularly reported their steps. There was a significant increase (17%) in average daily steps from 8,965 (week 1) to 10,436 (week 4). Unfortunately, participation in the intervention program was avoided by the less healthy staff. Two months after the intervention there was no significant difference in average steps/day, despite the fact that 89% of staff reporting they planned to make long-term changes to their lifestyle. An unexpected average increase of 2kg in body weight occurred in participants, although this was less than the 5.6kg in non-participants. A number of recommendations are made for future interventions, including the conclusion that pedometers were a useful tool and popular with participants.

***Keywords*—**Pedometers, walking, health, intervention.

I. Introduction

PHYSICAL inactivity is a major health risk behaviour in Malaysia, with a significant proportion of the adult population classified as inactive with estimates ranging from 20% [1] to 60% [2]. In addition, the prevalence of overweight and obesity in Malaysia has continued to rise from 4.4% in 1996 [3] to 14.0% in 2006, with the highest prevalence seen among adults aged 45-49 years [2]. This trend appears to be continuing, as evidenced by the results from 4,428 Malaysian adults from five regions in 2008 where the obesity level had increased to 19.5% [4]. Both physical inactivity and obesity are recognised as burdens on health care costs, a reduction in the quality of life and are associated with an increased incidence of cardiovascular disease and diabetes [5].

While the dangers of a sedentary lifestyle are well recognised, the effectiveness of different interventions to promote a more active lifestyle is less clear. Workplace interventions have the potential to reach a broad and captive audience. Recently there have been a number of systematic reviews and meta-analyses [6]-[10] on the effectiveness of workplace interventions. The general consensus is that workplace interventions have small positive effects on physical activity and those promoting walking as opposed to other forms of physical activity were more effective.

The use of pedometers has been recognised as one of the most cost-effective interventions to promote physical activity [11] and the use of pedometers in workplace interventions is a growing area of interest. Freak-Poli and colleagues [12] identified that participation is usually associated with a goal-setting competitive component with variations in the programs including teams, group facilitators, weekly meetings, health information, encouragement emails and a website for logging steps. Bravata and colleagues [13] systematically reviewed the literature and found overall pedometer users increased their physical activity by 27% over baseline and an important predictor of increased physical activity was having a step goal. However, they found that workplace interventions using pedometers were associated with a relatively smaller increase in physical activity levels, as participants tended to have relatively high baseline physical activity levels. Kang *et al.* [14] looked at the influence of the length of pedometer-based interventions and based on the results of 50 studies that the effect size for interventions shorter than eight weeks was moderate to high (0.68). While interventions lasting longer than 15 weeks had a slightly higher effect size (0.76), they concluded that the additional cost and feasibility probably did not warrant the extension of the program beyond eight weeks.

The purpose of the current study was to assess the effectiveness of a four week pedometer-based physical activity workplace program on the levels of physical activity and health measures.

II. Methods

Participants were all employees of four divisions of the Ministry of Youth and Sport (KBS), Putrajaya, Malaysia. The data were collected between February and July 2012. The study was approved by the ISN (Institut Sukan Negara) research committee and the KBS Management committee.

Mohd Zaid Bin Mohd Ghazali, Noela C Wilson, Ahmad Faiz Bin Ahmad Fuad, Mohd Uzaini and Muhamad Sukur Zainal Abidin are with the Division of Research & Education, National Sports Institute of Malaysia, Malaysia.

Muhamad Azizul Hakim B. Musa is with the Information Technology Department, National Sports Institute of Malaysia, Malaysia.

Mohamad Uzaini and Fazulia Zulkifli are with the Ministry of Youth and Sports, Malaysia.

Mohd Zaid Bin Mohd Ghazali is with the Division of Research & Education, National Sports Institute of Malaysia (phone: +60123588835, e-mail: isn.sharm01@gmail.com).

The study was conducted in three phases: The baseline data collection, four-week pedometer-based intervention program and two-month post intervention data collection.

A. Baseline Data Collection

After reading the information sheet and signing the consent form, height, weight, waist circumference, blood pressure and step length were determined. Each participant was given a short explanation on the use of the pedometer and a demonstration on how the pedometer should be worn (attached to the belt or waist band and suspended vertically over the midline of the thigh). Each staff member was asked to wear the pedometer (OMRON HJ113) for seven consecutive days during waking hours (except for showering and swimming). The staff who participated was asked to continue their normal activities and was also asked to complete a daily physical activity diary.

Height and Weight: A combined SECA scale and stadiometer was used to determine the weight and height of participants. Staff members were asked to remove their shoes and empty their pockets prior to weighing. The measurements for height were taken to the nearest 0.1 cm on two or three times. Two or three measurements of weight were taken to the nearest 0.1kg. Waist circumference (an estimate of abdominal obesity) was measured by tape measure (to the nearest 0.5 cm) in a horizontal plane, midway between the inferior margin of the ribs and the superior border of the iliac crest. This measurement was repeated.

Blood pressure was measured on the right arm using the automated Omron machine (HEM7080) on two occasions after a minimum of 10 minutes rest.

B. Intervention

This intervention named 'Jom Berjalan Malaysia' or 'Let's Move Malaysia' was based on the socio ecological model [15] which recognizes that to increase physical activity, efforts need to focus not only on the behavior choices of each individual, but also on factors that influence those choices. These factors include the social environment, the physical environment and policy. Participants were provided with a pedometer (Omron HJ005) and each staff member was assigned to one of nine groups, with each group consisting of ~10 individuals. Within each group, the steps walked were accumulated and each group attempted to simulate walking around Malaysia over the four-week period (Fig. 1). This represented an average of ~7,600 steps/day for each member of the group. A web-based data entry system was developed to monitor the impact of the intervention and to provide feedback to participants.

A member of the testing staff was assigned to monitor each group and act as a group leader. Each participant was asked to record the number of steps they completed each day in the web-based system. When participants did not have access to the Internet, they recorded their daily steps manually on a calendar and the staff monitoring the group entered the data into the database. Weekly checks were conducted by the monitoring staff to ensure the data was being entered as requested.

As a motivation to participate in the intervention and to provide a social environment, weekly group prizes were awarded to the best performing team, with an overall group prize awarded at the end of the competition. All participants who participated in the three phases of the program were allowed to keep the pedometer. Thus, the socio-ecological model multilevel strategies were implemented as follows: Individual-education (portal), program feedback (pedometer use, health report after baseline), motivation (tips to increase activity), self-monitoring (pedometer) and goal setting (walking around Malaysia); Social environment-team membership, team competition (weekly prizes and overall prize for best team); Physical environment-encouragement to use the surrounding area for walking; and Policy-active encouragement from Senior Management, recognition at Assemblies.

At the end of the intervention, participants had their health measurements (weight, waist circumference and blood pressure) re-measured to determine the immediate effect of the intervention program following the baseline protocols. In addition, participants were asked to complete an anonymous feedback questionnaire on their experiences during Stage II.

Two months following the intervention, the measurements completed during the baseline phase were repeated using the same protocols.

C. Data Treatment

All data were entered into an excel spreadsheet. Data from pregnant women was excluded. Individual's step data was included in calculation of the average steps/day if the monitor had been removed for < 3 hrs/day; there were data from at least three days including one weekend day and one weekday [16]; and the pedometer count was at least 800 steps/day. Average steps were calculated and each staff member was assigned to an activity level [17]: High (12,500+steps/day), Active (10,000-12,499), Somewhat active (7,500-9,999), Low (5,000-7,499) or Sedentary (<5,000).

Body Measurements. The median values for the three (or mean of two) height and weight measurements were used to calculate BMI and then each subject was assigned to a category of weight status using the standard World Health Organization classification. Abdominal obesity was estimated by the measurement of waist circumference, where individuals with a waist circumference of >85 cm (males) and >80 cm (females) are considered to have an increased cardiovascular risk [18].

Blood pressure levels were defined as: normal systolic <120 and diastolic <80; pre-hypertensive systolic 120-139 or diastolic 80-89; hypertensive systolic >140 or diastolic >90 [19].

T-tests were used to calculate significant differences between means and the z-test to calculate the differences between percentages. P<.05 was considered significant.

International Journal of Medical, Medicine and Health Sciences
ISSN: 2517-9969
Vol:10, No:10, 2016

III. Results

A. Baseline

From the 166 eligible staff, a total of 122 staff participated during the baseline data collection (74% response rate), however both pedometer and health data were only collected on 105 staff (63% response rate). The mean age of the staff was 33 ± 9.5 years and the majority were Malay (93%) with a college/university education (71%). There were no significant differences in age, ethnicity or education level between males and females.

From	To	Dist
KL	Melaka	150
Melaka	Johor Bahru	230
Johor Bahru	Mersing	130
Mersing	Kuantan	200
Kuantan	Koto Bahru	350
Koto Bahru	Butterworth	270
Butterworth	Ipoh	140
Ipoh	KL	200
Approx total 1,700 km		

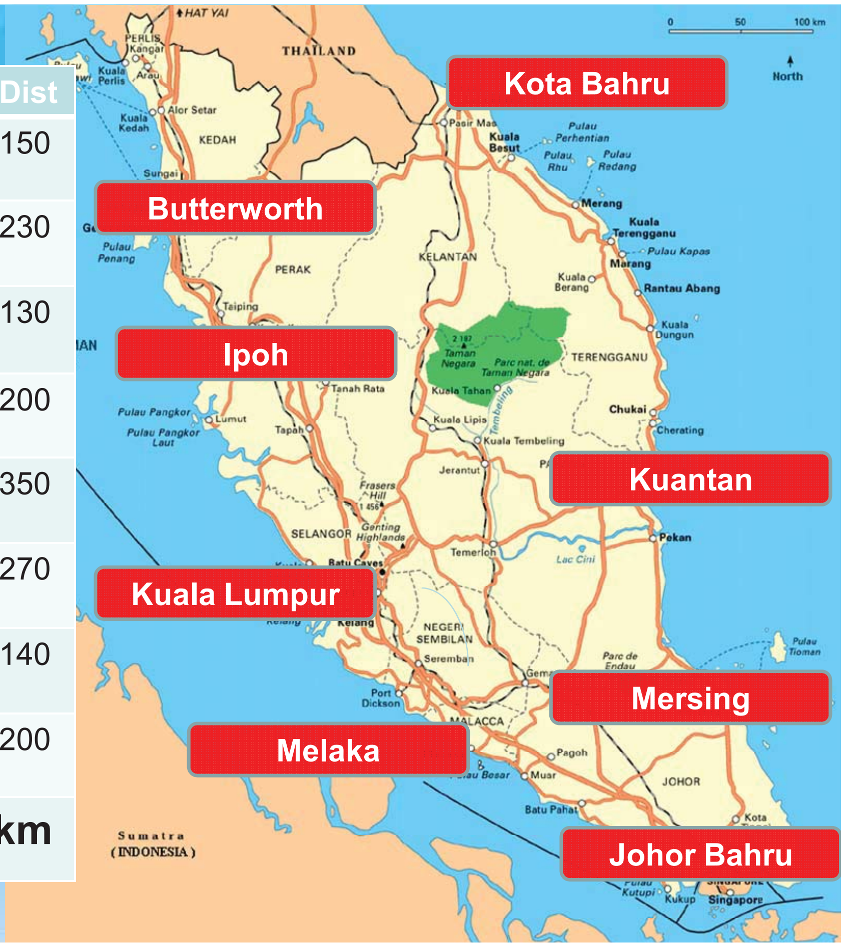

Fig. 1 Distances around Malaysia

The health profile of the participants was poor (Table I) with over 50% either overweight or obese. Sixty-six percent of males were overweight/obese compared with 40% of females. Only 17% of females but 52% of males had a waist circumference suggestive of cardiovascular risk. Hypertension was also high in males (23%) compared with only 6% of females. When these data are combined to look at the number of risk factors (overweight/obesity, inactivity, excessive waist circumference and high blood pressure) for each individual, 25% of males had all four risk factors putting them at risk of premature death. On the other hand, the female staff had a major healthier risk profile with 80% having zero or one risk factor.

The average number of steps walked per day was 7,102 (Table II), with the average number of steps being greater on weekdays compared with weekends (7,654 vs. 5,724). Males averaged a significantly higher number of steps (7,861) compared to females (6,114). Using the internationally recognized cut-off figure of 7,500 steps/day [17], only 53% males and 20% females achieved this. In addition, over one-quarter (28%) of females were in the sedentary category (<5,000 steps/day).

B. Intervention

A total of 86 staff participated in the intervention, although only 49 (57%) regularly reported their pedometer data either manually or in the database. The average daily steps completed by each participant increased significantly from an average of 8,965 (week 1) to 10,436 (week 4), an average increase of 17% (Table III). The average number of steps reported by females was significantly lower than males throughout the four weeks.

TABLE I
BASELINE HEALTH STATUS

	Total (n = 105)	Male (n = 58)	Female (n = 47)
Weight Status			
Underweight (BMI <18.5)	8%	3%	13%
Normal (BMI 18.5-25)	38%	31%	47%
Overweight (BMI >25 - <30	34%	42%	25%
Obese (BMI 30+)	20%	24%	15%
Excess Waist Circumference >85cm males, >80cm females	37%	52%	17%
Blood Pressure			
Normal: Systolic <120 and Diastolic <80;	46%	28%	70%
Pre-Hypertensive: Systolic 120-139 or Diastolic 80-89;	38%	49%	24%
Hypertensive: Systolic >140 or Diastolic >90.	16%	23%	6%
Number of Risk Factors*			
0-1	52%	29%	80%
2-3	32%	46%	15%
4	16%	25%	5%

*Four risk factors: obesity/overweight, inactivity (sedentary/low), pre-hypertensive/hypertensive, excess waist circumference

TABLE II
BASELINE PEDOMETER STEPS

		Total (n = 105)	Male (n = 58)	Female (n = 47)
Weekday steps/day		7,654±2,740	8,547±2,939	6,489±1,935^
Weekend steps/day		5,724±2,642*	6,145±2,664*	5,175±2,536*
Average steps/day		7,102±2,321	7,861±2,470	6,114±1,673 ^
Steps/day	**Category**			
12,500+	High Active	2%	4%	0%
10,000-12,499	Active	9%	15%	2%
7,500-9,999	Somewhat active	27%	34%	18%
5,000-7,499	Low Active	40%	30%	52%
<5,000	Sedentary	22%	17%	28%

*Significant differences between weekday and weekend day.
^Significant differences between males and females.

TABLE III
STEPS RECORDED DURING INTERVENTION

	Week 1	Week 2	Week 3	Week 4
Total	8,965±3,233	9,876±3,932	9,835±4,434	10,436±4,633#
Males	9,560±3,707*	10,334±3,955*	10,303±4,107*	10,886±4,118*#
Females	8,451±2,402	9,308±3,780	9,220±4,574	9,812±5,036#

*p<.05, males vs. females
#p<.05 compared with week 1

With respect to health changes at the end of the intervention, weight, waist circumference and blood pressure were re-measured. When all participants in the intervention were considered there was an overall weight increase of 0.6 kg. However, when the weight change is plotted against the change in activity steps during the intervention, there is a small but significant relationship ($y=-0.57x+0.94$), where y= weight change and x is %change in steps). This means that the bigger the percentage change in steps resulting from the intervention, the less likely a weight increase (correlation -0.61). The changes in waist circumference and blood pressure were 0.3% and <0.9% respectively, thus considered insignificant.

A survey of participants was undertaken to determine their satisfaction with the intervention. Ninety-five percent of the participants completed the survey. In general, positive comments were received about the intervention program with 82% of participants believing they had increased their number of daily steps and 89% thought they would make long term changes to their lifestyle as a result of the program. In addition, there was strong support for group activity (94%) and the use of pedometers (75%).

The participants who completed the intervention, compared with those who did not participate, were more likely to have a better health profile (Table IV). Participants in the intervention were lighter, had a lower BMI, smaller waist circumference and lower systolic blood pressure (all significant at $p<0.05$). However, there were no significant differences in pedometer steps completed or the age of the participants.

TABLE IV
COMPARISON OF INTERVENTION PARTICIPANTS AND NON-PARTICIPANTS[1]

Variable		Participants (n=86)	Non-Participants (n=19)
Demographics	Gender	47%(female)	38% (female)
	Age (years)	33.5 (10.0)	31.8 (8.5)
Pedometer Steps	Weekdays	7,771 (2,678)	7,101 (3,084)
	Weekends	5,911 (2,747)	5040 (1,977)
	Daily Average	7,239 (2,298)	6,512 (2,540)
Body Measurements	Height (cm)	162.1 (8.4)	165.0 (7.6)
	*Weight (kg)	65.6 (15.5)	78.6 (19.3)
	*BMI	24.8 (4.7)	28.8 (6.6)
	*Waist (cm)	78.4 (12.0)	87.4 (13.8)
Blood Pressure	*Systolic (mmHg)	118 (16)	126 (24)
	Diastolic (mmHg)	78 (11)	82 (15)

[1] Based on Baseline results, * significant difference at p<0.05

C. Two Months Post Intervention

A total of 57 staff completed the two months post intervention data collection. However, only 46 staff completed the activity data collection (Table V). Although there was a mean decrease of 468 steps (7%) from baseline to two months post intervention this was not significant. There was a 2.0 kg increase in body weight ($p<.05$) for participants in the two months post intervention (0.8kg immediately after the intervention). The 2.0kg increase in the two months post intervention was significantly less than for 10 participants who had not completed the intervention, where the increase was 5.9kg. With respect to the number of risk factors there were no significant changes between baseline, post intervention and two months post intervention.

TABLE V
IMPACT OF INTERVENTION

		Baseline	Post Intervention	2 mths post intervention
Pedometer Steps				
	Weekdays	7,765±2688		6915±2494
	Weekends	5,380±2553	No data	5913±3046
	Daily Average	7,083±2347		6615±2269
Weight (kg)		65.9	66.7	67.9
Risk Factors	0-1	41%	40%	39%
	2-3	43%	43%	44%
	4	16%	17%	17%

IV. Discussion

The level of physical activity of the staff before starting the program was particularly low for female staff with 80% falling below the goal of 7,500 steps/day, a level considered sufficient for obtaining health benefits [17]. For female staff, in comparison to other Malaysian government servants [16], the activity levels were significantly lower on weekdays and for average steps/day. There were no significant differences for male staff.

The health profiles of the staff at baseline were also poor, particularly for males with 24% having an excess waist circumference; 66% were overweight/obese; 23% hypertensive; and 71% having two or more risk factors. Compared with 2006 National Malaysian data [2], the level of hypertension in the male staff was similar to the national average, but overweight/obesity (66% vs. national 45%) in male staff was much higher. Female staff, on the other hand, had lower levels of hypertension (6% vs. national 25%), central obesity (17% vs. national 57%) and overweight/obesity (32% vs. national 51%).

Similar to other workplace intervention studies [12], [20], [21], participants in the intervention phase had healthier profiles than those who did not participate. In a recent systematic review, Foster et al. [22] identified that of the 47 studies included in the review, the majority reported very poorly on the strategies used to recruit the participants. They concluded that recruitment concepts and methods are poorly developed and currently limit the success of intervention programs with respect to recruiting those who perhaps need it the most. They recommend that specific attention should be paid to developing targeted recruitment approaches.

During the four-week period of the intervention there was an increase in the average daily step count from week one to week two (non-significant), a plateau between week two and three, and a further increase to week four. Overall there was a significant increase between week one and week four. The plateau between weeks two and three is not unusual [6]. In this study it may have been due to the failure to provide sufficient incentives at that time, while in week four staff knew the program was finishing and were keen to complete 'their journey' around Malaysia. Participants provided positive feedback about the intervention with 89% indicating they thought they would make long term changes to their lifestyle as a result of the intervention. However, the data from the two months post intervention data collection does not support this. Ongoing information on healthy lifestyle choices would appear to be necessary to maintain improvement in steps completed.

The use of two different OMRON pedometers (HJ113 and HJ005) meant the step data collected during the intervention phase could not be directly compared with the data collected during baseline and two months post intervention. A number of previous studies have used the HJ113 [23]-[25] and the HJ005 [23], [26], [27] pedometers. The HJ113 is spring-levered and the HJ113 is piezoelectric, with both devices worn on the waistband. The spring-levered device (HJ113) measures steps through a horizontal lever-arm moving up and down in response to vertical movement and opens and closes an electrical circuit. The device must remain vertical to be effective [28]. On the other hand, the piezoelectric device (HJ113) responds to movement with a horizontal cantilevered beam with a weight at the end compressing the pizoelectrical crystal, thus making it less susceptible to tilt than the spring-levered device [28].

When the average pedometer data was compared between the two pedometers (baseline with week 1 of the intervention) there was a correlation of 0.51 with the HJ005 steps, on average, 12% lower than the HJ113 steps. This lower recording of steps is consistent with the study of Sugden *et al.* [23], who reported an average of 15% lower for the HJ005 compared to the HJ113 for their subjects. The primary reason for using the two different pedometers was cost. The HJ113 cost about four times the amount of the HJ005. During baseline and two months post intervention phases, data collection (HJ113) occurred over a four-week period and thus the number of pedometers required was significantly less, compared to the intervention phase (HJ005) which was completed by all participants at the same time. In addition, as part of the incentive to participate in the intervention the decision was made to give the HJ005 to participants who completed all three phases.

V. Recommendations for Future Interventions

These recommendations arise from results of this study, including the feedback from participants, and previously reported intervention studies [6]-[10], [15], [20], [22].

1. Any workplace intervention program requires the full support of Senior Management, and staff should be actively encouraged to participate in the program.
2. Interventions should be based on the socio-ecological model, so that the intervention focuses not only on individual behavior, but also on the other factors influencing behavior such as the social and physical environments and policy.
3. Pedometers are a useful tool for objective measurement of physical activity, relatively cheap and popular with staff and it is recommended that they should be used as an objective measure of physical activity in future interventions.
4. The concept of 'walking around Malaysia' was enjoyed by the majority of participants but a number of changes need to be incorporated if this was to be repeated. For example: the data entry system should be modified to be more user-friendly; group activities should be arranged on a regular basis; group leaders should be more proactive in providing encouragement to group members to ensure each member achieves the desired objective of increasing their physical activity level; specific weekly goals should be set for each participant with weekly awards for participants who achieve those goals. It would also be recommended to increase the length of the intervention from four weeks to eight weeks.
5. A tangible recognition of achievement awarded to all participants who increase their level of physical activity.

6. Involvement in the intervention recognized as the equivalent/or part equivalent of a training course contributing to the workplace course requirements.
7. Future interventions should include a focus on improved nutrition, reducing tobacco use and reducing sitting time, in addition to the promotion of a more active lifestyle.
8. Development of an informative booklet outlining key concepts that are being promoted. For example, nutrition guidelines and simple strategies to reduce: leisure inactivity, weight gain, tobacco use, sitting time at work.
9. Identification and active encouragement of staff with less healthy profiles to participate in the intervention. This may be facilitated by the provision of a free health screening service before the program.
10. Evaluation of all components of the intervention should involve feedback from participants and reviewing outcome measures in the context of goals and objectives. This review should be submitted to Senior Management.

VI. Summary

The activity and health profiles of the staff collected at baseline established that an intervention program would benefit their lifestyles. Generally, overall activity levels were low (average 7,102 steps/day) and female step counts were significantly lower than males (6,114 vs. 7,861). Baseline health profiles were poor: over 50% overweight/obese (males 66%, females 40%); 23% of males had hypertension (females 6%); and excess waist circumferences were present in 52% of males (females 17%). A total of 86 staff participated in the intervention (82% of those who completed the baseline measurements), although only 49 regularly reported their steps. Participants average daily steps increased significantly from 8,965 (week 1) to 10,436 (week 4), an average of 17%. However, involvement in the intervention program was avoided by the less healthy staff. No significant differences in average steps/day were reported two months after the intervention despite the fact that 89% of staff reported they planned to makes long-term changes to their lifestyle. Although the weight of participants in the intervention increased by an average of 2kg, this was significantly less than non-participants where there was an average increase of 5.6kg. Several recommendations for future interventions include: the necessity for full support from management for the program; intervention should be based on the socio-ecological model; inclusion of goal setting and group activities; the recognition that pedometers are popular with participants and can be successfully used as an objective measure; the importance of providing tangible recognition of achievement; and importance of evaluation of the intervention.

Acknowledgments

We would like to acknowledge the KBS staff who willingly took up the challenge; Yasser Mohamad Arifin (ICT ISN) and Darren Douglas Jarukan (ICT, ISN) for the development of the web-based data entry system; the staff from KBS who formed part of the project Taskforce and assisted with data collection (Zainudin Hasan, Inderawati Mohamad Naser, Mohd Izzady Abd Lah, Siti Farida Bt Azhar, Nur Farhana Kamaruddin, Nor Azhani Bt. Abd Hazis, Mohd Muzhafar Bin Hamdan, Nik Mohd Fitra B. Wan Jaffar), and Nurul Akma Bt Musa (ISN) who also assisted with data collection.

References

[1] World Health Organization. WHO Global Infobase on Physical Activity – data from the World Health Survey 2002. (cited 2008). Available from: http://www.who.int/infobase.
[2] Ministry of Health. Malaysia NCD Surveillance 2006: NCD Risk Factors in Malaysia. Kuala Lumpur, Malaysia; Ministry of Health; 2006.
[3] National Health and Morbidity Survey. Institute for Public Health, Kuala Lumpur, Ministry of Health, Malaysia. 1996.
[4] Wan Nazaimoon Wan Mohamud, Kamarul Imran Musa, Amir Sharifuddin Md Khir, Aziz al-Safi Ismail *et al.* Prevalence of overweight and obesity among adult Malaysians: an update. Asia Pacific Journal Clinical Nutrition. 2011; 20(1):35-41.
[5] Bauman A. Updating the evidence that physical activity is good for health – an epidemiological review 2000-2003. Journal Science Medicine Sport. 2004; 7(Suppl 1):6-19.
[6] Dishman RK, Oldenburg B, O'Neal H, Shephard RJ. Worksite physical activity interventions. American Journal of Preventive Medicine. 1998;15(4):344-61.
[7] Abraham C & Graham-Rowe E. Are worksite interventions effective in increasing physical activity? A systematic review and meta-analysis. Health Psychology Review. 2009; 3(1):108-44.
[8] Chau J. Evidence module: Workplace physical activity and nutrition interventions. Physical Activity Nutrition and Obesity Research Group, University of Sydney; 2009.
[9] Conn VS, Hafdahl AR, Cooper PS, Brown LM, Lusk SL. Meta-analysis of workplace physical activity interventions. American Journal Preventive Medicine. 2009; 37(4):330-9.
[10] Rongen A, Robroek SJW, van Lenthe FJ, Burdorf A. Workplace health promotion. A meta-analysis of effectiveness. American Journal Preventive Medicine. 2013; 44(4): 406-15.
[11] Cobiac LJ, Vos T, Barendregt JJ. Cost-effectiveness of interventions to promote physical activity: A Modelling study. PLoS Medicine. 2009; 6(7): e1000110.
[12] 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. Preventive Medicine. 2011; 53: 162-71.
[13] Bravata DM, Smith-Spangler C, Sundaram V, Gienger AL *et al.* Using pedometers to increase physical activity and improve health. A systematic review. Journal American Medical Association. 2007; 298 (19) 2296-2304.
[14] Kang M, Marshall S J, Barreira TV, Lee J-O. Effect of pedometer-based physical activity interventions: A meta-analysis. Research Quarterly Exercise & Sport. 2009; 80(3): 648-55.
[15] Glanz K, Rimer BK & Viswanath K (eds). Health Behaviour and Health Education – Theory, Research and Practice. 4th ed. John Wiley & Sons, San Francisco, USA; 2008
[16] Mohd Zaid Bin Mohd Ghazali, Wilson NC. Physical activity levels of staff at the National Sports Institute of Malaysia. ISN Bulletin. 2009; 2(1): 27-34.
[17] Tudor-Locke CE, Bassett DR. How many steps/day are enough? Sports Medicine. 2004; 34:1-8.
[18] Lear SA, James PT, Ko GT, Kumanyika S. Appropriateness of waist circumference and waist-to-hip ratio cutoffs for different ethnic groups. European Journal Clinical Nutrition. 2010; 64:42-61.
[19] Chobanian AV, Bakris GL, Black HR, Cushman WC *et al.* Seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure. Hypertension. 2003; 42:1206-52.
[20] De Cocker KA, De Bourdeaudhuij IM, Cardon GM. The effect of multi-strategy workplace physical activity intervention promoting pedometer use and step count. Health Education Research. 2010; 25(4): 608-19.
[21] Thomas L, Williams M. Promoting physical activity in the workplace: using pedometers to increase daily activity levels. Health Promotion Journal Australia. 2006; 17(2):97-102.

[22] Foster CE, Brennan G, Matthews A, McAdam C *et al.* Recruiting participants to walking intervention studies: a systematic review. Int. J. Behavioral Nutrition & Physical Activity. 2011; 8:137.
[23] Sugden JA, Sniehotta FF, Donnan PT, Boyle P *et al.* The feasibility of using pedometers and brief advice to increase activity in sedentary older women – a pilot study. BMC Health Services Research. 2008; 8:169-78.
[24] Kahleova H, Matouelek M, Malinska H, Oliyarnk O *et al.* Vegetarian diet improves insulin resistance and oxidative stress markers more than convetional diet in subjects with Type 2 diabetes Diabetes Medicine. 2011; 28(5):549-59.
[25] Bulckaen M, Capitanini A, Lange S, Caciula A *et al.* Implementation of exercise training programs in a hemodialysis unit: effects on physical performance. Journal Nephrology. 2011; 24(6):790-7.
[26] Kousar R, Burns C, Lewandowski P. A culturally appropriate diet and lifestyle intervention can successfully treat the components of metabolic syndrome in female Pakistani immigrants residing in Melbourne, Australia. Metabolism. 2008; 57(11):1502-1508.
[27] Kitagawa J, Nakahara Y. Association of daily walking steps with calcaneal ultrasound parameters and a bone resorption marker in elderly Japanese women. Journal Physical Anthropology. 2008; 27(6)295-300.
[28] Crouter SE, Schneider PL, Bassett DR. Spring-levered versus piezo-electric pedometer accuracy in overweight and obese adults. Medicine Science Sports Exercise. 2005; 37: 1673-1679.