Can motivational signs prompt increases in incidental physical activity in an Australian health-care facility?

A. L. Marshall¹, A. E. Bauman², C. Patch³, J. Wilson³ and J. Chen⁴

Abstract
This study aimed to evaluate whether a stair-promoting signed intervention could increase the use of the stairs over the elevator in a health-care facility. A time-series design was conducted over 12 weeks. Data were collected before, during and after displaying a signed intervention during weeks 4–5 and 8–9. Evaluation included anonymous counts recorded by an objective unobtrusive motion-sensing device of people entering the elevator or the stairs. Self-report data on stair use by hospital staff were also collected. Stair use significantly increased after the first intervention phase \(P = 0.02\), but after the intervention was removed stair use decreased back towards baseline levels. Moreover, stair use did not significantly change after the re-introduction of the intervention. Lastly, stair use decreased below the initial baseline level during the final weeks of evaluation. Furthermore, there was no significant change in self-reported stair use by hospital staff. Therefore, the signed intervention aimed at promoting an increase in incidental physical activity produced small brief effects, which were not maintained. Further research is required to find more effective ‘point of choice’ interventions to increase incidental physical activity participation with more sustainable impact.

Introduction
Physical activity is now recognized as a central component of overall approaches to primary prevention (Mathers et al., 1999) and although physical activity was once fundamental to daily life, recent societal trends have led to decreases in energy expenditure (Prentice and Jebb, 1995). These trends have shown that participation in leisure time physical activity has remained relatively stable in the US over the past 10 years (Pratt et al., 1999), but that rates have declined in Australia since 1997 (Armstrong et al., 2000). Both these National surveillance systems rely upon reported leisure time physical activity, which may in fact ‘mask’ a substantial decline in overall daily energy expenditure levels due to decreased physical demands of work, transportation and other activities of daily living. The health promotion agenda for the 21st century includes promoting incidental physical activity as part of an overall plan for Active Living (WHO, 1997). It is the decline in incidental activity, which may be the major contributing factor in increased sedentariness and hence to increasing rates of obesity (Prentice and Jebb, 1995). Rising obesity rates across populations resulting from reduced physical activity contributes to substantial morbidity, mortality and reduced well being (Mathers et al., 1999). Therefore, it is important that health promotion interventions are aimed at increasing lifestyle-related physical activ-

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ity, which can help in weight maintenance (Andersen et al., 1999).

Consistent with the current recommendations for physical activity, people should be encouraged to 'accumulate' physical activity throughout the day (Jakicic and Wing, 1995). Even including small amounts of activity may lead to the accumulation of an adequate level of energy expenditure over the course of a day (Dunn et al., 1998). One opportunity for accumulating incidental physical activity, which is accessible and feasible for population health, is to recommend people use the stairs instead of escalators or elevators. An intervention program encouraging participants to accumulate several 2-min bouts of stair climbing throughout the day was shown to produce favorable health and fitness effects after 7 weeks (Boreham et al., 2000). Furthermore, men who climbed fewer than 20 flights of stairs a week had a 23% higher risk of premature death than men who climbed more (Paffenbarger et al., 1993). This evidence suggests that intermittent stair climbing may be an effective way of incorporating health-promoting activity into daily life.

To date there have been six studies which have evaluated the effectiveness of simple environmental change interventions to encourage people to use the stairs (Brownell et al., 1980; Blamey et al., 1995; Andersen et al., 1998; Russell, 1999; Andersen et al., 2000; Kerr et al., 2000). Five of these studies showed that a simple signed intervention resulted in modest but significant increases in commuters' use of the stairs over adjacent escalators in commuter stations and shopping malls (Brownell et al., 1980; Blamey et al., 1995; Andersen et al., 1998, 2000; Kerr et al., 2000). Furthermore, it did not matter whether the sign promoted health gain or weight loss; it was still effective (Andersen et al., 1998). Only one study evaluated the change between stair and elevator use in a non-commuter environment using a slightly different approach by discouraging use of the elevator (Russell et al., 1999).

The aim of this study was to assess the effectiveness of a signed intervention to promote the use of stairs in a health-care facility, which ultimately aimed at encouraging staff and visitors to increase their level of incidental physical activity. The present investigation also attempted to overcome some of the limitations of previous research by collecting data 24 h a day using an objective motion-sensing device (MSD). Based on the results of previous research, it was hypothesized that the minimal signed intervention would result in increased use of the stairs by the hospital staff and visitors.

### Methods

This study used a simple time-series design of collecting data before, during and after the introduction of the intervention. The first phase of the study was the baseline phase (B) where data were collected for 3 weeks (weeks 1–3). The second phase was the introduction of the intervention (Ix1) which ran for 2 weeks (weeks 4–5), followed by a control (C1) no-intervention phase for 2 weeks (weeks 6–7). The second intervention phase (Ix2) ran during weeks 8–9, followed by another control/runout phase (C2) from weeks 10 to 12. Further data were also collected from self report surveys administered to all hospital staff who worked on the fourth and fifth floor of the intervention site during week 1 and 6.

Data were recorded by a small infrared MSD, an unobtrusive battery-powered device designed to objectively count 'people movements' up the stairs and into the elevators. The directional measure was facilitated by using two infrared beams and a closed circuit linked to an incremental LCD counter. A count was only registered if the beams were broken in a specific order. The directional measure was important since the energy cost of ascending stairs is approximately 3 times that of descending the stairs (Bassett et al., 1997). Each MSD was monitored daily by a research assistant within the hospital. Participants in the study were largely unaware they were being monitored as part of an intervention study due to the inconspicuous MSDs.

Observational data were also collected by research assistants for 1 h each morning between
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8.00 and 9:00 a.m. each workday throughout the entire study. These observational data were transformed into a percentage of number recorded by the MSD to validate the MSD counts. The MSD slightly under-represented the total number of observed counts by 10–15% of people entering the elevator and 0–5% of people entering the stairs. The difference may be explained by a limitation of the MSD, where two people walking side by side would only be counted as one person by the MSD. Nonetheless, this level of measurement consistency is acceptable, as the MSD provided continuous unobtrusive monitoring, with participants in the study unaware they were being counted, and thus the measurement device was unlikely to influence behavior. Furthermore, the measurement error was found to be consistent over the entire study period, thus shifts between the use of the stairs compared with the elevator and vice versa should be detected.

Additional data were collected from all staff members who worked on the fourth and fifth floors of the hospital. These staff members were selected as the intervention was aimed specifically at changing the behavior of people working within five floors of the intervention. A pre-intervention survey was conducted during the baseline phase and the second post-intervention survey was administered during the first control phase. The survey asked about frequency of stair use, perceptions of the stairwell and recall of the components of the intervention.

The intervention materials were displayed between weeks 4–5 and 8–9. The intervention consisted of colored signs mounted on the wall next to the elevator and stair areas and vinyl footprints stuck on the floor, which led people to the stairs (see Figure 1). The signs measured 80×45 cm and stated ‘Improve Your Health and Fitness One Step at a Time...Use the Stairs’, and featured caricatures of a man and a woman walking up the stairs. The intervention aimed to provide a ‘point of choice’ instant motivational prompt to encourage staff and visitors to use the stairs as an alternative to the elevator to improve their health and fitness.

Results from the literature suggest an effect size of stairs promotion studies range between small 2–3% changes (Andersen et al., 1996; Russell et al., 1999) and large 9–13% changes (Brownell et al., 1980; Blamey et al., 1995). In this study, based on a baseline level of stair use around 9%, in order to have adequate power to detect a 3% shift, 1700 observations (α = 0.05, 1 = β = 0.8) were required and to detect a 9% shift around 370 observations were required.

Pooled data from the MSD counts for the stairs and elevators were analyzed by logistic regression to determine the probability of choosing to use the stairs over the elevator before and after the intervention phases. Predictor variables included in the model were days of the week (from Monday to Sunday, Monday being used as the reference) and the five different intervention phases (B, Ix1, C1, Ix2 and C2, with B being used as the reference). These data were analyzed using Stata 6.0. The self-report survey data were descriptive, with unpaired data analysis conducted in SPSS 8.0.

Results

A total of 158 350 MSD counts were recorded and entered into the logistic regression model. These results indicate that after controlling for differences in the days of the week, there was a significant increase (P = 0.02) in the likelihood of people choosing to use the stairs over the elevator during the first phase of the intervention (Ix1) compared to baseline. The odds ratios and 95% confidence intervals are shown in Table I. However, it appeared that after the intervention was removed (C1) there was a non-significant decline in stair use. Furthermore, the re-introduction of the intervention during phase 4 (Ix2) did not significantly change stairs use from the initial baseline period. Interestingly the final control phase (C2) showed significantly less stair use than the initial baseline period (a 24% reduction in the adjusted likelihood of stair use, P < 0.001). Figure 2 presents the proportion of stair users for each phase of the study and the 95% confidence intervals based on the total number of potential stair users counted by the MSDs.
Fig. 1. Motivational signs and footprints were used to promote use of the stairs.

<table>
<thead>
<tr>
<th>Table 1. Likelihood of stair use by day of the week and intervention period [adjusted odds ratio (OR) and 95% confidence intervals (CI)]</th>
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<tbody>
<tr>
<td><strong>Outcome variables</strong></td>
</tr>
<tr>
<td>Baseline(^a)</td>
</tr>
<tr>
<td>Intervention 1</td>
</tr>
<tr>
<td>Control 1</td>
</tr>
<tr>
<td>Intervention 2</td>
</tr>
<tr>
<td>Control 2</td>
</tr>
<tr>
<td>Sunday(^a)</td>
</tr>
<tr>
<td>Monday</td>
</tr>
<tr>
<td>Tuesday</td>
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<td>Wednesday</td>
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<td>Thursday</td>
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<td>Friday</td>
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<td>Saturday</td>
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</tbody>
</table>

\(^a\)Reference group.

Therefore, the difference in proportions across the study period were small (the difference between baseline and Ix1 proportions was only 1%).

Self-report data on the use of the stairs in the hospital were obtained from 53 staff pre-intervention and 40 staff post-intervention. These data represent the total number of staff on location at the time the survey was conducted. Despite these data being unmatched, both data sets had similar proportions by gender (77 and 78% female in pre- and post-intervention surveys) and similar age distributions (50% aged less than 40 years in both surveys).

The intervention prompts (the colored signs and footprints) were seen and recognized by 90% of respondents in the post-intervention survey. Of these 90%, most respondents reported they saw the signs (38%), followed by 30% of respondents that reported they saw the footprints, and 18% that recalled seeing both the signs and the footprints.
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**Fig. 2.** The proportions and 95% confidence intervals of stair users based on observations recorded by the motion sensing devices during the different phases of the study.

**Table II.** Reported use of the stairs by hospital staff in the past week

<table>
<thead>
<tr>
<th></th>
<th>No. days reported using the stairs in the past week</th>
<th>No. flights climbed per day in the past week</th>
<th>No. flights climbed in the past week</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Median 25th percentile 75th percentile</td>
<td>Median 25th percentile 75th percentile</td>
<td>Median 25th percentile 75th percentile</td>
</tr>
<tr>
<td>Pre-survey</td>
<td>53 5 3.5 5</td>
<td>4 2.5 10</td>
<td>20 10 41</td>
</tr>
<tr>
<td>Post-survey</td>
<td>40 5 3 5</td>
<td>9 3 20</td>
<td>33 14 90</td>
</tr>
</tbody>
</table>

\(^a\)Mann–Whitney \(U\)-test, \(Z = -1.22; P = 0.22\) between pre and post.

\(^b\)Mann–Whitney \(U\)-test, \(Z = -1.65; P = 0.10\) between pre and post.

Despite good recall of the intervention prompts and a positive trend in reported stair use at the post-intervention survey, the results were not significant (see Table II).

Further self-report data indicated that staff members perceived that they already used the stairs regularly (66%) during the pre-survey. Other reasons reported for not using the stairs more regularly included having no time or being too busy and simply being too lazy. Interestingly more staff members in the post-survey reported they use the stairs regularly (75%) and the same reasons were reported at follow-up for not using the stairs more regularly.

**Discussion**

It is apparent from the literature that physical activity levels are static or declining as energy expenditure associated with work and other activities of daily living declines (Pratt et al., 1999; Armstrong et al., 2000). Promoting the accumulation of physical activity throughout the day seems to be a promising option when trying to reverse these sedentary trends. In particular interventions aimed at increasing the utilization of stairs above taking an elevator seems logical given that stair climbing has been shown to improve health and
fitness characteristics (Boreham et al., 2000). It was thought that a intervention focused on encouraging use of the stairs as part of a health-promoting environmental intervention might work well, particularly in a health-care setting. Hence, this intervention study was located and evaluated in a hospital environment, before recommending more widespread dissemination (Tones, 1995).

Motivational signs prompting ‘point of choice’ decisions to increase the accumulation of incidental physical activity by promoting the use of stairs have been shown to produce modest increases in stair use over use of adjacent escalators or elevators (Brownell et al., 1980; Blamey et al., 1995; Andersen et al., 1998; Russell et al., 1999). Although significant, these results have produced relatively small short-term effects ranging from 2.1 (Andersen et al., 1998; Russell et al., 1999) to 13% (Blamey et al., 1995). A smaller effect was observed (1% increase in stair use) in the present study. Contrary to our investigation, previous studies have also reported a residual effect of increased stair use up to 12 weeks after the intervention was removed (Brownell et al., 1980; Blamey et al., 1995). However, it was only during the first intervention phase in the present trial that significant effects were observed, as immediately after the intervention was removed stair usage declined below the baseline level and remained there for the remaining 7 weeks of data collection.

Also consistent with previous studies (Kerr et al., 2000), the main barrier to the use of the stairs in the present study cited by the hospital staff was laziness and/or being too busy to use the stairs. The latter is an interesting finding since several people would often be seen queuing and waiting several minutes for the elevator to return to the ground floor during the observation/validation component of the study. So it may be that the Russell et al. approach of restricting the use of the elevator to those people with physical challenges is the best way to overcome these particular barriers (Russell et al., 1999).

Direct human observers have been used to measure stair use in previous interventions. Data presented here represent a more objective and comprehensive view of overall stair use, over the entire intervention study (24 h a day, 7 days a week). Therefore, these data were not subject to observer bias or ‘snapshot’ observation periods. The present measurement system, however, was unable to collect descriptive data of the characteristics of individuals and people who should be excluded based on physical challenges (Andersen et al., 1998). The self-report data on the number of flights of stairs climbed per day showed a positive trend, with the number of flights climbed per day increasing in the follow-up survey. While this result was not significant, for this increase in the reported number of flights per day to be significant at least 101 subjects would have been required, which was twice as many people as actually worked on the relevant floors surveyed. Nonetheless, given the results of the MSD data, as well as the lack of significant increases found in the self report data collected from the hospital staff, the real value of signed interventions in a health-care work-site setting remains unresolved.

The effect size reported here was smaller than those reported by Brownell et al. (Brownell et al., 1980) and Blamey et al. (Blamey et al., 1995), but similar to those reported by Andersen et al. (Andersen et al., 1998) and Russell et al. (Russell et al., 1999), therefore this intervention may have been as effective as could be expected. The lack of maintained effects also weakens the value of such interventions being disseminated more widely into other settings such as shopping malls, commuter stations and office buildings. Furthermore, Andersen et al. suggested that an increased in stair use may not prompt people to significantly alter their overall level of physical activity (Andersen et al., 1998). Hence, the widespread investment in stair campaigns, as suggested by Mutrie and Blamey (Mutrie and Blamey, 2000), requires further appraisal.

Therefore, given the results of the present study, one must revisit the question whether disseminating stair-promoting interventions is a viable public health strategy for increasing incidental physical activity. In this trial, the intervention to promote stair use in a health-care facility was not as effective
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as was expected and further investigation is required to identify more effective ‘point of choice’ physical activity interventions with sustainable impact.

References


Received on April 9, 2001; accepted on October 19, 2001