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Article

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Enhancing participation in a national pedometer-based workplace intervention amongst staff at a Scottish university.

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Abstract

Background

Physical inactivity is the fourth leading risk factor for global mortality. Increasing physical activity improves health, reduces the risk of multiple causes of chronic ill health, and improves psychological wellbeing. Walking is an ideal way to meet physical activity guidelines, reduce sedentary behaviour, and improve health and wellbeing.

Aim

To examine the effectiveness of a facilitated pedometer-based intervention to increase walking behaviour amongst staff at a Scottish university.

Methods

20 participants (4 men, 16 women) volunteered to take part in a national work-based step count challenge, which required them to wear a pedometer and record their steps for 8 weeks. The intervention was enhanced by the use of additional techniques including encouragement, education, story sharing, goal setting, and social support.

Results

All participants significantly increased their step counts. Increases were particularly marked in the most physically inactive participants. Support staff recorded significantly more steps than academic staff.

Conclusion

Pedometer-based interventions can be effective in increasing walking behaviour amongst university staff, particularly in physically inactive individuals. However, participation can be enhanced through the use of additional behaviour change techniques such as goal setting and social support.

Introduction

Physical inactivity has been identified as the fourth leading risk factor for global mortality (WHO, 2010). In Scotland, it is currently the most common risk factor for coronary heart disease in Scotland, affecting two-thirds of the adult population, and is a major target for policy makers (Physical Activity Task Force, 2003). Increasing physical activity brings a number of health benefits, including lowering blood pressure, increasing psychological wellbeing, and reducing the risk of heart disease, diabetes and other causes of chronic ill health (Department of Health, 2004a; Penedo and Dahn, 2006; Warburton, Nicol and Bredin, 2006; Tully et al., 2007; WHO, 2010). The World Health Organisation's recommendation that adults aged 18-64 years accumulate at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity aerobic physical activity throughout the week (WHO, 2010) is currently not achieved by 72% of women and 59% of men in Scotland (PATF, 2003). Lack of time due to other commitments is a significant barrier to physical activity, reported by 71% of 25-44-year-olds (HEBS, 1998). Evidence suggests that many adults are unclear how the recommendations can best be achieved and what level of activity is required to give the maximum health benefit. Walking has been described as ideal exercise. Walking at a moderate pace meets the definition of 'moderate physical activity', and is free, sociable and easily incorporated into everyday life (Morris and Hardman, 1997; Mutrie and Hannah, 2004; Reger-Nash et al., 2006; Ogilvie et al., 2007). Walking outside is an ideal way to improve fitness and health, and provide access to fresh air – all of which have been shown to improve psychological wellbeing (Johansson, Hartig and Staats, 2011; Thompson et al., 2011).

Beattie's model of health promotion characterises health-related interventions as occurring at the collective or individual level, and developed using either a 'top down' (authoritative) or 'bottom up' (negotiated) approach (Beattie, 1991). Most walking interventions are conducted at a community (collective) level using a negotiated approach, whereby participants are empowered to make healthier behavioural choices. Ogilvie et al. (2007) reviewed walking interventions and concluded that the most effective interventions are both targeted towards specific populations and tailored to participants' needs. Workplace interventions –promoting 'active commuting' (e.g. Mutrie et al., 2002) or walking while at work (e.g. Gilson, McKenna and Cooke, 2007; Gilson et al., 2007) – can be particularly effective in increasing physical activity, given the proportion of time most people spend at work (Department of Health, 2004b; Dugdill et al., 2007). However, interventions need to be based on sound theory and be adapted to fit the cultural, educational and environmental needs of the audience (Canadian Cancer Society, 2011). University staff represent a promising target for walking interventions as most are in relatively sedentary occupations (Tudor-Locke and Bassett, 2004; Gilson et al., 2007; Gilson et al., 2009).

Pedometers are commonly used in walking interventions as a motivational tool and a practical and inexpensive means of measuring step counts. Pedometer-based interventions motivate and enable participants to monitor their own walking behaviour. They are often effective in increasing walking in the short term by around 2000 steps per day (Bravata et al., 2007; Kang et al., 2009), even among sedentary individuals (Dugdill et al., 2008; Morabia and Costanza, 2012), and particularly when accompanied by facilitated goal setting (Chan, Ryan and Tudor-Locke, 2004, Thomas and Williams, 2006, Baker, Mutrie and Lowry, 2008; Warren et al., 2010), diaries and self monitoring (Chan, Ryan and Tudor-Locke, 2004; Murphy et al., 2006; Thomas & Williams, 2006) and walking routes (Gilson et al., 2007). However, these changes may not be sustained (Ogilvie et al. 2007; De Greef et al., 2010) and their impact on objective measures of health (e.g. weight loss) require further study (Richardson et al., 2008; De Greef et al., 2010; Shaw et al., 2011). In a systematic review, Mansi et al. (2014) suggested that pedometer interventions were most effective when combined with additional behaviour strategies such as goal setting and information provision.

Health psychology models and principles provide a basis for understanding the causal processes and mechanisms underlying human behaviour (Abraham et al., 1998; Michie and Abraham, 2004). Behaviour change interventions need to be based on well-specified, empirically-supported techniques in order to evaluate their success in terms of behaviour change principles (Michie and Abraham, 2004; Abraham and Michie, 2008). The majority of papers describing walking interventions fail to delineate the behaviour change techniques (BCTs) used. The taxonomy of BCTs developed by Michie, Abraham and colleagues is a useful tool for describing and evaluating interventions (Michie et al., 2011; Michie et al., 2013).

The primary aim of this study was to investigate whether participation in a national pedometer-based workplace step count challenge would increase walking behaviour amongst staff at a Scottish university. The secondary aim of this study was to identify behaviour change techniques that might enhance the effectiveness of this intervention at a local level.

Methods

Participants

Volunteers interested in increasing their walking levels were recruited via email. 20 individuals agreed to participate in the intervention (4 men and 16 women, 10 administrative/support staff and 10 academic/research staff). All were employed by Edinburgh University and based within one of two buildings, located on the main city-based campus with easy access to parkland, shops and cafés.

Outcome measures

Participants were all provided with a Silva Ex Step pedometer, and requested to wear this on the waistband of their clothing as much as possible throughout the intervention. They were provided with a spreadsheet on which to record their daily steps. Participants were encouraged to wear the pedometers for up to 3 weeks before the intervention in order to ensure their familiarity with the device, and obtain a baseline measure of steps. Eleven participants provided baseline steps for an average of 8.50 days (sd=8.33); for the remainder steps taken during week 1 of the intervention were used as a baseline measure.

In weeks 0, 4 and 7 of the intervention, participants were invited to complete an online survey. This survey assessed their current walking level and other physical exercise, the barriers and motivators influencing their walking behaviour, their use of goals and strategies, and their current level of motivation, confidence, and control (i.e. self-efficacy) to increase their walking behaviour.

Procedures

The intervention consisted of facilitated participation in the Walk at Work Step Count Challenge 2012, co-ordinated by Paths for All (Paths for All, 2011; Paths for All, 2012). This involved teams of up to 5 from workplaces across Scotland signing up to measure and record their daily step counts for 8 weeks in spring 2012. Reviews of pedometer-based interventions have shown equivalent effect sizes regardless of intervention length (Bravata et al., 2007; Kang et al., 2009). However, eight weeks was chosen by Paths for All as 12 weeks had been reported to be too long (Paths for All, 2011). Once participants signed up to the Challenge, Paths for All encouraged participation by sending weekly emails, publishing league tables, regular blog updates, and occasional prize draws.

Participants were formed into four teams of 5; where practicable the teams consisted of close colleagues to encourage social support, which has been shown to lead to increased and sustained weight loss (Wing and Jeffery, 1999). Participation was further encouraged at a local level using a non-didactic, collaborative approach. Participants were invited to take part in a weekly walking lunchtime walking group. Walking with others facilitates social support and has been positively associated with walking behaviour (Wendel-Vos et al., 2007). Each week the local co-ordinator emailed participants to remind them to submit their steps counts, provide a league table for all four teams, and to provide additional encouragement and education in the form of hints and tips for increasing their step count. The reminder email acted as an antecedent cue or prompt, which can be particularly effective in increasing physical activity in an ecological setting (e.g. Olander and Eves, 2011; Lewis and Eves, 2012). Participants were also encouraged to set individual step count goals. Goal-setting is an effective technique for increasing physical activity (Shilts, Horowitz and Townsend, 2004; Bravata et al., 2007; Kang et al., 2009; Warren et al., 2010), particularly when the goal is specific, proximal in attainment and realistic (Bandura, 1997, Artinian et al., 2010). Social cohesion and support was facilitated by encouraging teams to choose their own team names, the setting of and reported progression towards a collective goal consisting of a virtual destination to 'walk' towards, and the organisation of social events to enable participants to meet and share experiences. Communal events have been suggested to contribute to experiential knowledge and facilitate long-term behaviour change (Gilson et al., 2009). Finally, continuing participation was encouraged by the distribution of prizes for individual and team step counts, and individuals showing the biggest improvement in a single week and overall. Incentives have been shown to be effective in increasing adherence to exercise programmes by enhancing the positive consequences of exercise (Jeffery et al. 1998, Harland et al., 1999, Herman et al., 2006)**,** but have little impact on long-term behaviour change (Jochelson, 2007).

A number of behaviour change techniques were incorporated into the intervention, primarily the regular self-monitoring of walking behaviour and the support and encouragement inherent to being part of the Challenge. The specific techniques used, based on Michie et al.'s CALO-RE taxonomy of behaviour change techniques in physical activity interventions (Michie et al., 2011), are shown in Table 1.

[Table 1 near here]

The Walk at Work Step Count Challenge is an annual occurrence. Volunteers were again sought for the Challenge in 2013. On this occasion, participants were signed up to the Challenge alone and no further intervention techniques were used. Fifteen participants (3 teams of 5) signed up, although one team (5 participants) failed to provide step counts beyond week 5. Of the remaining 10 participants, 7 had participated in the 2012 Challenge.

Statistical analyses

All data was analysed using SPSS version 23.0. Percentage change in step counts each week were calculated relative to the previous week, and mean daily step count and percentage change for the 8 weeks calculated.

Bivariate correlations were used to investigate associations between scores on the motivation, confidence and control questions and overall percentage change and daily step counts. A mixed ANOVA, with time (nine levels – baseline and weeks 1-8) as a repeated measure and staff type (two levels – support versus academic) as a between subjects measure, was conducted, with average daily step counts as the dependent variable.

Results

The mean daily step counts and percentage change across the 8 weeks of the Challenge are shown for the whole group, and by staff type, in Table 2. The results for the 10 participants in the 2013 Challenge are also shown for comparison. Overall, participants' daily step counts increased by an average of 1487 steps relative to baseline. The mean percentage change across all 8 weeks of the Challenge was positive, equating to a mean increase of 385.66 (sd=310.74) steps per day relative to baseline. All but two participants obtained a positive mean percentage change relative to baseline. Four participants increased their steps by over 10% on average across the Challenge; these participants all reported low (4777-6237) baseline daily step counts.

[Table 2 near here]

The mixed ANOVA results suggested a significant main effect for Time ($F(4.179, 144)=3.783$, $p<.01$; Greenhouse-Geiser statistics reported owing to a significant Mauchly's sphericity test). However, planned contrasts did not suggest differences between any specific weeks. There was no significant interaction effect between group and time ($F(4.179, 144)=1.399$, $p>.05$). Tests of between subject effects confirmed significantly higher step counts (including at baseline) amongst support staff than academic staff (13155.88 versus 9307.48; $F(1,18)=8.810$, $p<.01$). However, an independent samples t-test suggested that the mean percentage change in step counts over all 8 weeks did not differ significantly between the groups (5.79 versus 4.23; $t(18)=-.679$, $p>.05$).

Figure 1 shows the mean daily step counts across all 9 time points (baseline and weeks 1-8) for the two staff groups, and demonstrates an overall trend towards lower step counts in weeks 5, 6, and 8. Weeks 5 and 6 straddled the Easter vacation, while the weather in week 8 was notably wet and windy, resulting in lower step counts across all participants.

[Figure 1 near here]

Participants' motivation, confidence, and control were high at both the midpoint (motivation: mean=8.50, sd=1.08; confidence: 7.40, sd=2.17; control: 8.20, sd=2.20), with 80% of participants indicating motivation had increased since starting the intervention, and endpoint (motivation: 7.64, sd=1.21; confidence: 7.18, sd=1.54; control: 7.45, sd=1.57). Bivariate correlations between the main step count measures and the motivational and self-efficacy measures are shown in table 3. Of particular interest is the negative correlation between percentage change and baseline daily steps, confirming that the largest increases were seen in participants with the lowest baseline steps, and the positive correlation between total steps and baseline daily steps, indicating that participants with the highest baseline steps maintained this level throughout the Challenge. The confidence and control measures were also highly correlated, supporting the notion that these measures together capture self-efficacy.

[Table 3 near here]

Of the participants who responded to the surveys in weeks 4 and 7, the majority stated their main motivation to walk more – both during and after the intervention – was to improve fitness. In terms of barriers to walking, participants cited lack of time (60%), the weather (50%), and a lack of motivation (60%) as barriers at the start of the intervention, echoing the findings of the HEBS (1998) physical activity survey. The weather (54.5%) and lack of time due to family (45.5%), work (36.4%) and/or in general (18.2%) were given as principal reasons for failure to achieve walking goals during the intervention. A number of participants reported using successful strategies to increase their walking, many of which they intended to pursue beyond the intervention. The most popular strategies were to incorporate walking into everyday life by walking for leisure, to/from shops, and to/from work.

Seven participants also took part in the Step Count Challenge 2013. Statistical comparison between the two, while woefully underpowered, did not indicate any differences between the two years in terms of daily step count (14260.60 versus 13536.65; $t(6)=1.059$, $p>.05$) or average percentage change (6.02 versus 4.40; $t(6)=.896$, $p>.05$). However, it is important to note the differential drop-out rates between the two interventions: 0 in the facilitated intervention and 5/15 (33.3%) in the non-facilitated intervention.

Discussion

The current study has shown that participation in a national pedometer-based step count challenge can increase walking behaviour amongst university staff in Scotland. These increases were particularly evident in individuals with low baseline step counts (indicating low physical activity levels), a group that is of particular interest to policymakers and public health professionals, and for whom the benefits of increased physical activity are perhaps most marked.

The findings are in accordance with previous research suggesting that pedometer use is associated with increased physical activity (Bravata et al., 2007; Mansi et al., 2014). Recording daily step counts enabled participants to closely monitor and understand their own walking behaviour. Many participants in the current study set specific goals – e.g. 10,000 steps a day – and monitoring enabled them to adjust their behaviour to attain those goals. Both techniques have been identified as key aspects of successful interventions (Bravata et al., 2007; Kang et al., 2009; Artinian et al., 2010). Being part of a team introduced accountability and support and provided feedback about others' behaviour. Interestingly, participants' comments suggest that competitiveness was largely restricted to an individual level – 'beating' their own previous step counts was a greater motivation than 'beating' other teams.

The intervention described in this study incorporated a number of additional behaviour change techniques in order to enhance participation in this population, fulfilling the criteria of being targeted and tailored to the needs of a specific population (Ogilvie et al., 2007; Canadian Cancer Society, 2011). The Transtheoretical stages of change model (Prochaska and DiClemente, 1982) is a useful tool for considering changes in health-related behaviour and has been successfully used in the design of physical activity interventions (Callaghan, Khalil and Morres, 2010; Kirk, MacMillan and Webster, 2010). It utilises four key concepts: stage of change (readiness to change behaviour), decisional balance (weighing up pros and cons of changing behaviour), self-efficacy (how able the individual feels to enact a change) and processes of change (the means by which change occurs). The Physical Activity Task Force's report (PATF, 2003) suggests that three conditions are necessary to enable behaviour change: high self-efficacy, a strong intention and readiness to change, and a supportive social network and environment with no barriers, echoing the stages of change model. Participants in the current study were either at the preparation (walking a little and hoping to increase this – mostly academic staff) or action (walking a lot and hoping to improve and maintain this – mostly support staff) stage of change. The intervention was designed to address the needs of both groups. Facilitating a lunchtime walking group, providing encouragement and education on incorporating walking into everyday life, and enhancing social support by increasing group cohesion amongst participants were incorporated in order to minimise barriers and maximise benefits of walking, thus tipping the decisional balance in favour of increased walking, while also encouraging and supporting participants' efforts – moving preparers to action and actioners to maintenance. Although the study design did not allow for direct evaluation of the effectiveness of these additional techniques, the high drop-out rate evident in the following years' Step Count Challenge participation suggests these techniques may have, indeed, enhanced participation.

The current study raises some interesting issues regarding the implementation of walking interventions amongst university staff. Support staff reported significantly higher step counts than academic staff, although the percentage change did not differ between the two groups. This suggests that this group of support staff were better able to incorporate walking into their everyday lives. Indeed, academic staff were more likely to report that work pressures – such as teaching, lunchtime meetings, or urgent deadlines for grant applications or journal articles – precluded regular daytime walking. This manifested as poor uptake of the lunchtime walking group, although several academic staff reported going for lunchtime walks on other occasions. It is possible that support staff were more able to manage their workload in order to spend lunchtime away from their desks, or to leave work early enough to allow walking in the evenings. These findings are in contrast to Gilson, McKenna and Cooke's (2007) study, in which academic staff were more able to integrate walking into their working lives than administrative staff. Regardless of job role, those participants who reported setting specific goals and successfully incorporating walking into their daily routines were more likely to also report increased motivation and self-efficacy, and to express positivity towards the intervention as a whole.

Limitations

There are a number of limitations to the current study. Firstly, the small number of participants did not allow for sufficient statistical power to fully test the effectiveness of the intervention. Similarly, the study design – particularly the lack of a control group – did not allow for full examination of the effectiveness of the additional behaviour change techniques employed.

Secondly, the pedometer used for this intervention was designed to measure purposeful activity, and did not record the first 6-7 steps of any movement, or especially slow or fast movement. Given the prevalence of sedentary behaviour, particularly amongst university staff, a more accurate measurement method which records all movement – even getting up from one's chair and walking briefly round the room can be beneficial – might have produced more significant and clinically relevant results. Similarly, the pedometer needed to be worn on the waistband of clothing, which posed difficulties for participants wishing to wear dresses or loose clothing. Despite these potential difficulties, the vast majority of research has suggested no difference in accuracy between pedometers and accelerometers worn under clothing (e.g. Le Masurier and Tudor-Locke, 2003; Kinnunen et al., 2011), or other more modern activity trackers (Evenson, Goto and Furberg, 2015).

Thirdly, the intervention relied on participants' self-reported step counts. It is possible that participants either forgot to record their step counts, forgot to wear their pedometer, or due to pedometer failure or loss their steps were not recorded.

Conclusions

Physical inactivity and/or sedentary behaviour are significant public health concerns. Walking has been shown to be effective in improving health and reversing the effects of sedentary behaviour (Beddhu et al., 2015; Matthews et al., 2016). The study has provided useful evidence that a simple pedometer-based intervention can be effective in increasing walking behaviour amongst university staff, who are generally in relatively sedentary occupations (Gilson et al., 2007; 2009). Pedometers are inexpensive and easy to use, and have been shown to be a useful motivational tool in increasing physical activity (Bravata et al., 2007; Kang et al., 2009; Mansi et al., 2014). However, the study also illustrates the importance of identifying the specific needs of a population and designing a tailored intervention, using specified behaviour change techniques. These can be simple techniques such as facilitated goal setting (Chan, Ryan and Tudor-Locke, 2004; Warren et al., 2010), social support (Wendel-Vos et al., 2007), or walking routes (Gilson et al., 2007), although the latter proved less effective in the current study. Future research in this area should consider the long-term benefits of pedometer-based interventions, and further identify techniques that can enhance the effectiveness of such interventions within specific populations.

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Table 1

Behaviour change techniques included in the intervention (after Michie et al., 2011).

Intervention element	**Behaviour change technique**
Pre-Challenge survey. Participants asked to specify barriers to walking from a list	8. Barrier identification / problem solving
Invitation email listing benefits of walking group, plus documentation from Paths for All	1. Provide information on consequences of behaviour in general
Weekly emails offering encouragement to all participants, offering tips for increasing step counts, details of the walking group and providing anecdotes from authors' own experiences with the Challenge. Participants were encouraged to set individual and group behavioural goals.	12. Provide rewards contingent on effort or progress towards behaviour 20. Provide information on where and when to perform the behaviour 22. Model/demonstrate the behaviour 5. Goal setting (behaviour)
Weekly results emails giving step counts for all teams. Informal comparison between team members	4. Provide normative information about others' behaviour 28. Facilitate social comparison
Participants were provided with a pedometer to record their daily step counts	10. Prompt review of behavioural goals 16. Prompt self-monitoring of behaviour

Table 2

Step counts and percentage change across all time points, by staff type for 2012 Challenge and all staff for 2013 Challenge.

Time	2012 Challenge						2013 Challenge	
	All		Support		Academic		All	
	Steps Mean (SD)	% Mean (SD)	Steps Mean (SD)	% Mean (SD)	Steps Mean (SD)	% Mean (SD)	Steps Mean (SD)	% Mean (SD)
Baseline	9909.48 (3471.03)	N/A	10554.76 (3818.15)	N/A	9264.20 (3151.37)	N/A	N/A	N/A
Week 1	10159.09 (3360.04)	7.60 (32.68)	11634.84 (3187.34)	16.90 (35.20)	8683.33 (2972.44)	-1.71 (28.69)	12691.17 (5200.71)	N/A
Week 2	10938.45 (3629.48)	11.29 (25.22)	13159.26 (3868.59)	13.91 (17.64)	8717.64 (1372.55)	8.66 (31.87)	13467.86 (5906.07)	5.18 (16.21)
Week 3	11834.47 (3965.89)	11.16 (29.55)	14101.81 (4227.15)	9.17 (20.94)	9567.13 (1977.67)	13.16 (37.36)	13252.59 (5845.32)	1.55 (19.10)
Week 4	12468.87 (3852.54)	9.75 (29.28)	144775.11 (4457.23)	5.31 (27.67)	10462.63 (1588.02)	14.19 (31.62)	13201.81 (5328.72)	2.40 (16.46)
Week 5	11274.95 (4487.25)	-7.99 (28.27)	13348.41 (4919.08)	-4.88 (28.10)	9201.49 (2959.20)	-11.10 (29.59)	13039.88 (5249.34)	0.68 (26.08)
Week 6	11129.80 (4041.31)	4.08 (32.88)	13342.63 (4468.31)	2.88 (18.45)	8916.97 (1905.79)	5.28 (44.03)	13485.66 (5447.70)	6.21 (29.04)
Week 7	12409.26 (4640.57)	14.08 (27.00)	14490.30 (5364.29)	9.72 (20.50)	10328.21 (2657.62)	18.45 (32.80)	14146.49 (5786.90)	11.01 (36.33)
Week 8	10960.73 (3993.09)	-9.87 (17.56)	13295.79 (4215.54)	-6.66 (11.05)	8625.67 (1942.62)	-13.07 (22.50)	14495.73 (4822.80)	6.65 (19.94)
Challenge overall	11396.95 (3605.34)	5.01 (5.07)	13481.02 (4013.56)	5.79 (4.63)	9312.88 (1296.44)	4.23 (5.62)	13472.66 (5213.63)	4.81 (3.86)

Table 3

Bivariate correlations between main step count measures and motivational and self-efficacy measures

Variable	% change	Total steps	Baseline daily	Motivation w4	Confidence w4	Control w4	Motivation w7	Confidence w7
Total steps	.013	--						
Baseline daily steps	-.664**	.583**	--					
Motivation w4	-.111	.121	.240	--				
Confidence w4	-.004	.373	.148	.521	--			
Control w4	-.189	.156	.076	.093	.795**	--		
Motivation w7	-.112	.160	.217	.661	.015	-.169	--	
Confidence w7	-.167	.254	.128	.389	.306	.098	.632*	--
Control w7	-.335	.089	.175	.192	.122	.096	.623*	.914**

Note: *=p<.05, **=p<.01

Figure 1

Mean daily step counts for both staff groups across all time points.