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Are motivational signs to increase stair use a thing of the past? A multi-building study

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Abstract

Issue addressed: Only half of Australia's adult population is sufficiently physical active. One method thought to increase incidental physical activity at work is the use of stair-promoting interventions. Stairs are readily available and stair climbing is considered vigorous physical activity. Motivational signs have been extensively and effectively trialled to increase stair use, but are they suitable for contemporary populations?

Methods: Participants were occupants of three selected University of Sydney buildings using the elevators or stairs. Infrared people counters were installed to monitor stair and elevator use for 24 h/day during two baseline weeks, followed by two intervention weeks, where motivational and directional signs were placed at points of choice.

Results: At baseline there was a large between-building variation in the change in stair to elevator proportion, where we observed a small increase in two buildings (81–84%, odds ratio (OR): 1.16 (1.09, 1.23), and 26–27%, OR: 1.09 (1.03, 1.15)), and a decrease (30–25%, OR: 0.75 (0.72, 0.77) in the third building.

Conclusions: Differences in stair use among buildings could be due to building design and function. Motivational and directional signs to promote stair use showed small or nil effects. The future of interventions promoting stair use in occupational settings may need more interactive or personalised intervention methods.

So what? The implications of this study are that posters to promote stair use might be a thing of the past and this should be considered in future workplace health promotion efforts to increase physical activity. More novel and interactive methods using new media are recommended.

Key words: health promotion, occupational setting, physical activity, posters, stairs.

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Introduction

A recent Australian Health Survey[1] reports that only half of Australia's young adults (18–34 year olds) are sufficiently physically active. Considering the large amounts of time people spend at work or in educational settings, a potential strategy is to increase incidental workplace physical activity. Stairs are available in many settings and stair climbing has proven physiological benefits,[2,3] hence, focusing settings-based interventions on increased stair use is a promising avenue to increase incidental physical activity.

Stair climbing is hard work; with an energy expenditure of ~8.5 kcal/kg/h,[4] it is classified as vigorous physical activity. The benefits of stair climbing have been reported over the last 20 years and go beyond energy expenditure to include increased aerobic capacity,[2,5] and improved lipid profiles, body composition and blood pressure.[3,6] In terms of specific health outcomes, stair climbing is associated with a reduced risk of cardiac events,[7,8] reduced risk of lung cancer,[9] improved blood lipid profile and improved bone mineral density.[2] Hence, using the stairs as opposed to the escalator or elevator is a simple, free and accessible way of incorporating more incidental physical activity into daily living.[10]

The first passenger safety elevator was installed in New York City in 1857. Elevators rapidly proliferated and within a short period of time were standard in all office buildings. This increased user convenience, but consequently stairs lost popularity and usage. In recent years, architects have once again started designing buildings where the stairs are prominent and accessible. However, many people still use the elevator instead of stairs out of habit, following prompts or modelling of other people, lack of access to stairs in buildings or simply not knowing where the stairs are.

Numerous interventions have promoted stair use in public settings.[11] The most common approach to encouraging stair use is to utilise 'point of choice' prompts. These are motivational signs, placed at staircases or near locations where an immediate conscious decision can be made between stairs or elevators and escalators.[12] Inexpensive prompts, such as signs or posters have consistently demonstrated effectiveness in increasing stair use across a range of settings and population groups, showing significant but small absolute effects,[11,13,14] with a higher effectiveness in public setting compared with worksites. The effects are between 2.8% and 4% absolute increase in stair use.[14,15] Although most studies have reported a small effect, some have reported no effect on stair use in worksites[16,17] and in sites where the choice was between stairs and elevators, rather than stairs and escalators.[18]

The research on the effects of stair use signage spans several decades. Previous settings have mainly been universities, health facilities, shopping malls and train stations. A recent systematic review found that combining motivational and directional signs in worksites increased stair climbing to some extent in 80% of studies.[14] However, considering the predominantly young, educated demographics of universities, in combination with rapid technological development, it is not clear whether signs alone are still effective in younger populations, who live with numerous simultaneous messages and 'interactions', mediated through platforms such as smartphones and social media.

Previous stair use research has often involved manual observations for quantifying stair use, which has the advantage of including contextual information such as gender, age and mobility issues of users. However, this method is limited by time and budget constraints, and lack of opportunity to capture temporal differences. Automated methods, such as infrared people counters, have been introduced[19] and validated against manual observations (details of our method, and its acceptable validation and measurement properties, available in the online supplementary material).

This paper describes a stair use promotion intervention in different university buildings. The intervention comprised informative and motivating signs promoting stair use placed near stairs, elevators and building entrances, in combination with directional signs pointing to the stairs. This was introduced into well used buildings on the university campus (usually of no more than four or five stories high), such that using the stairs would be an achievable option for many people. The aim of the study was to assess whether signage to promote stair-use results in changes to the proportion of stair to elevator use.

Methods

Locations

University buildings were selected based on proximity of elevator and stairs, accessible stairs, functioning elevators and having at least three floors. In addition, buildings were chosen to reflect diversity of design across campus and those undergoing maintenance were excluded. Of the 24 buildings assessed, three were selected in consultation with the university's Campus Infrastructure Services (CIS) and building managers (Table 1).

For selected buildings with more than one entrance and set of stairs and elevators, we chose to use the stairs and elevators closest to the main or most used entrance in order to capture the largest volume of users.

Permission for this research was granted by the University of Sydney's Human Research Ethics Committee (2013/910), as well as the university's Injury Management and Workers Compensation Group and the CIS.

Participants

The target groups for this study were the University of Sydney students and staff who worked in or visited the buildings where the study took place. All stair and elevator users were included in the study; however, there was no means of identifying individuals.

Manual observations

Three trained observers (inter-rater agreement 95%) conducted manual observations of the number of individuals ascending and descending the stairs or using the elevator. In addition, gender, approximate age and whether the individual had a visible disability or were carrying a visibly heavy load were noted. Manual observations were made in total on six occasions at all locations (twice during three 1-h time slots (0900–1000; 1200–1300; 1600–1700 hours) at baseline and intervention).

Table 1. Characteristics of buildings included in the study

Building	Levels	Entry level	Stairs	Elevator *N* (speed)	Stair and elevator location	Signs
Architecture	5	1	Wide stairs in concrete staircase, partly natural light	1 (slow)	Stairs and elevators located close to each other	1. On wall next to elevator button
Education	7	3	Wide stairs, natural light	2 (fast)	Elevator around the corner from the stairs, but simultaneously visible	1. On the corner between stairs and elevators 2. On wall next to elevator buttons
New Law	6	2	Glass and stone, natural light	2 (fast)	Stairs and elevators opposite each other	1. Attached to free-standing stand placed in the middle of entrance, at point of choice 2. On wall next to elevator button

Materials

Two types of digital bi-directional counters were used: cloud based Cohera counter (Coheratech.com.au) and the USB stick counter EvolvePlus (evolveplus.com.au). Two types of counters were required as one of the locations did not have access to power and Ethernet connection, hence an alternative solution was found for that location. In a pilot study the two types of counters produced similar results. The bi-directionality of the counters enabled distinguishing between people walking up and down the stairs.

Motivational posters in four different designs (Fig. 1) were prepared after formative evaluation, through consultation with a group of academics and students. From the original 15 motivational messages, four were chosen for their appropriateness and messages pertaining to equity, meeting the daily recommended physical activity guidelines, mental health and time pressures of daily life (Table 2). In addition, signs with a large arrow and the text 'Stairs this way' were placed adjacent to the motivational sign to direct towards the stairs, combining motivational and directional signs.

Protocol

The infrared counters were installed on either side of the stairwell or elevator entrance. Data were collected continuously through the cloud-based system. The study design was a pre-post design, with a 2-week baseline period and a 2-week intervention period. Following a 2-week run-in period of the university semester in order for most staff and students to get into a routine, data were collected during August and September 2014. Baseline data were collected for 2 weeks continuously, where after signs were placed at point of choice locations, including motivational posters and signs pointing to the direction of the stairs. Intervention data collection commenced immediately after introduction of the intervention (signs) and lasted 2 weeks.

Effect of signage on stair use

For all buildings, the average stair use per hour over each 2-week period (weekdays only) was calculated over the two time points (Baseline, Intervention). For the three buildings that had both stair and elevator monitors the average elevator use per hour was also calculated. At two locations (Edu, New Law), more than one elevator was connected to a central dispatch computer, hence, the traffic would be equally distributed between the elevators over time. At those locations the digital counts were multiplied by the number of elevators before comparison. The proportion of stair to elevator use at each hour of each day over the 2-week period of intervention or baseline was calculated and used as the primary outcome measure.

Analysis

Data were downloaded from the infrared devices into Excel and prepared for analyses in SAS v. 9.2. Generalised linear mixed models were used to estimate the odds of taking the stairs over the elevator for each building before and after the intervention. The day and time of the observation was modelled as a random effect to account for the fact that similar behaviour patterns are expected at given times of a given day (i.e. the number of students using the stairs on a given Monday at 0900 hours would be more similar to the number of students using the stairs on another Monday at 0900 hours the following week than, for example, Wednesday at 1500 hours). Phase was modelled as a fixed effect. $P < 0.05$ was considered significant.

Results

Over the 4 weeks, a total of 148 071 individual counts were measured using either the stairs (92 536) or elevators (55 535).

There were large differences observed among the buildings, where the counted stair use varied six- fold from the building with lowest stair use volume (New Law) to the building with the highest stair use volume (Architecture) (Table 3).

Change in stair users

To ascertain the effect of motivational posters on stair use, the proportion of stair to elevator use was calculated and compared between the baseline and post-test phases using generalised linear mixed models. Due to the large differences among the buildings, in terms of architecture and layout as well as the observed stair counts, each building was analysed separately (Table 3).

At the Architecture building, which already had a high proportion of stair use at baseline, the proportion of stair to elevator use further increased by 2.6% (from 81% to 84%) during the intervention (odds ratio (OR):1.16 (1.09,1.23)). The proportion of stair use increased to a lesser extent in the New Law building (from 26% to 27%; OR: 1.09 (1.03, 1.15)) and in the Education building the proportion declined by 4.5%, from 30% to 35% (OR: 0.75 (0.72, 0.77)). Fig. 2 shows the proportions of stair users at each day and time point as well as averaged over all day and time points at baseline and after the intervention.

Discussion

This study used infrared people counters to monitor the stair and elevator use at three University of Sydney buildings before and after the introduction of motivational and directional signs at points of choice promoting stair use.

The effect of the intervention using motivational and directional signs to promote stair use was not clear-cut, we observed increases as well as decreases depending on the location (building) of measurement. This is in accordance with previous studies, where varied results were reported; most studies showed a positive effect of the intervention,[14,20] but some studies have shown no effect[18] or negative effects[16] in multi-site studies. The effects in both directions (increase and decrease) were minor, but comparable to the magnitude observed in some studies and significantly smaller than in others. Considering this was a multi-site intervention, it is not surprising that the baseline rates varied markedly among buildings that had different types of users, architectural features, and placement and efficiency of elevators. There was also some variation

Fig. 1. Four designs for motivational posters to encourage stair use used in the present study.

in the observed intervention effects among the buildings. Eighty-one percent stair use was considerably higher than previously reported stair use, where the highest reported stair use at baseline in intervention studies was 40%[11] and 69%.[14] These results also show that our study population used the stairs more than most reported studies, even in the building with the lowest proportion of stair use.[11,14] One possibility for the high stair to elevator proportions is that the elevators were under-dimensioned for the high volume of building users or occupants in some of the buildings. It was reported that the one elevator present in the Architecture building (80% stair use already at baseline) was very slow. This building has a high traffic with on average close to 130 people using the stairs per hour over 24 h. Although the building has 5 floors, it would not be feasible to use the elevator and the occupants chose to use the stairs. Over the 2 baseline weeks, more than 32 031 stair counts were registered in that building. Considering that the proportion of stair use increased even further over the 2 intervention weeks, an additional 3% had taken the stairs. This was the largest observed increase in stair use, and occurred in the building where most were already active, a previously noted issue in interventions succeeding with those that need them least.[21]

Observations of the other buildings revealed that the two elevators per building seemed to be relatively efficient and well used, which coincides well with the relatively lower proportion of stair users in those buildings. A previous study concluded that in buildings where the staircases were centrally located, accessible and aesthetically pleasing, a much larger proportion of people chose to take the stairs.[22] In our study, however, the locations were chosen due to both stairs and elevators being equally easy to find and access. One can speculate about other reasons for the high overall stair use in the studied locations, such as modelling by other users of the building, a real perception of the health benefits of stair climbing, or a spatial quality of these locations, that optimise the convenience and legibility of stairs.[23]

The building in which proportion of stair use decreased at intervention had a relatively low total traffic volume, with only 47 people per hour. The reason for the decrease in stair use is unclear. One possible explanation could be malfunctioning elevators during baseline, forcing occupants to use the stairs. However, the respective building managers confirmed through the outage logs that there had been no known malfunctioning of the elevators during this time. Another explanation could be a natural fluctuation in the number of stair and elevator users; hence, it would be interesting to study the traffic over prolonged periods. We checked the variation between the two baseline weeks, and the two intervention weeks, and although there was some variation, this difference was not significant.

Although we did observe an increase in stair use during the intervention in two of the buildings, this increase was very modest compared with the median change of 12% presented in the most recent review.[14] Reports from the manual observers state that few people actually looked at the signs and even fewer changed direction as a result of seeing them. This suggests that static point of choice prompts may not attract the attention of this population of mostly young adults, who are used to being constantly stimulated and 'online'. To reach this population, future behavioural interventions may need interactive or personalised components to be more effective than signs in increasing stair use or changing other health promoting behaviour. Previous studies have successfully implemented static adjunctive interventions, for example, interactive paintings such as maps, storyboards and wish lists, and music to encourage stair use.[24,25] The piano stairs introduced at Odenplan station in Stockholm (www.thefuntheory.com/piano-staircase, accessed 22 August 2016) is an example of a highly interactive intervention to encourage more stair use, however, this intervention was expensive, has not been evaluated and may be transient in its effects. Other technological solutions could include smartphone prompts or gamification, increasing motivation and peer influence. Given that stair climbing is a high intensity activity, even small increases could contribute positively to overall physical activity and

Table 2. The types of message and motivational text used on posters to promote stair use

Message type	Motivational text
Equity	Stairs are for everyone, remaining active is more important than your size in preventing chronic disease
Meeting daily physical activity recommendations	Got a Minute? Take the stairs, you only need 30 min of physical activity a day to prevent chronic disease. . .and it doesn't all have to be at once
Mental health benefits	Feeling down? The only way is up. . .the stairs, Physical activity has many improved health benefits, including improved mental health
Time pressures of daily life	Can't get to the gym? Take the stairs, get your workout and shape your muscles in the staircase, and for FREE!

Table 3. Average counts of stair and elevator users per hour, and proportion of stair to elevator users at baseline and during intervention with posters over 24 h

Building	Elevators		Stairs		Mean proportion stair to elevator		Odds ratio	*P*	d.f.
	Baseline	Intervention	Baseline	Intervention	Baseline	Intervention	(±95%CI)		
Architecture	12.14 (12.0)	10.57 (9.61)	127.9 (136.1)	124.1 (131.6)	0.81 (0.25)	0.84 (0.21)	1.16 (1.09,1.23)	<0.0001	1361
Education	58.55 (53.3)	71.3 (65.8)	47.44 (59.78)	42.81 (53.46)	0.30 (0.24)	0.25 (0.21)	0.75 (0.72, 0.77)	<0.0001	1336
New Law	41.26 (36.5)	42.2 (38.0)	20.67 (23.47)	22.60 (25.5)	0.26 (0.18)	0.27 (0.18)	1.09 (1.03, 1.15)	0.0020	1249

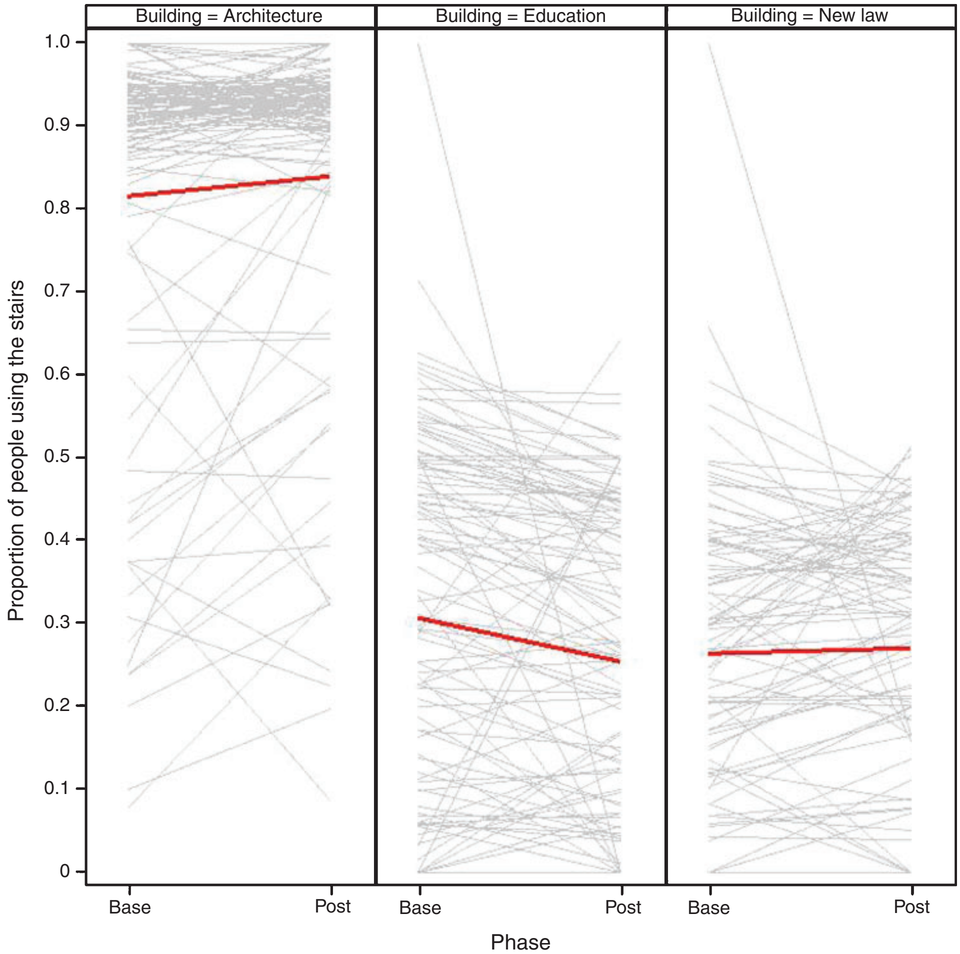

Fig. 2. Proportion of people using the stairs at baseline and after the posters were put up in each building at each day and time. The solid line shows the average proportion per building.

health. Therefore, it would be beneficial to trial future stair use interventions using interactive methods as well as ensuring that attractive and central stair cases are designed into future buildings.

Another challenge facing stair use promotion efforts is the sustainability of such efforts at changing and maintaining stair use behaviour. However, information about long-term maintenance is scarce and it is recommended that future studies include this.

Strengths and weaknesses of the study

The multi-site replication design enabled us to study three different locations simultaneously. Although the sites were all on the university campus, they all had very different designs with different user groups from law, architecture and education. However, considering they were all university staff, students and visitors, the findings are not generalisable to wider populations. Limitations also include the relatively short duration of the intervention and lack of control sites. By considering the ratio of stair and elevator use, we could circumvent biases relating to changes in total volume of people using the building, including special meetings, holidays and periods of flu epidemics. The use of infrared counters enabled us to monitor several locations simultaneously, over full days and over a longer continuous period of time saving resources in comparison to manual counts, however it is beneficial to gather contextual information through manual observations for a few times points.

Conclusions

In conclusion, increasing stair use is a promising avenue to increase incidental physical activity that also has the benefit of being of a high intensity. Infrared people counters are recommended for monitoring stair and elevator traffic as they are cost-effective and can give rich temporal and continuous data. However, static point of choice prompts (motivational and directional signs) had limited impact on stair usage in these university buildings. This highlights the challenges of generating salient stair use promotion initiatives and maintaining behaviour change among young adults in the long-term. We suggest more novel and interactive methods using new media should be trialled in future workplace health promotion efforts to increase physical activity.

The implications of this study are that posters to promote stair use might be a thing of the past and this should be considered in future health promotion efforts to increase physical activity. More novel and interactive methods using new media are recommended.

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References

1. Australian Bureau of Statistics. Australian Health Survey 2011–12. 2014. Available from: http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/4364.0.55.004Chapter100 2011-12 [Verified 19 August 2916].
2. Boreham CAG, Kennedy RA, Murphy MH, Tully M, Wallace WFM, Young I. Training effects of short bouts of stair climbing on cardiorespiratory fitness, blood lipids, and homocysteine in sedentary young women. *Br J Sports Med* 2005; **39**(9): 590–3. doi:10.1136/bjsm.2002.001131
3. Meyer P, Kayser B, Kossovsky MP, Sigaud P, Carballo D, Keller P-F, *et al.* Stairs instead of elevators at workplace: cardioprotective effects of a pragmatic intervention. *Eur J Cardiovasc Prev Rehabil* 2010; **17**(5): 569–75. doi:10.1097/HJR.0b013e328338a4dd
4. Halsey LG, Watkins DAR, Duggan BM. The energy expenditure of stair climbing one step and two steps at a time: estimations from measures of heart rate. *PLoS One* 2012; **7**(12): e51213. doi:10.1371/journal.pone.0051213
5. Andersen LL, Sundstrup E, Boysen M, Jakobsen MD, Mortensen OS, Persson R. Cardiovascular health effects of internet-based encouragements to do daily workplace stair-walks: randomized controlled trial. *J Med Internet Res* 2013; **15**(6): e127. doi:10.2196/jmir.2340
6. Kamani CH, Gencer B, Montecucco F, Courvoisier D, Vuilleumier N, Meyer P, *et al.* Stairs instead of elevators at the workplace decreases PCSK9 levels in a healthy population. *Eur J Clin Invest* 2015; **45**(10): 1017–24. doi:10.1111/eci.12480
7. Lee I-M, Sesso HD, Paffenbarger RS. Physical activity and coronary heart disease risk in men: does the duration of exercise episodes predict risk? *Circulation* 2000; **102**(9): 981–6. doi:10.1161/01.CIR.102.9.981
8. Morris JN. Exercise in the prevention of coronary heart disease: today's best buy in public health. *Med Sci Sports Exerc* 1994; **26**: 807–14. doi:10.1249/00005768-199407000-00001
9. Lee IM, Sesso HD, Paffenbarger RS. Physical activity and risk of lung cancer. *Int J Epidemiol* 1999; **28**: 620–5. doi:10.1093/ije/28.4.620
10. Schumacher JE, Utley J, Sutton L, Horton T, Hamer T, You Z, *et al.* Boosting workplace stair utilization: a study of incremental reinforcement. *Rehabil Psychol* 2013; **58**(1): 81–6. doi:10.1037/a0031764
11. Soler RE, Leeks KD, Buchanan LR, Brownson RC, Heath GW, Hopkins DH. Point-of-decision prompts to increase stair use. A systematic review update. *Am J Prev Med* 2010; **38**(2): S292–300. doi:10.1016/j.amepre.2009.10.028
12. Aarts H, Paulussen T, Schaalma H. Physical exercise habit: on the conceptualization and formation of habitual health behaviours. *Health Educ Res* 1997; **12**(3): 363–74. doi:10.1093/her/12.3.363
13. van Nieuw-Amerongen ME, Kremers SPJ, de Vries NK, Kok G. The use of prompts, increased accessibility, visibility, and aesthetics of the stairwell to promote stair use in a university building. *Environ Behav* 2011; **43**(1): 131–9. doi:10.1177/0013916509341242
14. Bellicha A, Kieusseian A, Fontvieille A-M, Tataranni A, Charreire H, Oppert J-M. Stair-use interventions in worksites and public settings – a systematic review of effectiveness and external validity. *Prev Med* 2015; **70**: 3–13. doi:10.1016/j.ypmed.2014.11.001
15. Dolan MS, Weiss LA, Lewis RA, Pietrobelli A, Heo M, Faith MS. 'Take the stairs instead of the escalator': effect of environmental prompts on community stair use and implications for a national 'Small Steps' campaign. *Obes Rev* 2006; **7**(1): 25–32. doi:10.1111/j.1467-789X.2006.00219.x
16. Coleman KJ, Gonzalez EC. Promoting stair use in a US-Mexico border community. *Am J Public Health* 2001; **91**(12): 2007–9. doi:10.2105/AJPH.91.12.2007
17. Adams J, White M. A systematic approach to the development and evaluation of an intervention promoting stair use. *Health Educ J* 2002; **61**(3): 272–86. doi:10.1177/001789690206100308
18. Nocon M, Müller-Riemenschneider F, Nitzschke K, Willich SN. Review article: increasing physical activity with point-of-choice prompts – a systematic review. *Scand J Public Health* 2010; **38**(6): 633–8. doi:10.1177/1403494810375865
19. Bellicha A, Kieusseian A, Fontvieille A-M, Tataranni A, Copin N, Charreire H, *et al.* A multistage controlled intervention to increase stair climbing at work: effectiveness and process evaluation. *Int J Behav Nutr Phys Act* 2016; **13**(1): 47.
20. Lee KK, Perry AS, Wolf SA, Agarwal R, Rosenblum R, Fischer S, *et al.* Promoting routine stair use: evaluating the impact of a stair prompt across buildings. *Am J Prev Med* 2012; **42**(2): 136–41. doi:10.1016/j.amepre.2011.10.005
21. Macniven R, Engelen L, Rosen M, Bauman A. Does a corporate worksite physical activity program reach those who are inactive? Findings from an evaluation of the Global Corporate Challenge. *Health Promot J Austr* 2015; **26**(2): 142–5. doi:10.1071/HE14033
22. Bassett D, Browning R, Conger S, Wolff-Hughes D, Flynn J. Architectural design and physical activity: an observational study of staircase and elevator use in different buildings. *J Phys Act Health* 2013; **10**(4): 556–62. doi:10.1123/jpah.10.4.556
23. Nicoll G. Spatial measures associated with stair use. *Am J Health Promot* 2007; **21**(4 Suppl): 346–52. doi:10.4278/0890-1171-21.4s.346
24. Swenson T, Siegel M. Increasing stair use in an office worksite through an interactive environmental intervention. *Am J Health Promot* 2013; **27**(5): 323–9. doi:10.4278/ajhp.120221-QUAN-104
25. Kerr NA, Yore MM, Ham SA, Dietz WH. Increasing stair use in a worksite through environmental changes. *Am J Heal Promot* 2004; **18**(4): 312–5. doi:10.4278/0890-1171-18.4.312