PUBLIC HEALTH INTERVENTIONS

An uphill struggle: Effects of a point-of-choice stair climbing intervention in a non-English speaking population

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Accepted 1 June 2006

Background

Increases in lifestyle physical activity are a current public health target. Interventions that encourage pedestrians to choose the stairs rather than the escalator are uniformly successful in English speaking populations. Here we report the first test of a similar intervention in a non-English speaking sample, namely the Hong Kong Chinese.

Methods

Travellers on the Mid-Levels escalator system in Hong Kong were encouraged to take the stairs for their health by a point-of-choice prompt with text in Chinese positioned at the junction between the stairs and the travelator. Gender, age, ethnic origin, and walking on the travelator were coded by observers. A 2 week intervention period followed 2 weeks of baseline monitoring with 57 801 choices coded. Specificity of the intervention was determined by contrasting effects in Asian and non-Asian travellers.

Results

There was no effect of the intervention on stair climbing and baseline rates (0.4%) were much lower than previous studies in Western populations (5.4%). Nonetheless, a modest increase in walking up the travelator, confined to the Asian population (OR = 1.12), confirmed that the intervention materials could change behaviour.

Conclusions

It would be unwise to assume that lifestyle physical activity interventions have universal application. The contexts in which the behaviours occur, e.g. climate, may act as a barrier to successful behaviour change.

Keywords stair climbing, exercise promotion, walking, humidity

Introduction

Increasing physical activity levels in the population is a major public health target given the high prevalence of sedentary behaviour in the industrialized world.1,2 The current physical activity recommendations are for at least 30 min of moderate intensity activity on five or more days of the week. Further, activity can be accumulated throughout the day and does not need to be achieved in a single session.2,3

The lifestyle physical activity of stair climbing

Given that brisk walking is moderate in intensity,4 one simple way to achieve this aim is to accumulate walking throughout the day. An additional way to further this aim is to accumulate stair climbing whenever possible. Like walking, stair climbing requires no equipment and is freely available. Unlike walking, however, stair climbing is physiologically vigorous, with a field study estimating that it uses 9.6 times more energy that the resting state.5 With obesity prevention as a major target of public health, this high energy expenditure of stair climbing has important implications. For example, an 80 kg man climbing a typical 3 m flight of stairs in his home eight times a day would expend approximately 29.5 kcal a day, equating to 10 754 kcal over a year. This energy expenditure would be equivalent to more than three and a half days worth of food over a year.5,6 Further, for the purposes of energy

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expenditure, the speed at which the walker climbs is of minimal importance; energy is expended to raise weight against gravity and the work done against gravity is independent of the speed at which the walker climbs. Hence stair climbing automatically triggers more energy expenditure in those who are overweight.

Importantly, interventions to increase stair climbing are effective. Typically, a sign is placed at the point-of-choice between stairs and the escalator encouraging travellers to take the stairs for their health. So far, all published studies that have attempted to increase stair usage in this context have been successful, with 18 separate studies reporting positive effects. Nonetheless, all previous research has been conducted in either the UK or the US and only one study has used anything other than an English speaking population. Thus studies in a non-English context will provide information on the generality of the success of point-of-choice interventions. Here we report the results of an intervention in Hong Kong where 95% of the population is Chinese.

Compared with mainland China, Hong Kong is affluent with many of the trappings of Western culture, making it a reasonable non-English speaking comparison for the UK and the US. The Population Health Survey, a representative sample of 7084 Hong Kong Chinese, revealed that only 14% of males and 12% of females were physically active at health enhancing levels, considerably lower figures than in the UK (males 37%, females 25%). In contrast, 41% of males and 45% of females in Hong Kong reported that they had done no exercise or physical activity in the past month, a level of inactivity higher than in the UK (males 35%, females 25%). In Hong Kong, a pedestrian transit system that aims to provide a stair climbing intervention. Additionally, there are many non-Asian pedestrians provides a natural control group for the study. Furthermore, there are many non-Asian visitors to Hong Kong, despite the preponderance of non-Asian visitors to Hong Kong, despite the preponderance of the population being Chinese.

Methods

The study was conducted on the Mid-Levels escalator system in central Hong Kong, a pedestrian transit system that aims to reduce motorized traffic in the city. Roads in the area are narrow, with an abundance of commercial premises and minimal opportunities for parking. Until 10:00 a.m., the escalators of the Mid-Levels system bring pedestrians down the hill into central Hong Kong. After 10:00 a.m., the direction is reversed so that pedestrians are carried up the hill out of the area. The study was conducted on the section between Wyndham Street and Hollywood Road where a travelator, i.e. an escalator without steps, climbed 5.72 m over a horizontal distance of 51.5 m, with a total length of 57.5 m. Adjacent to the travelator were 44 stairs (stair riser height = 13 cm) in groups of four separated by 4.12 m horizontal sections. While this site is shielded from the sun, open sides mean that pedestrians are subject to the effects of air temperature and humidity. The intervention point-of-choice prompt (73 cm \times 53 cm) depicted a silhouette figure with a red heart outline on the chest climbing stairs with a message above the figure in Chinese characters that read ‘Get healthy—start with these steps’.

Inter-observer checks with a standard protocol were made in two separate 30 min sessions prior to the main observations to minimize differences in coding. For appearance of over 60 years old, preliminary discussions between observers standardized the criterion. Inter-observer agreements were acceptable for stance use (99%), walking on the escalator for more than a third of the way (99%), gender (97%), ethnic grouping (Asian vs non-Asian; 98%), adolescent/children (below the shoulder height of accompanying adults; 98%), and appearance of age over 60 years old (92%). Consequently, three alternating observers coded 57801 pedestrian choices between the travelator and stairs for gender, appearance of over 60 years old, ethnic grouping, and whether they were walking on the travelator. Observations were made around midday (11:00–13:00) and in the early evening (17:00–19:00), on the weekend (Saturday and Sunday) and during the week (Monday and Wednesday). Through an oversight, successive 30 min periods were not coded separately to allow pedestrian traffic volume to be entered in the analysis as in previous work. Consequently, effects of traffic volume could not be statistically distinguished from those due to differing time periods.

Following a 2 week baseline, the poster was positioned at the point-of-choice between the stairs and travelator and observations continued for a further 2 weeks. During the study period May–June, maximum temperature and humidity ranges were 26.2–31.8°C and 84–97% respectively, with no significant differences between the baseline and intervention periods [temperature t(14) = 0.62; humidity t(14) = 0.81]. The maximal values for the days on which the observations were made were employed in the analyses.

Analyses employed logistic regression with the method of ascent as the dichotomous outcome variable and presence of poster, gender, age, ethnic grouping, time of day, and time of week as dichotomous independent variables. As in previous research, pedestrians coded as children were excluded for subsequent analyses. Maximum temperature and relative humidity were entered as continuous variables.

Results

Stair climbing

During the 4 weeks of the study, 57801 choices between the stairs and the escalator were coded. Of these observations, 48.4% were female and 18.4% were coded as non-Asian. For age, 8.6 and 2.1% were coded as old and children, respectively,
leaving 88.6% coded as adults. Preliminary analysis revealed that stair climbing was a very infrequent behaviour with 0.36 and 0.30% climbing during the baseline and intervention periods, respectively. Hence, there was no significant effect of the intervention on stair climbing (Chi square = 1.14, df = 1, \( P = 0.29 \)).

**Walking up the travelator**

All subsequent analyses concentrated on walking up the travelator, with children excluded as in previous research.\(^{10,14,15}\) Preliminary analyses revealed that humidity and temperature were negatively correlated and had opposite effects. Of the two climate variables, humidity was more strongly correlated with the behaviour and, hence, humidity was retained in the models. As noted earlier, an oversight meant that pedestrian traffic volume was not coded for separate time periods to allow inclusion in subsequent modelling. Comparisons between time periods revealed greater pedestrian traffic volume during the week (17.6 ± 4.0 min\(^{-1}\)) than the weekend (12.5 ± 1.8 min\(^{-1}\); t(30) = 4.71, \( P < 0.001 \)) but no differences between the lunchtime (14.2 ± 4.5 min\(^{-1}\)) and evening periods (15.9 ± 3.4 min\(^{-1}\); t(30) = 1.23, \( P = 0.22 \)).

Figure 1 depicts the percentage of Asian and non-Asian participants walking on the travelator before (pre) and after (post) the intervention was introduced for the midday and early evening observation periods.

An omnibus analysis that included both Asian and non-Asian participants revealed that walking up the travelator was less common in Asian pedestrians as the figure illustrates [odds ratio (OR) = 0.50, 95% confidence interval (CI) 0.47–0.54; \( P < 0.001 \)]. In addition, there was the predicted interaction between the effects of the intervention and ethnic grouping (OR = 1.25, CI 1.14–1.38 \( P < 0.001 \)). Therefore, separate analyses for Asian and non-Asian participants were conducted. Table 1 summarizes the results of these analyses.

As can be seen from the table, an intervention aimed at the Chinese speaking individuals, had an effect in the Asian population but not in the non-Asian population. Unexpectedly, however, this effect interacted with time of day such that the effects of the intervention were greater in the midday period (OR = 1.27, CI 1.18–1.36, \( P < 0.001 \)) than in the early evening (OR = 1.18, CI 1.10–1.26, \( P < 0.001 \)). For non-Asians, there were no effects of the poster, time of day, or an interaction between the two. Whereas levels of humidity had no effect on the acclimatized Asians, higher humidity was associated with a reduced number walking in the non-Asian population. Follow-up linear regressions indicated that the significant negative effect of humidity in non-Asians was equivalent to a 0.42% reduction in walking on the travelator for each 1% increase in humidity whereas for Asians there was a 0.03% reduction per 1% increase.

Consistent with previous studies,\(^{10,14–16} \) males and the young in both groups were more likely to walk up the travelator. In percentage terms for those responding to the intervention, i.e. Asians, the young were more likely to walk than the older individuals for both males (Young pre; 21.3%, post 23.8%; Old pre; 12.2%, post; 23.4%) and females (Young pre; 17.8.3%, post 20.1%; Old pre; 6.7%, post; 17.3%). Finally, both Asian and non-Asian pedestrians were more likely to walk during the week (Asian 24.2%; non-Asian 37.0%) than at weekends (Asian 13.4%; non-Asian 21.9%).

**Discussion**

In summary, rates of stair climbing were very low in this context and they were uninfluenced by the intervention. Nonetheless, this adaptation of the standard point-of-choice prompt for a Chinese population did change behaviour; Asian pedestrians were encouraged to walk up rather than simply ride on the travelator. In addition, walking up the travelator was less common in Asians than non-Asian pedestrians, despite similar effects of gender and age on the behaviour in the two populations. Finally, humidity had no apparent effect on Asians but reduced the incidence of walking in non-Asian pedestrians.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Asian (( n = 4567 )) OR (95% CI)</th>
<th>Non-Asian (( n = 10537 )) OR (95% CI)</th>
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<tbody>
<tr>
<td>Intervention (Poster &gt; baseline)</td>
<td>1.12*** (1.04–1.20) 1.01 (0.93–1.11)</td>
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<tr>
<td>Time of day (11–13:00&gt;17–19:00)</td>
<td>1.14*** (1.07–1.22) 0.92 (0.84–1.02)</td>
<td></td>
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<tr>
<td>Intervention × time of day</td>
<td>1.19*** (1.08–1.31) ns</td>
<td></td>
</tr>
<tr>
<td>Maximum humidity (continuous variable)</td>
<td>1.00 (0.99–1.01) 0.98*** (0.97–0.99)</td>
<td></td>
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<tr>
<td>Males &gt; females</td>
<td>1.30*** (1.24–1.36) 1.49*** (1.36–1.62)</td>
<td></td>
</tr>
<tr>
<td>Young &gt; old</td>
<td>2.04*** (1.87–2.23) 1.46** (1.11–1.91)</td>
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<tr>
<td>Weekday &gt; weekend</td>
<td>2.23*** (2.12–2.35) 2.04*** (1.87–2.23)</td>
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\( * P < 0.05 \); \( ** P < 0.005 \); \( *** P < 0.001 \).
The low level of stair usage in this context is remarkable; the baseline rates of 0.36% contrast sharply with average rates of 5.4% for public access staircases in shopping centres, airports, and banks in the UK and US.\(^{11}\) While we speculate below on possible reasons for low levels of stair climbing in this study, a note of caution is appropriate. Informal observations indicate that stair climbing is also rare in the underground rail system whereas rates of 11.6% (range 5.6–31.1%) are found in the UK and US.\(^{11}\) Similarly, a recent study of stair climbing in public housing estates in Hong Kong\(^{19}\) revealed only 1.7% of pedestrians climbed stairs prior to the intervention. Hence, a result specific to Hong Kong, reflecting a cultural norm, cannot be excluded. It should be noted, however, that 90% of respondents thought stair climbing was good for their health prior to the Public Housing intervention. Therefore, low rates of stair climbing were not accompanied by negative perceptions of the behaviour.

Walking up the travelator, nonetheless, represents a modest increase in lifestyle physical activity relative to simply riding. The travelator took \(64\) s to cover its 40.35 m length (0.63 m/s). Assuming a walking speed similar to the Hong Kong underground at low pedestrian density,\(^{10,16}\) i.e. 0.80 m/s, a pedestrian would traverse the travelator at the combined speed of 1.43 m/s. Hence a walker on the travelator could accumulate 28 s of walking and have to make about 60 such journeys to accumulate the 30 min of moderate intensity activity that is the current target.\(^{11,13}\) Walking up more than one travelator and the associated sections in between would allow greater accumulation of physical activity.

**Possible effect of behavioural context**

One plausible explanation for low rates of stair climbing concerns the function of the Mid-Levels escalator system. It was designed as a pedestrian transit system that would reduce levels of motorized traffic within the central part of the city. In the morning, pedestrians are brought down the hill into the city and at 10:00 a.m., the direction is reversed and it carries travellers up the hill and out of the city. Hence users of this system will always be travelling between destinations; a pedestrian in a hurry will simply walk up the travelator without considering the stairs as a means of ascent. Such an effect of behavioural context would be consistent with differential effects of the message ‘Save time’ in train stations and shopping centres\(^{10,19}\) travelling to leave a station differs from the potentially less hurried pursuit of shopping. Further, this emphasis on a behavioural context of transport would be consistent with the higher rates of walking on the travelator during the week than at weekends; one might expect more time pressure during the week. It should be noted that the greater pedestrian traffic volume during the week is unlikely to explain the difference between week days and weekends. Increased pedestrian traffic volume is associated with increased stair climbing.\(^{10,14–16}\) For walking up the escalator, however, a similar behaviour to walking up the travelator, increased traffic volume, is associated with reduced walking. More pedestrians mean it is more likely that a person blocks the path of someone attempting to walk up the escalator (Eves FF, Hoppé R and Kerr J, manuscript submitted; Webb OJ and Eves FF, unpublished data). Thus the lower traffic volume at weekends should have been associated with higher rates of walking on the travelator.

**Possible effects of visual appearance**

An alternative explanation for low rates of stair climbing is the visual appearance of the ascent in this section of the Mid-Levels system. Choice of stairs rather than the escalator, in the absence of any intervention, is influenced by the number of stairs that confront travellers; the lower the height to be climbed, the more likely pedestrians are to opt for the stairs.\(^{11}\) The section of stairs here climbed 5.94 m, a height greater than any previously published study. Nonetheless, the highest climb in our own work, 4.48 m, was associated with rates of stair climbing just over 2.3%,\(^{14}\) more than six times greater than the rates reported here. An additional feature of the appearance may deter travellers. Groups of four stairs were separated by a 2.05 m flat section such that the total distance travelled would have been 39.92 m; this is in marked contrast to a distance of 12.9 m that would have resulted from the 30 cm depth of stair riser alone. Hence the height of the stairs and the apparent duration of the climb could have deterred pedestrians from using the stairs. Low rates of stair climbing in both Asian and non-Asian pedestrians would be consistent with a general effect of appearance.

Any surface similarity in rates of stair usage between the populations, however, may be illusory as the two populations may have different contexts for the behaviour. The Hong Kong Chinese may be going about their daily business, i.e. travelling with a specific destination in mind, whereas the non-Asian participants may be seeing the sights of the city, i.e. be less time pressured. Any differences in behavioural context, however, are unlikely to explain the differential response to the intervention. Greater time pressure in Asians should result in higher rates of walking on the travelator throughout; the opposite was seen. Further, the poster itself emphasized health alone, unlike interventions in the UK, which contained the additional message save time.\(^{9,10}\) It seems unlikely that Asians would have responded to a message emphasizing health with efforts to save time by walking.

**Possible effects of prior history of lifestyle physical activity**

While there was no effect of humidity on the Asian pedestrians, the reduced walking at higher levels of humidity in the non-Asian population may be informative. We have argued elsewhere that choice of the escalators at the expense of the stair reflects the repeated reinforcement of escalator use by reduced energy expenditure.\(^{14}\) Minimization of energy expenditure is characteristic of human locomotion.\(^{19,20}\) In essence, habitual behaviours such as escalator use develop by pairing of the reinforcing stimulus with the behaviour in a consistent context.\(^{21,22}\) As a result, the effects of conscious intention are reduced.\(^{23,24}\) Using the same logic, repeated pairing of any behaviour with punishment would reduce the likelihood of the behaviour. Physical activity in humid conditions is associated with increased ratings of both perceived exertion and discomfort\(^{15}\) relative to activity in low humidity at the same temperature. It is clear that humidity deters walking up the travelator in non-Asians, many of whom may
not be acclimatized. In addition, it is possible that the lower rates of walking in the Asian sample reflect a prior history of punishment by the discomfort of walking up the escalator in humid conditions. Hence lower rates of walking may not result from any attitudinal differences to physical activity in the Hong Kong Chinese but rather from the history of attempts at lifestyle physical activity by pedestrians. From this perspective, attempts to increase lifestyle physical activity in humid climates may truly represent an uphill struggle.

In summary, this study tested whether the uniformly positive effects of point-of-choice interventions for stair climbing in English speaking populations would generalize to a non-English speaking sample, namely the Hong Kong Chinese. Despite a modest increase in walking up the escalator, no effects on stair climbing were seen. Further, rates of lifestyle physical activity in Asians were lower than that in the non-Asian controls. It would be unwise to assume that successful interventions for lifestyle physical activity have universal application.

**Acknowledgements**

This research was funded by a grant from the Health and Health Services Research Fund of the Hong Kong Government (grant number 02030081). We thank Laura Walsh, Mok Lai Hong, and Eva Chu for making the observations.

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<th>KEY MESSAGES</th>
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<td>- Uniformly successful reports of stair climbing interventions on public access staircases have all been conducted in the UK or US. When a point-of-choice prompt in Chinese was tested in Hong Kong, there was no effect on stair climbing but a modest increase in walking on the escalator confined to the Asian population. For non-Asians, increasing humidity was associated with a reduction in the percentage walking on the escalator. Lifestyle physical activity, and interventions to increase it, may be impeded by contextual barriers such as climate.</td>
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**References**