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**Summary (195 words)**

Objective: We performed a literature review with the main aim to propose an updated overview of the effectiveness of stair-use interventions and to determine the most effective type of intervention.

Methods: We systematically searched stair-use interventions performed in worksites or public settings, published up to mid 2013. We used a harvest plot approach to visualize the findings in addition to a quantitative synthesis. We also assessed external validity using the RE-AIM framework.

Results: Of 8,571 articles identified, 50 were included. In worksites (25 studies) and public settings (35 studies), an increase in stair climbing was found during the intervention period in 64% and 76% of studies, respectively. Combining motivational and directional signs in worksites or conducting a second intervention phase in public settings increased stair climbing in 83% and 86% of studies, respectively. Elements of external validity were overall largely under-reported.

Conclusion: There is evidence that stair-use interventions are effective to increase stair climbing in public settings, but evidence of such effect is limited in worksites. Issues regarding the best sequencing of interventions or the potential importance of environmental interventions should be addressed in future studies. Process evaluation should be an integral part of interventions.

**Word counts**: 4,607

**Key words**: physical activity, stair-use interventions, worksites, public settings, point-of-decision prompts, systematic review.

## Introduction

Increasing population physical activity (PA) level is recognized as a major public health priority (Physical Activity Guidelines Advisory Comitee, 2008). The accumulation of small bouts of PA, which can fit into daily life, has been mentioned as a strategy that may be effective to reach the recommended total level of PA (Task Force on Community Preventive, 2002). Stair climbing is one of the activities that can be easily integrated into everyday life and contribute to the accumulation of PA throughout the day. Regular stair climbing has been associated with numerous health benefits (Boreham et al., 2005, Meyer et al., 2010, Meyer et al., 2009). In sedentary women, an improvement in fitness and lipid profile was observed with an 8-week progressive stair-climbing program (40 floors a day at the end of the program) (Boreham et al., 2005). In sedentary men, a simple 12-week intervention based on posters resulted in an increase in stair climbing (from 4.5 floors a day before the intervention to 20.6 during the intervention), an improvement of fitness, weight control, and lipid profile and a decrease of blood pressure (Meyer et al., 2010). Despite those benefits, the use of stairs is still limited, as a majority of studies report a level of stair climbing compared to elevators lower than 20% (Soler et al., 2010). Defining characteristics of effective stair-use interventions is therefore an important public health research objective.

The importance of analyzing stair use according to the setting where the intervention takes place (worksites or public settings) has been highlighted by Eves (Eves, 2010). According to this author, a median +5.9% increase in stair climbing was observed with interventions in public settings, whereas only a +0.1% increase in worksites (Eves, 2010). Since then, other studies have reported higher increases in stair climbing during interventions in worksites (Eves et al., 2012b, Lewis and Eves, 2012a, Olander and Eves, 2011a), suggesting a possible effect in this setting that remains to be more firmly established. Another important characteristic of most stair-use interventions is the use of point-of-decision (POD) prompts (Olander and Eves, 2011b). POD prompts are signs placed close to stairwells or at the base of elevators and escalators, encouraging people to use the stairs (Soler et al., 2010). Two recent reviews showed that POD prompts could increase stair climbing with increases ranging from +0.3 to 10.6% (Soler et al., 2010, Nocon et al., 2010). However, data in these reviews were not analyzed by setting. Therefore, a systematic updated overview of results of such intervention studies, taking into account recent papers not included in the reviews by Soler et al. (2010) and Nocon et al. (2010), and analyzing results by setting is relevant.

Several issues regarding the strategy and the type (one-phase or two-phased intervention) of stair-use interventions remain unclear. First, it is unknown whether all types of POD prompts have similar effects. Two different types of POD prompts based on different strategies have been used: motivational signs (posters or stair-riser banners informing individuals about a health or weight loss benefit of stair climbing) and directional signs (arrows pointed to the stairs or footprints informing individuals about a nearby opportunity to use the stairs) (Grimstvedt et al., 2010, Soler et al., 2010). Their effectiveness was compared in only one study, which found a positive effect with POD prompts based on both motivational and directional signs (Lewis and Eves, 2012a). Second, the impact of repeated interventions on stair

use has not been systematically evaluated in detail. Therefore, there is a need to systematically assess the literature on effects of types of POD prompts and of repeated interventions.

Finally, there is an increasing interest in the assessment of external validity (i.e. transferability), which aim is to translate research findings into practice (Glasgow and Emmons, 2007). Studies assessing the effectiveness of physical activity promotion interventions have mainly focused on internal validity, and to a lesser extent on external validity (Vuillemin et al., 2011). To our knowledge, the extent to which research has reported on elements of external validity in the field of stair-use interventions has not been examined in detail.

The first aim of this review is to propose an updated overview of the effectiveness of stair-use interventions separately in worksites and in public settings. The second aim is to determine which strategy or type of intervention appears to be the most effective. Regarding the second aim, a first hypothesis was that POD prompts based on a combination of motivational and directional signs would be more effective than POD prompts based on motivational signs only. A second hypothesis was that conducting a second intervention phase would increase stair climbing substantially more than a single intervention phase. The third aim is to evaluate how elements of external validity had been assessed and reported. Our hypothesis was that only few studies had reported such element.

## Material and methods

### Literature search, selection of studies and data extraction

The literature search was performed in June 2013, using three electronic databases (PubMed, Web of Science and Cochrane Library). The reference sections of the included articles were also reviewed and a search based on the first author of the articles was carried out. Figure 1 presents the flow chart of the systematic literature search. The search was limited to English language articles. It was conducted using combinations of the following keywords: ‘stair intervention’ OR ‘stair climbing’ OR ‘stair use’ OR ‘point-of-decision’ OR ‘point-of-choice’ OR ‘worksite AND stair’ OR ‘public setting AND stair’ OR ‘prompts AND stair’. The initial inclusion criterion was the implementation of stair-use interventions. We included studies only if 1) interventions were implemented in worksites or in public settings, 2) the alternative to stairs was an elevator or an escalator, 3) stair use or stair climbing was measured before and during the interventions (e.g. when prompts were still present); studies measuring stair use only before and after the interventions (e.g. when prompts had been removed), were therefore excluded, 4) stair use or stair climbing was expressed as a percentage relative to the use of escalator or elevator. The same inclusion criteria were used for the 3 objectives of our review. All studies published as of the date of the search were included.

The characteristics of each included article were extracted by one reviewer (AB) and checked by a second reviewer (JMO), and included: authors, journal, year of publication, country, setting, alternative to stairs, main outcome, assessment tools, duration and description of interventions.

**Quality assessment**

The quality of included studies was assessed with a standardized quality assessment tool, the Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies 2003 (Thomas et al., 2004, www.ephpp.ca/tools.htlm), which has been developed to evaluate both randomized and non-randomized studies (Deeks et al., 2003). This tool estimates a global rating of study quality using six components which can be rated as 'strong', 'moderate' or 'weak': A) selection bias, B) study design, C) confounders, D) blinding, E) data collection methods, F) withdrawals and drop-outs. The global rating defined the study quality as strong if no component was rated as weak, moderate if one component was rated as weak and weak if two or more components were rated as weak (Thomas, 2004). In order to adapt the tool to our research question, we excluded components A and F from the analysis because they were not found applicable to the study design of included studies. The estimation of the global rating, based on the 4 relevant dimensions that we selected in our study, however, was unchanged. Quality of each included study was assessed by one reviewer (AB) and checked by a second reviewer (JMO). When opinions differed, consensus on ratings was reached through discussion.

**Assessment of effectiveness**

We reported the percentages of stair use (defined as the action of going up or down the stairs) or stair climbing (defined as the action of going up the stairs) for all the study phases: during baseline (pre-intervention), intervention (first and second phase) and follow-up (post-intervention) periods when results were available. For studies with multiple post-intervention data collection, we reported the last measurement (after the end of the intervention). When an intervention was conducted in more than one location, we reported the result obtained for each location. In some studies, stair use was reported only for specific socio-demographic subgroups (e.g. according to sex, age or ethnicity). In this case, we calculated the mean percentage of stair use of the subgroups as described by Soler et al. and Dolan et al. (Dolan et al., 2006, Soler et al., 2010). We therefore reported only one percentage of stair use per study and per location. For each study phase, we converted the results into absolute and relative change and we calculated an overall median change for both absolute and relative change (the calculation method followed the one presented by Soler et al., 2010). Then, based on the results of the study arms, we estimated the overall effectiveness for each study (Van Cauwenberghe et al., 2010). The overall result was considered an improvement if an increase in stair use was found in at least one study arm and no decrease was found, 2) a deterioration if a decrease in stair use was found in at least one study arm and no increase was found, 3) mixed if an increase and a decrease in stair use was found in at least one study arm, 4) no change if no significant change in any direction was found in any location.

The number of studies included in the analysis varied according to the research question.

Effectiveness of all stair-use interventions: we selected all types of stair-use interventions (based on POD prompts, social approaches and stairwell enhancements) and we reported both the results of the first phase and follow-up period of the intervention.

Comparison between different types of POD prompts (motivational and/or directional signs): we selected studies conducted in worksites only (interventions with directional signs have not yet been performed in public settings) and we reported results for the first intervention phase.
Effectiveness of repeated exposure to interventions: we selected studies conducted in worksites and in train stations and excluded studies conducted in other public settings such as malls or airports (it can be hypothesized that shoppers or travelers do not visit the same malls or airports on a regular basis, and that a majority of persons exposed, for example, to the second intervention phase have not been exposed to the first phase (Boen et al., 2010)). We reported both the results of the first and the second intervention phase.

**Synthesis of findings**

We used a harvest plot approach developed by Ogilvie and colleagues (Barnett et al., 2012, Ogilvie et al., 2008) to visualize the findings for the first and second aims of the study (updated overview of effectiveness of stair-use interventions, identification of most effective strategy, respectively). This approach allows a graphic presentation of findings which takes into account study quality, sample size and effectiveness of interventions. A hypothesis-testing approach was adopted, comparing the null hypothesis of no change in stair use during or after interventions with two alternative hypotheses of a positive change and mixed results. Each plot consisted of three columns representing the three competing hypotheses. The rows represented our research questions. Each study was represented by a bar in one of the two columns depending on the study result. The height of the bars illustrated the study quality and the shading of the bars indicated the sample size. The harvest plots were combined with the quantitative synthesis: the absolute and relative median change in stair climbing was presented in the fourth column of the plots.

**External validity: RE-AIM framework**

RE-AIM is a five-step framework designed to help translate research findings into practice and policy (Glasgow et al., 1999). This framework has been used in a number of prevention research fields including obesity prevention (Klesges et al., 2008, Vuillemin et al., 2011). Our analysis was based on the 5 following criteria: 1) Reach measures participation at the individual level (e.g. participation rate and representativeness of individuals), 2) Efficacy refers to the impact on selected outcomes (e.g. whether outcomes were compared to a standard goal, whether adverse effects were reported), 3) Adoption measures the proportion and representativeness of settings and staff members adopting a given program (e.g. participation rate and representativeness of settings), 4) Implementation is the extent to which a program is delivered as intended (e.g. staff expertise or training, consistency of delivery), 5) Maintenance refers to the long-term change at both the individual and setting level (e.g. which components are institutionalized or modified over time after the end of the intervention). The percentage of studies that used the respective external validity criteria was reported.

## Results

**Study characteristics and quality**

Of the 8,571 articles initially identified, 50 were included in our review (Figure 1). In five articles, 2 distinct studies were performed, in one article 3 distinct studies were performed and in one article 4 distinct studies were performed (studies were considered distinct when different interventions were conducted in different locations or when different outcomes were measured, i.e. stair use or stair climbing). Sixty studies were therefore included. Sixty, 29 and 60 studies have been used to investigate the first, second and third aim of the study, respectively. The main characteristics of these studies are presented in Table 1 where studies are listed alphabetically according to setting (worksites then public settings). Twenty-five studies were conducted in worksites and 35 in public settings such as train station or shopping mall.

The studies were conducted in different countries, with a majority of studies from the United Kingdom and the United States (28 in the UK, 18 in the USA, 3 in Belgium, 2 in Australia, China, Netherlands, and 1 in Denmark, Germany, Japan, South Africa and Spain). Study quality was rated as strong, moderate and weak in 0, 22 and 38 studies, respectively (summary results of quality assessment are shown in Table 2 and detailed results of quality assessment of included studies are shown in Supplementary Table 1). Less than half of reviewed studies (23 of 60 studies) included measurements during a follow-up period after the intervention. Only 1 study evaluated long-term effectiveness during follow-up (at least six months after the end of the intervention).

Duration of the interventions ranged from 1 day (Andersen et al., 2008) to 16 weeks (Lewis and Eves, 2012c). Interventions were either designed as single (36 studies) two phases (24 studies) and were conducted in one or several locations. Each phase of the interventions and each result of different locations were considered as a study arm. Therefore, in the 50 articles included in our review, 94 study arms were identified. During the first intervention phase, POD prompts strategy was used alone in 63 study arms (motivational signs in 56 study arms, and supplemented by directional signs in 7 study arms). Stairwell enhancements (e.g. artwork and music or painting in the stairwell) and interventions based on social approaches (e.g. promotion days, behavioral modeling or e-mails sent by the worksite's doctor), alone or in addition of POD prompts, were both conducted in 3 study arms. During the second intervention phase, POD prompts, stairwell enhancements and social approaches were used in respectively 22, 1 and 2 study arms.

The main outcome was stair climbing in 48 studies and stair use (ascent and descent combined) in 12 studies, 11 of these in worksites. The alternative to stairs was always an elevator in worksites and an escalator in public settings. Stair use was measured by observers in 50 studies, by automatic counters in 6 studies, by a combination of camera and observer in 3 studies and by an interviewer in 1 study.

**Effectiveness of interventions**

In studies conducted in worksites, stair use and stair climbing ranged during the baseline period from 11.1% to 69.0% and from 19.0% to 59.4%, respectively. The calculated mean stair use and stair climbing were of 30.7% and 37.4%, respectively. In studies conducted in public settings, stair climbing ranged

from 1.7% to 41.9% during the baseline period, with a mean stair climbing of 16.4% (Supplementary Table 2).

Figure 2 (in worksites) and Figure 3 (in public settings) show the harvest plots of evidence for changes in stair climbing and stair use during and after interventions and the calculated mean change in stair use. During the intervention period of all studies, an increase in stair climbing was found in 64% of studies in worksites and 76% of studies in public settings, with a median absolute increase in stair use of approximately +4% in both settings. An increase in stair use was found in 73% of studies in worksites, with a median absolute change of +4.3%, and in the only study measuring stair use in public settings (Nomura et al., 2009). In worksites, all the studies reporting an increase in stair climbing scored weak on quality and were heterogeneous in terms of sample size. The only study of moderate quality found no effect of intervention. In public settings, studies reporting an increase in stair climbing were, for about half of them, of moderate quality and for the other half of weak quality. During follow-up (after the removal of interventions), stair climbing remained elevated compared to baseline in 75% of studies in worksites and 67% of studies in public settings.

Studies using a combination of motivational and directional signs in worksites reported more often an increase in stair climbing compared to studies using motivational signs only (83% vs. 40%). The median absolute change was also markedly higher in the former compared to the latter (+8.1% vs. +0.8%). Studies measuring stair use found more often a positive change with motivational signs alone compared to studies measuring stair climbing (75% vs. 40%). Most studies, using either motivational signs alone or a combination of motivational and directional signs, received a weak quality rating with a range of sample sizes.

A majority of studies conducting a second intervention phase found an increase in stair climbing compared to the baseline period (67% of studies in worksites and 86% in public settings). The median absolute increase in stair climbing ranged from +2.7% in worksites to +8.7% in public settings. When measuring stair use in worksites, all studies found a positive change, with a median absolute increase of +8.4%. Compared to the first intervention phase, only 36% of studies found an increase in stair use or stair climbing during the second intervention phase. The majority of studies conducting two intervention phases received a weak and moderate quality rating in worksites and public settings, respectively.

Finally, three of four studies using stairwell enhancements in addition to POD prompts in worksites (Boutelle et al., 2001, Swenson and Siegel, 2013, van Nieuw-Amerongen et al., 2011b) found a significant increase in stair use or stair climbing. The median absolute and relative change in stair climbing was of +4.4% and +39.6%, respectively (Supplementary Table 2).

**External validity**

The majority of studies lacked reporting on external validity (Table 3). In worksites, 19 of 25 studies reported at least one element of the RE-AIM framework, but only 5 and 2 studies reported 2 and 3 elements, respectively. In public settings, 32, 20 and 4 studies reported one or more, 2 and 3 elements, respectively. Elements receiving the highest attention in both settings were related to the Efficacy dimension: a moderator effect by participant and by setting characteristic(s) was reported in 13 and 9 studies in worksites, and in 32 and 19 studies in public settings, respectively. The criterion reported on the Reach dimension was the participation rate (8 studies in worksites, 5 studies in public settings) which was estimated indirectly when participants could remember the message delivered by the posters, or their thoughts or feelings about the message (Kerr et al., 2001a), or if they reported they had been encouraged to climb stairs by interventions (Eves et al., 2006, Kerr et al., 2000). Very few studies reported elements on the Implementation dimension. Some studies have included information about the consistent implementation of program and staff expertise (2 studies in worksites, 1 study in public settings), cost of interventions (1 study in both settings) and the time needed to deliver the interventions (1 study in worksites). Only 1 study in public settings reported elements on Maintenance. No study reported elements on Adoption.

## Discussion

The main objective of this systematic review was to provide an updated overview of the effectiveness of stair-use interventions to increase stair use or stair climbing in worksites and in public settings. The review identified 50 articles including 60 studies analyzing, with different intervention designs, the impact of stair-use interventions. Compared to the previous reviews on this topic by Soler et al. (2010) and Nocon et al. (2010), we have added in the present review 40 and 26 new articles, respectively.

We found an increase in stair climbing during the intervention period in about two-thirds of studies in worksites and in three-quarters of studies in public settings. In worksites, the median absolute change observed in our review was larger than that observed in previous studies (Eves, 2010). In addition, the percentage of studies reporting a positive result was higher in our review than in others (Nocon et al., 2010). In public settings, the median absolute change and the percentage of studies reporting a positive result observed in our review were similar to results observed in previous reviews (Eves, 2010, Nocon et al., 2010). In contrast with previous reviews which found an increase in public settings but not in worksites, our findings appear novel and encouraging.

Studies measuring stair use (ascent and descent combined) in worksites reported a positive result slightly more often than studies measuring specifically stair climbing, with an increase during the intervention period in 73% of studies. The median absolute change, however, was similar. The greater effectiveness obtained when measuring stair use may be explained by a preferential increase in stair descent, as it has been suggested by some studies which found an increase in stair descent but not in stair climbing (Eves, 2012, Kerr, 2001). That discrepancy may be explained by the higher energy cost of stair climbing (the intensity of stair climbing and stair descent is 9.6 and 4.8 metabolic equivalents,

respectively) (Teh and Aziz, 2002). Stair climbing being clearly the preferential public health target (Eves et al., 2012b), future studies should more consistently separate stair climbing and stair descent in their analysis.

During the follow-up period, findings were mixed. Stair climbing remained elevated from baseline in three-quarters and two-thirds of studies in worksites and public settings, respectively. It is worth noting that only 35% of the included studies evaluated the short-term effectiveness of interventions (immediately after the removal of the intervention), and only 1 study evaluated their long-term effectiveness (at least six months after their removal). We would therefore recommend, in line with previous reports, that future studies evaluate the maintenance of effects, especially in worksites where it is more likely that the same group of individuals is followed throughout the study (Eves et al., 2012b).

The second objective of the review was to identify what strategy or type of intervention is most likely to be effective. In accordance with our first hypothesis, we observed that studies in worksites using a combination of motivational and directional signs reported more often an increase in stair climbing, and that the median change was larger in these studies. Therefore, the addition of directional signs to motivational signs should be considered in worksites, especially when the stairwell is distant from the elevator and not immediately visible, which is often the case in this setting (Eves and Webb, 2006).

Another intervention strategy, based on stairwell enhancements, was used in 4 studies. Therefore, it was difficult to analyze its effectiveness. However, the first results based on these 4 studies seem promising. The three studies using important stairwell enhancements in addition to POD prompts, such as artwork and music (Boutelle et al., 2001), interactive paintings (Swenson and Siegel, 2013) or painting and replacement of doors (Van Nieuw-Amerongen et al., 2011a), found high increases in stair use. This finding is in line with the recent results of health promotion programs that combine environmental strategies (e.g. enhancements of physical activity facilities, creation of walking path within worksite) with educational interventions (Kahn-Marshall and Gallant, 2012).

Regarding our second hypothesis, findings of our review suggest that conducting a second intervention phase allows maintaining over time a higher level of stair climbing compared to baseline, especially in public settings. This is also a promising result since maintaining a long-term change in physical activity behavior represents a major challenge. In worksites, the strategies of interventions used during the first and the second phase in the included studies were diverse. This heterogeneity between studies and between phases of intervention did not allow us analyzing what sequencing of intervention is the most effective in this setting. In contrast, all studies conducted in public settings used motivational prompts during both intervention phases. The possibility to repeat low-cost and easy to implement interventions like posters (Olander and Eves, 2011a) is encouraging from a public health perspective because these interventions could be more easily extended to many public settings.

Elements on external validity were largely underreported in reviewed studies, especially information on implementation, adoption and maintenance. Such findings have been observed in other reviews of health promotion programs that used the RE-AIM framework (Dzewaltowski et al., 2004, Klesges et al., 2008, Vuillemin et al., 2011). The lack of external validity information is problematic because it limits the estimation of the potential effectiveness and successful dissemination of the interventions into practice settings (Klesges et al., 2008). It is worth noting that the RE-AIM framework is not fully adapted to stair use interventions due to the difficulty in that setting to measure indicators of the "Reach" and "Maintenance" dimensions, such as participation or attrition rate. However, when using the RE-AIM framework it is possible to restrict the analysis to the relevant dimensions available to researchers (www.re-aim.org). Future studies should systematically assess external validity with a focus on the "Effectiveness", "Adoption" and "Implementation" dimensions that fit with stair use interventions.

**Study limitations**

Our review did not include a meta-analysis given the heterogeneity of studies in terms of design and interventions. Therefore, our quantitative analysis does not provide statistical significance of results; rather, it helps to illustrate the effectiveness of different interventions and to compare it to previous reviews. Beyond that quantitative analysis, we used a harvest plot method proposed recently to synthetize evidence about the effects of heterogeneous and population-level interventions (Ogilvie et al., 2008). This method is useful because it integrates into one graphic several characteristics commonly used to assess level of evidence (study quality, sample size and effectiveness of interventions) (Barnett, 2012). We considered the harvest plot approach more relevant for evaluating stair-use interventions than a general rating system, which would have underestimate the evidence largely because of study design (non-controlled and non-randomized at individual level).

A key limitation of published studies is that they were not controlled or randomized at individual level given the inability of available measurement tools to measure stair use on an individual level. To this end, a new assessment tool could be used (Engbers et al., 2007). Each subject is given a chip card with a unique identifier and a detection device, placed behind the doors of the stairwell and elevator, detects the card and records some data (e.g. the direction, the number of floors taken, and the time of stair use). However, one disadvantage of this technology is its high cost making it difficult to use on a broad scale. Another limitation of published studies is that they did not assess the number of floors taken. This measure would be of great interest as it would help estimate the clinical significance of the increases in stair climbing observed during the interventions. Indeed, we cannot compare the +4% median change observed in our review with climbing 20 to 40 floors shown to provide health benefits (Boreham et al., 2005, Meyer et al., 2010). Better estimating the impact of stair interventions at the individual level remains a major challenge.

## Conclusion

In conclusion, results of this review emphasize the importance of separating studies by intervention setting (i.e. worksites and public settings) in assessing the effectiveness of stair interventions. The data

provide evidence that stair climbing is increased during the interventions in public settings. However, evidence of such effect is limited in worksites. They also suggest that some interventions may be recommended in each setting for greater effectiveness: in worksites, stair climbing is increased to a larger extent when directional signs supplement motivational signs; in public settings, increase in stair use appears maintained over time when interventions include two phases. Designing more effective interventions in worksites appears especially important from a public health perspective because worksites offer more opportunities to climb the stairs throughout the day than public settings and could allow a large number of people reaching the recommended level of physical activity by accumulating short bouts of physical activity. Stairwell enhancements seem promising in addition to POD prompts in this setting, and should be examined in future studies to better assess the evidence of their effectiveness. Information on external validity also needs to be better reported in future studies to help translate research results to practice.

## Conflicts of interest

The authors declare that there are no conflicts of interest.

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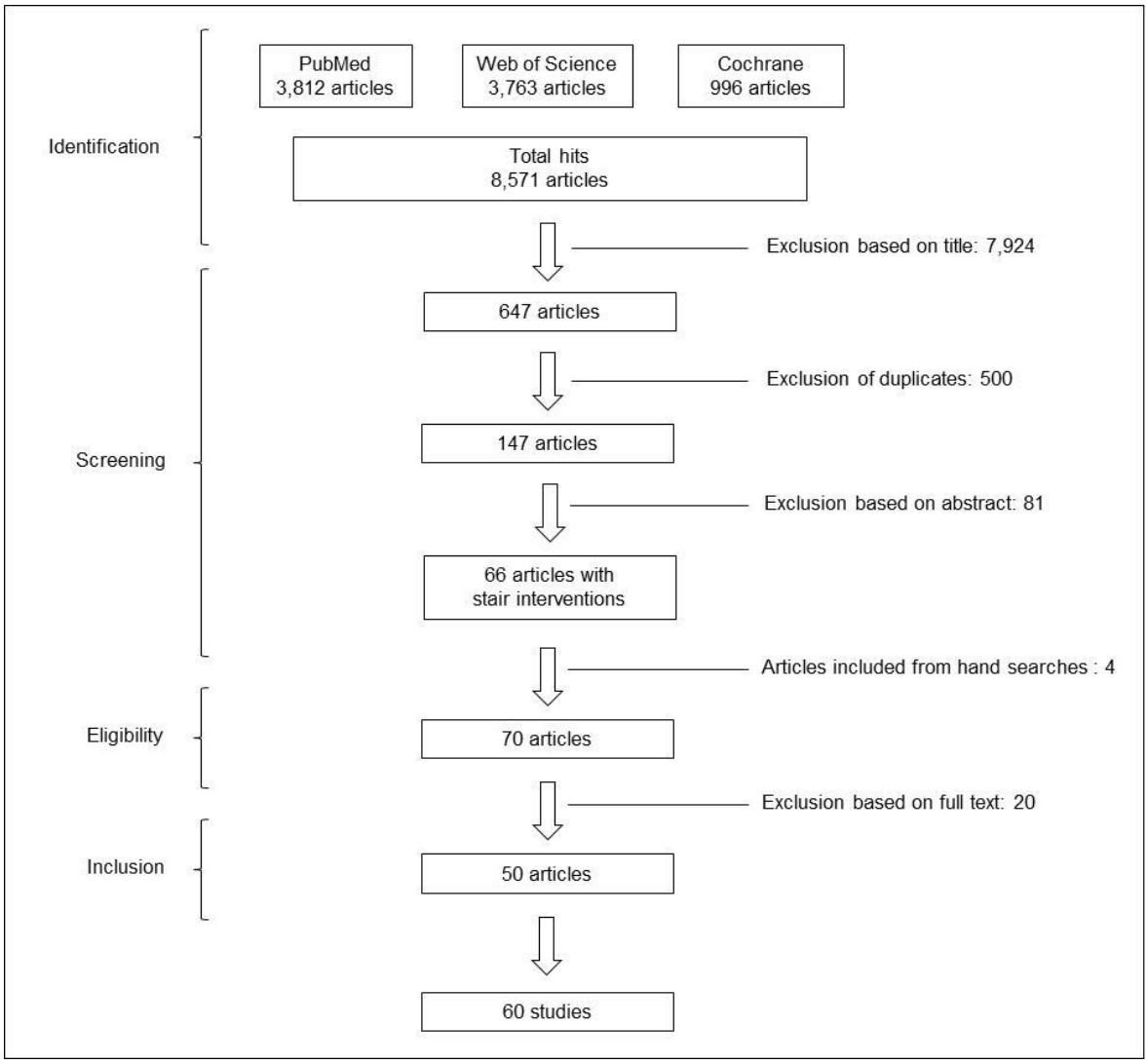



**Figure 1- Chart flow of the literature search**

**Table 1- Characteristics of the 50 articles included in the review (corresponding to 60 studies)**

| Authors | Country | Setting | Alternative to stairs | Assessment tools | Main outcome [1] | Total counts [2] | Duration of intervention (weeks) | Description of intervention (phase 1) | Description of intervention (phase 2) |
|---|---|---|---|---|---|---|---|---|---|
| (Adams and White, 2002) | UK | Worksites: university (1) [3] | Elevators | Observers | Stair use | 5,273 | 4 | POD motiv. prompts (posters) + stairwell enhancements | — |
| (Boutelle et al., 2001) | USA | Worksites: university (1) | Elevators | Observers | Stair use | 35,475 | 8 | POD motiv. prompts (posters) | POD motiv. prompts (posters) + stairwell enhancements |
| (Bungum et al., 2007) | USA | Worksites: universities (2), bank buildings (5), parking garage (1) | Elevators | Observers | Stair use | 2,050 | 4 | POD motiv. prompts (posters) | POD motiv. prompt (posters) |
| (Coleman and Gonzalez, 2001) | USA | Worksites: office building (1), university library (1) | Elevators | Observers | Stair climbing | 32,851 | 8 | POD motiv. prompts (posters) | — |
| (Cooley et al., 2008) | Australia | Worksites: government building (1) | Elevators | Automatic counters | Stair use | 62,732 | 12 | POD motiv. prompts (posters) | POD motiv. prompts (posters) |
| (Eves et al., 2006) | UK | Worksites: office building (1) | Elevators | Camera + observers | Stair climbing | 26,806 | 6 | POD motiv. + direct. prompts (posters + arrow pointed to the stairs) | — |
| (Eves et al., 2012a) | UK | Worksites: office building (1) | Elevators | Automatic counters | Stair climbing | 123,934 | 18 days | POD motiv. + direct. prompts (posters + arrow pointed to the stairs) | — |
| (Eves et al., 2012b) | UK | Worksites: city council building (1) | Elevators | Automatic counters | Stair climbing | 58,206 | 3 | site n° 1 : POD motiv. + direct. prompts (posters + arrow pointed to the stairs) | — |
| | | Worksites: water supply company (1) | Elevators | Automatic counters | Stair climbing | | 3 | site n°2 : POD motiv. + direct. prompts (posters + stair-riser banners + arrow pointed to the stairs) | — |
| (Ford and Torok, 2008) | USA | Worksites: university (1) | Elevators | Observers | Stair climbing | 18,389 | 1 | POD motiv. prompts (posters) | — |
| (Grimstvedt et al., 2010) | USA | Worksites: universities (4) | Elevators | Observers | Stair use | 8,431 | 3 | POD motiv. + direct. prompts (posters + arrow pointed to the stairs + sign attached to the door indicating stair access) | — |
| (Howie and Young, 2011) | USA | Public setting: university dormitory (1) [4] | Elevators | Observers | Stair climbing | 5,711 | 2 | POD motiv. prompts (posters) + social environment (promotion day) | — |
| (Kerr et al., 2001a) | UK | Worksites: office buildings (2) | Elevators | Camera + observers | Stair climbing | 14,982 | 2 | POD motiv. prompts (posters) | — |
| (Kwak et al., 2007) | Netherlands | Worksites: office building (1), paper factory (1) | Elevators | Observers | Stair use | 6,771 | 3 | POD motiv. prompts (posters) | — |
| (Lee et al., 2012) | USA | Worksites: health clinic (1) | Elevators | Observers | Stair climbing | 4,987 | 36 | POD motiv. prompts (posters) | — |
| | | Worksites: academic building (1) | Elevators | Observers | Stair use | 5,151 | 1 | POD motiv. prompts (posters) | — |
| | | Worksites: housing site (1) | Elevators | Observers | Stair use | 8,324 | 36 | POD motiv. prompts (posters) | POD motiv. prompts + social environment (health education event) |

**Table 1- Characteristics of the 50 articles included in the review (corresponding to 60 studies) (cont'd)**

| Authors | Country | Setting | Alternative to stairs | Assessment tools | Main outcome | Total counts | Duration of interventions (weeks) | Description of intervention (phase 1) | Description of intervention (phase 2) |
|---|---|---|---|---|---|---|---|---|---|
| (Lewis and Eves, 2012a) | UK | Worksites: universities (4) | Elevators | Observers | Stair climbing | 14,138 | 2 | POD motiv. prompts (posters) | POD motiv. + direct. prompts (posters + arrow pointed to the stairs) |
| (Marshall et al., 2002) | Australia | Worksites: hospital (1) | Elevators | Automatic counters | Stair climbing | 158,350 | 4 | POD motiv. + direct. prompts (posters + footprints) | POD motiv. + direct. prompts (posters + footprints) |
| (Olander and Eves, 2011a) | UK | Worksites: universities (4) | Elevators | Observers | Stair climbing | 4,279 | 6 days | Social environment (promotion day) | POD motiv. prompts (posters) |
| (Pillay et al., 2009) | South Africa | Worksites: university (1) | Elevators | Observers | Stair climbing | 4,256 | 1 | POD motiv. + direct. prompts (posters + footprints) | — |
| (Russell et al., 1999) | USA | Worksites: university library (1) | Elevators | Observers | Stair use | 6,216 | 5 | POD motiv. prompts (posters) | — |
| (Swenson and Siegel, 2013) | USA | Worksites: office building (1) | Elevators | Automatic counters | Stair use | NA | 6 | POD motiv. prompts (posters) + stairwell enhancements | — |
| (Vanden Auweele et al., 2005) | Belgium | Worksites: office building (1) | Elevators | Observers | Stair use | 3,146 | 2 | POD motiv. prompts (posters) | Social environment (e-mail sent by the worksite's doctor) |
| (van Nieuw-Amerongen et al., 2011b) | Netherlands | Worksites: university (1) | Elevators | Camera + observers | Stair climbing | 21,786 | 4 | POD motiv. + direct. prompts (posters + stair-riser banners + footprints) + stairwell enhancements | — |
| (Andersen et al., 1998) | USA | Public setting: shopping mall (1) | Escalators | Observers | Stair climbing | 17,901 | 8 | POD motiv. prompts (posters) | POD motiv. prompts (posters) |
| (Andersen et al., 2006) | USA | Public setting: train station (1) | Escalators | Observers | Stair climbing | 16,035 | 3 | POD motiv. prompts (posters) | POD motiv. prompts (posters) |
| (Andersen et al., 2008) | USA | Worksites: scientific meeting (1) [4] | Escalators | Observers | Stair climbing | 16,978 | 1 day | POD motiv. prompts (posters) | — |
| (Blamey et al., 1995) | UK | Public setting: train station (1) | Escalators | Observers | Stair climbing | 22,275 | 3 | POD motiv. prompts (posters) | — |
| (Boen et al., 2010) | Belgium | Public setting: shopping mall (1) | Escalators | Observers | Stair climbing | 1,437 | 2 days | POD motiv. prompts (posters) | POD motiv. prompts (posters) |
| | | Public setting: train station (1) | Escalators | Observers | Stair climbing | 2,869 | 2 days | POD motiv. prompts (posters) | POD motiv. prompts (posters) |
| (Brownell et al., 1980) | USA | Public setting: shopping mall (1), train station (1), bus terminal (1) | Escalators | Observers | Stair climbing | 21,091 | 4 | POD motiv. prompts (posters) | POD motiv. prompts (posters) |
| | | Public setting: train station (1) | Escalators | Observers | Stair climbing | 24,603 | 3 | POD prompts (posters) | — |
| (Coleman and Gonzalez, 2001) | USA | Public setting: airport (1), bank (1) | Escalators | Observers | Stair climbing | 82,302 | | POD prompts (posters) | — |

**Table 1- Characteristics of the 50 articles included in the review (corresponding to 60 studies) (cont'd)**

| Authors | Country | Setting | Alternative to stairs | Assessment tools | Main outcome | Total counts | Duration of interventions (weeks) | Description of intervention (phase 1) | Description of intervention (phase 2) |
|---|---|---|---|---|---|---|---|---|---|
| (Eves et al., 2008a) (study n°2) | Hong-Kong (China) | Public setting: shopping mall (1) | Escalators | Observers | Stair climbing | 18,257 | 2 | POD motiv. prompts (stair-riser banners) | — |
| (Eves et al., 2008b) (study n°3) | Hong-Kong (China) | Public setting: shopping mall (1) | Escalators | Observers | Stair climbing | 18,257 | 2 | POD motiv. prompts (stair-riser banners) | — |
| (Eves et al., 2009) | UK | Public setting: train station (1) | Escalators | Observers | Stair climbing | NA | 3.5 | POD motiv. prompts (stair-riser banners) | — |
| (Iversen et al., 2007) | Denmark | Public setting: train stations (2) | Escalators | Observers | Stair climbing | 32,082 | 1 | POD motiv. prompts (posters) | — |
| (Kerr et al., 2000) | UK | Public setting: shopping malls (2) | Escalators | Interviewers | Stair climbing | 658 | 6 | POD motiv. prompts (posters) | — |
| (Kerr et al., 2001b) | UK | Public setting: shopping mall (1) | Escalators | Observers | Stair climbing | 12,018 | 4 | POD motiv. prompts (posters | — |
| | | Public setting: shopping mall (1) | Escalators | Observers | Stair climbing | 11,961 | 4 | POD motiv. prompts (posters) | POD motiv. prompts (posters + stair-riser banners) |
| (Kerr et al., 2001c) | UK | Public setting: shopping mall (1) | Escalators | Observers | Stair climbing | 45,361 | 12 | POD motiv. prompts (stair-riser banners) | — |
| (Kerr et al., 2001d) | UK | Public setting: shopping mall (1) | Escalators | Observers | Stair climbing | 23,665 | 6 | POD motiv. prompts (stair-riser banners) | — |
| (Kerr et al., 2001e) | UK | Public setting: shopping mall (1) | Escalators | Observers | Stair climbing | 13,934 | 2 | POD motiv. prompts (posters) | — |
| | | Public setting: shopping mall (1) | Escalators | Observers | Stair climbing | 16,084 | 6 | POD motiv. prompts (posters) | POD motiv. prompts (posters) |
| | | Public setting: train station (1) | Escalators | Observers | Stair climbing | 25,319 | 4 | POD motiv. prompts (posters) | POD motiv. prompts (posters) |
| | | Public setting: shopping mall (1) | Escalators | Observers | Stair climbing | 12,588 | 4 | POD motiv. prompts (posters) | POD motiv. prompts (posters) |
| (Lewis and Eves, 2011) | UK | Public setting: train station (1) | Escalators | Observers | Stair climbing | 23,121 | 8 | POD motiv. prompts (posters) | POD motiv. prompts (posters) |
| (Lewis and Eves, 2012b) | UK | Public setting: train station (1) | Escalators | Observers | Stair climbing | 48,697 | 3 | POD motiv. prompts (posters) | — |
| (Lewis and Eves, 2012c) | UK | Public setting: train station (1) | Escalators | Observers | Stair climbing | 38,187 | 16 | POD motiv. prompts (posters) | POD motiv. prompts (posters) |
| (Muller-Riemenschneider et al., 2010) | Germany | Public setting: train stations (3) | Escalators | Observers | Stair climbing | 5,467 | 8 | POD motiv. prompts (posters) | — |
| (Nomura et al., 2009) | Japan | Public setting: train station (1) | Escalators | Observers | Stair use | 43,241 | 4 | POD motiv. prompts (posters + stair-riser banners) + social environment (written information in a newspaper) | — |
| (Olander et al., 2008) | UK | Public setting: train station (1) | Escalators | Observers | Stair climbing | 36,239 | 14 | POD motiv. prompts (stair-riser banners) | POD motiv. prompts (posters + stair-riser banners) |
| (Puig-Ribera and Eves, 2010) | Spain | Public setting: train station (1) | Escalators | Observers | Stair climbing | 33,119 | 6 | POD motiv. prompts (posters) | POD motiv. prompts (posters) |
| (Russell and Hutchinson, 2000) | USA | Public setting: airport (1) | Escalators | Observers | Stair climbing | 3,369 | 2 | POD motiv. prompts (posters) | POD motiv. prompts (posters) |

**Table 1- Characteristics of the 50 articles included in the review (corresponding to 60 studies) (cont'd)**

| Authors | Country | Setting | Alternative to stairs | Assessment tools | Main outcome | Total counts | Duration of interventions (weeks) | Description of intervention (phase 1) | Description of intervention (phase 2) |
|---|---|---|---|---|---|---|---|---|---|
| (Ryan et al., 2011) | UK | Public setting: train stations (2) | Escalators | Observers | Stair climbing | 20,315 | 4 | POD motiv. prompts (posters) | — |
| (Webb and Eves, 2005) | UK | Public setting: shopping mall (1) | Escalators | Observers | Stair climbing | 32,597 | 4 | POD motiv. prompts (stair-riser banners) | POD motiv. prompts (stair-riser banners) |
| (Webb and Eves, 2007a) | UK | Public setting: shopping mall (1) | Escalators | Observers | Stair climbing | 81,948 | 6 | Stairwell enhancements | POD motiv. prompts (stair-riser banners) |
| (Webb and Eves, 2007b) | UK | Public setting: shopping mall (1) | Escalators | Observers | Stair climbing | 77,266 | 13 | POD motiv. prompts (stair-riser banners) | — |
| (Webb and Cheng, 2010) | UK | Public setting: shopping mall (1) | Escalators | Observers | Stair climbing | 20,807 | 5 | POD motiv. prompts (stair-riser banners) | — |

POD = point-of-decision prompts, POD motiv. prompts = POD motivational prompts, POD motiv. and direct. prompts = POD motivational and directional prompts.

1- For studies measuring both stair climbing and stair descent, we have reported only the outcome of stair climbing. 2- Number of people who used the stairs and the elevator or escalator during the study. 3- The number in brackets indicates the number of locations in which the intervention was conducted. 4- The study by Howie and Young (2011), conducted in an university dormitory, was coded under worksites because the alternative to stairs was an elevator. Conversely, the study by Andersen et al. (2008), realized in a convention center, was coded under public settings because the alternative to stairs was an escalator rather than an elevator.

## Table 2 – Summary of results on quality assessment

| | **Study design** n (%) | **Confounders** n (%) | **Blinding** n (%) | **Data collection methods** n (%) | **Global rating** n (%) |
|---|---|---|---|---|---|
| **Studies conducted in worksites** (n = 25) | | | | | |
| Strong quality | 0 (0%) | 0 (0%) | 0 (0%) | 7 (28%) | 0 (0%) |
| Moderate quality | 15 (60%) | 4 (16%) | 6 (24%) | 15 (60%) | 3 (12%) |
| Weak quality | 10 (40%) | 21 (84%) | 19 (76%) | 3 (12%) | 22 (88%) |
| **Studies conducted in public settings** (n = 35) | | | | | |
| Strong quality | 0 (0%) | 11 (31%) | 0 (0%) | 12 (34%) | 0 (0%) |
| Moderate quality | 26 (74%) | 14 (40%) | 0 (0%) | 23 (66%) | 19 (54%) |
| Weak quality | 9 (26%) | 10 (29%) | 35 (100%) | 0 (0%) | 16 (46%) |

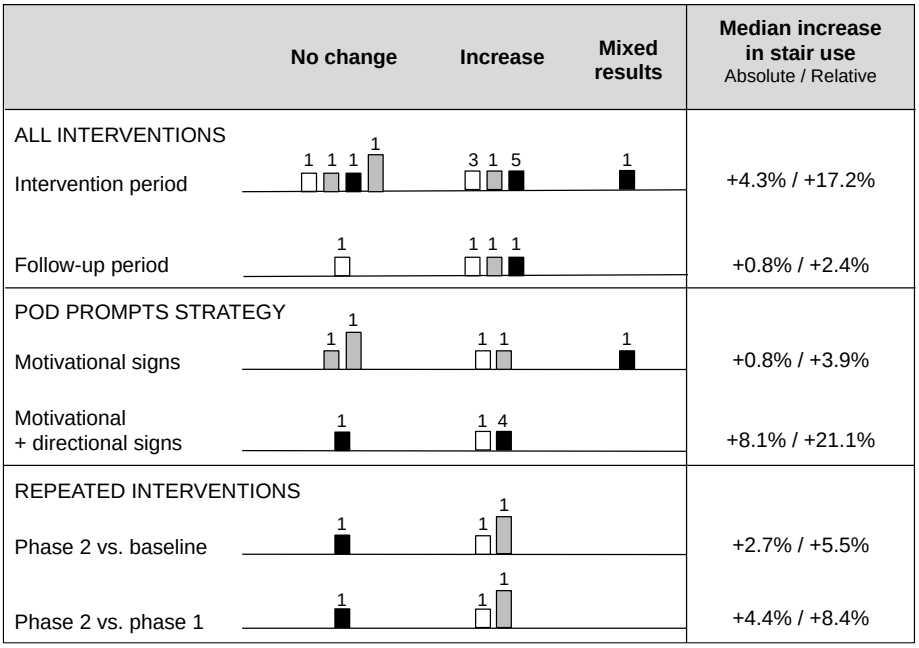



**Figure 2a - Evidence for changes of stair climbing in worksites**

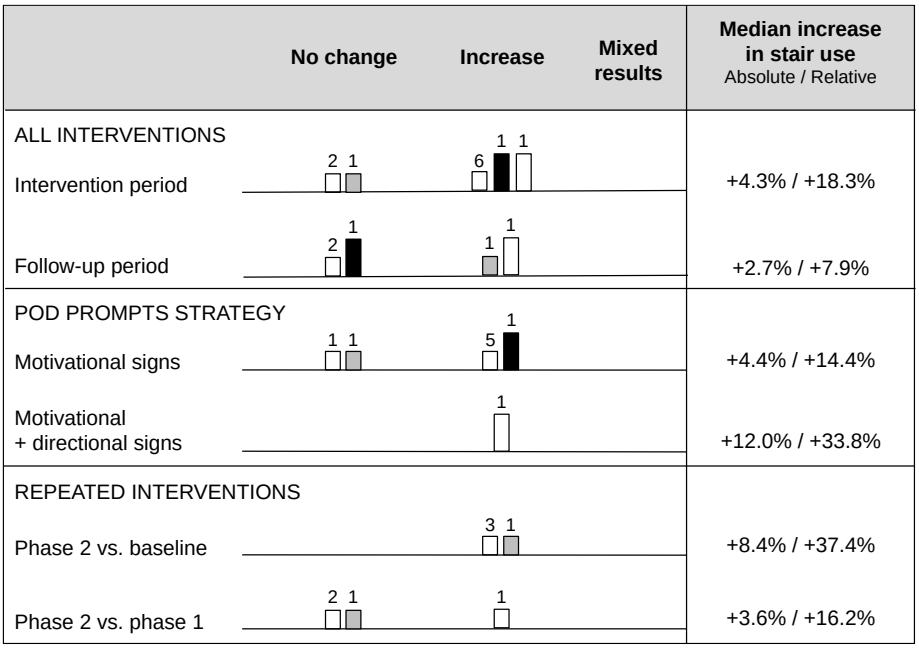


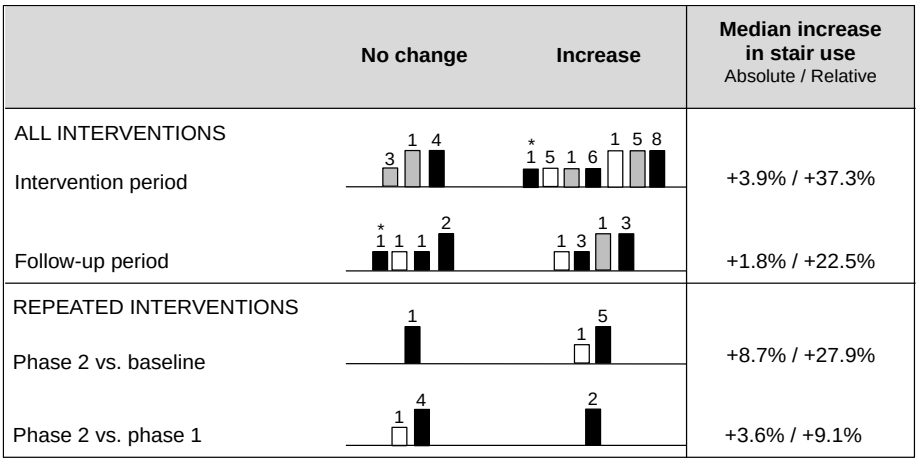

**Figure 2b - Evidence for changes of stair use in worksites**

As no study reported a decrease in stair use, we did not represent the hypothesis of decrease in stair use.

The height of the bar indicates the study quality (short = weak quality, medium = moderate quality, tall = strong quality). The color of the bar indicates the sample size (white: < 10,000; grey: 10,000 to ≤ 20,000; black: > 20,000). Numbers above the bras refer to study citations.

The median increase in stair use is calculated from all studies (i.e. which found an increase in stair use, ~~or~~ no change or mixed results).

**Figure 2 - Evidence for changes in stair climbing and stair use during and after interventions in worksites**




As no study reported a decrease in stair use or mixed results, we did not represent those hypotheses in the figure.

The bar with the asterisk represents the only study measuring stair use (Nomura et al., 2009).

The height of the bar indicates the study quality (short = weak quality, medium = moderate quality, tall = strong quality). The color of the bar indicates the sample size (white: < 10,000; grey: 10,000 to ≤ 20,000; black: > 20,000). Numbers above the bras refer to study citations.

The median increase in stair use is calculated from all studies (i.e. which found an increase or no change in stair use).

**Figure 3 - Evidence for changes of stair climbing and stair use in public settings**

**Table 3- Number and percentage of 60 studies reporting external validity dimensions (using the RE-AIM framework)**

| | **All settings** n (%)[1] | **Worksites** n (%)[2] | **Public settings** n (%)[3] |
|---|---|---|---|
| ***Reach*** | | | |
| *Individual participants* | | | |
| Target audience description | 0 (0%) | 0 (0%) | 0 (0%) |
| Individual inclusion/exclusion criteria | 0 (0%) | 0 (0%) | 0 (0%) |
| Participation rate | 13 (22%) | 8 (32%) | 5 (14%) |
| Representativeness of participants | 1 (2%) | 1 (4%) | 0 (0%) |
| ***Efficacy*** | | | |
| Outcomes compared to standard goal | 0 (0%) | 0 (0%) | 0 (0%) |
| Adverse consequences | 1 (2%) | 1 (4%) | 0 (0%) |
| Effect moderator by participant characteristic(s) | 45 (75%) | 13 (52%) | 32 (91%) |
| Effect moderator by staff/setting | 28 (47%) | 9 (36%) | 19 (54%) |
| ***Adoption*** | | | |
| *Setting level* | | | |
| Target setting description | 0 (0%) | 0 (0%) | 0 (0%) |
| Setting inclusion/exclusion criteria | 0 (0%) | 0 (0%) | 0 (0%) |
| Participation rate | 0 (0%) | 0 (0%) | 0 (0%) |
| Representativeness of setting | 0 (0%) | 0 (0%) | 0 (0%) |
| *Delivery staff* | | | |
| Participation rate | 0 (0%) | 0 (0%) | 0 (0%) |
| ***Implementation*** | | | |
| Consistent implementation of program | 3 (5%) | 2 (8%) | 1 (3%) |
| Staff expertise or training | 3 (5%) | 2 (8%) | 1 (3%) |
| Implementation differed by staff | 0 (0%) | 0 (0%) | 0 (0%) |
| Program adaptation | 1 (2%) | 1 (4%) | 0 (0%) |
| Number of sessions or time needed to deliver interventions | 1 (2%) | 1 (4%) | 0 (0%) |
| Costs | 2 (3%) | 1 (4%) | 1 (3%) |
| ***Maintenance*** | | | |
| Long-term effects (at least 6 months) | 1 (2%) | 0 (0%) | 1 (3%) |
| Program sustainability | 0 (0%) | 0 (0%) | 0 (0%) |
| Attrition rate | 0 (0%) | 0 (0%) | 0 (0%) |
| Differential attrition by condition tested | 0 (0%) | 0 (0%) | 0 (0%) |
| Drop-out representativeness | 0 (0%) | 0 (0%) | 0 (0%) |

1- The total number of included studies was 60. 2- The number of included studies was 25. 3- The number of included studies was 35.

**Supplementary Table 1- Quality assessment of studies (using the Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies 2003)**

| | Adams and White, 2002 | Andersen et al., 1998 | Andersen et al., 2006 | Andersen et al., 2008 | Blamey et al., 1995 | Boen et al., 2010 (study 1) | Boen et al., 2010 (study 2) | Boutelle et al., 2001 | Brownell et al., 1980 (study 1) | Brownell et al., 1980 (study 2) | Bungum et al., 2007 | Coleman and Gonzalez, 2001 (study 1) | Coleman and Gonzalez, 2001 (study 2) | Cooley et al., 2008 | Eves et al., 2006 | Eves et al., 2008a | Eves et al., 2008b |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Study design** | | | | | | | | | | | | | | | | | |
| Question 1 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 7 | 7 | 6 | 7 | 7 | 7 |
| Rating | M | M | M | M | M | M | M | M | M | M | M | W | W | M | W | W | W |
| **Confounders** | | | | | | | | | | | | | | | | | |
| Question 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Question 3 | 3 | 1 | 1 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 3 | 2 | 2 | 2 |
| Rating | W | S | S | M | W | W | W | W | S | S | W | W | W | W | M | M | M |
| **Blinding** | | | | | | | | | | | | | | | | | |
| Question 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| Question 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Rating | W | W | W | W | W | W | W | W | W | W | W | W | W | M | W | W | W |
| **Data collection tools** | | | | | | | | | | | | | | | | | |
| Question 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Question 7 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 3 |
| Rating | M | M | M | M | M | M | M | S | M | M | M | S | S | M | M | M | M |
| **Global rating** | Weak | Moderate | Moderate | Moderate | Weak | Weak | Weak | Weak | Moderate | Moderate | Weak | Weak | Weak | Moderate | Weak | Weak | Weak |

| | Eves et al., 2009 | Eves et al., 2012a | Eves et al., 2012b (study 1) | Eves et al., 2012b (study 2) | Ford and Torok, 2008 | Grimstvedt et al., 2010 | Howie and Young, 2011 | Iversen et al., 2007 | Kerr et al., 2000 | Kerr et al., 2001a | Kerr et al., 2001b (study 1) | Kerr et al., 2001b (study 2) | Kerr et al., 2001c | Kerr et al., 2001d | Kerr et al., 2001e (study 1) | Kerr et al., 2001e (study 2) | Kerr et al., 2001e (study 3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Study design** | | | | | | | | | | | | | | | | | |
| Question 1 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 7 | 7 | 7 | 6 | 6 | 7 | 7 | 6 | 6 |
| Rating | W | W | W | W | M | M | M | M | W | W | W | M | M | W | W | M | M |
| **Confounders** | | | | | | | | | | | | | | | | | |
| Question 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Question 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 2 | 2 |
| Rating | W | W | W | W | W | M | W | W | W | W | M | M | S | S | M | M | M |
| **Blinding** | | | | | | | | | | | | | | | | | |
| Question 4 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Question 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Rating | W | M | M | M | W | W | W | W | W | W | W | W | W | W | W | W | W |
| **Data collection tools** | | | | | | | | | | | | | | | | | |
| Question 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Question 7 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Rating | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M | M |
| **Global rating** | Weak | Weak | Weak | Weak | Weak | Moderate | Weak | Weak | Weak | Weak | Weak | Moderate | Moderate | Weak | Weak | Moderate | Moderate |

**Supplementary Table 1- Quality assessment of studies (using the Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies 2003) (cont'd)**

| | Kerr et al., 2001e (study 4) | Kwak et al., 2007 | Lee et al., 2012 (study 1) | Lee et al., 2012 (study 2) | Lee et al., 2012 (study 3 | Lewis and Eves, 2011 | Lewis and Eves, 2012a | Lewis and Eves, 2012b | Lewis and Eves, 2012c | Marshall et al., 2002 | Muller-Riemenschneider et al., 2010 | Nomura et al., 2009 | Olander et al., 2008 | Olander and Eves, 2011a | Pillay et al., 2009 | Puig-Ribera and Eves, 2010 | Russel et al., 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Study design** | | | | | | | | | | | | | | | | | |
| Question 1 | 6 | 6 | 6 | 7 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 7 |
| Rating | M | M | M | W | M | M | M | M | M | M | M | M | M | M | M | M | W |
| **Confounders** | | | | | | | | | | | | | | | | | |
| Question 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Question 3 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 1 | 2 |
| Rating | M | W | W | W | W | M | M | M | M | W | W | W | M | W | W | S | M |
| **Blinding** | | | | | | | | | | | | | | | | | |
| Question 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Question 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Rating | W | W | W | W | W | W | W | W | W | M | W | W | W | W | W | W | W |
| **Data collection tools** | | | | | | | | | | | | | | | | | |
| Question 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Question 7 | 3 | 3 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 3 | 3 | 1 | 1 | 1 | 3 | 1 | 1 |
| Rating | M | M | S | S | S | S | M | S | S | W | M | S | S | S | M | S | S |
| **Global rating** | Moderate | Weak | Weak | Weak | Weak | Moderate | Moderate | Moderate | Moderate | Weak | Weak | Weak | Moderate | Weak | Weak | Moderate | Weak |

| | Russel and Hutchinson, 2000 | Ryan et al., 2011 | Swenson and Siegel, 2013 | Vanden Auweele et al., 2005 | van Nieuw-Amerongen et al., 2011 | Webb and Eves, 2005 | Webb and Eves, 2007a | Webb and Eves, 2007b | Webb and Cheng, 2010 |
|---|---|---|---|---|---|---|---|---|---|
| **Study design** | | | | | | | | | |
| Question 1 | 6 | 6 | 7 | 6 | 7 | 6 | 6 | 6 | 7 |
| Rating | M | M | W | M | W | M | M | M | W |
| **Confounders** | | | | | | | | | |
| Question 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Question 3 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 |
| Rating | M | W | W | W | W | S | S | S | S |
| **Blinding** | | | | | | | | | |
| Question 4 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Question 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Rating | W | W | M | W | W | W | W | W | W |
| **Data collection tools** | | | | | | | | | |
| Question 6 | 1 | 1 | 3 | 1 | 3 | 1 | 1 | 1 | 1 |
| Question 7 | 1 | 1 | 3 | 3 | 3 | 1 | 1 | 1 | 1 |
| Rating | S | S | W | W | W | S | S | S | S |
| **Global rating** | Moderate | Weak | Weak | Weak | Weak | Moderate | Moderate | Moderate | Weak |

S = strong, M = moderate, W = weak
Question 1 = Indicate the study design (*1- randomized controlled trial, 2- controlled clinical trial, 3- cohort analytic, 4- case control, 5- cohort, 6- interrupted time series, 7- other*), Question 2 = Were there important differences between groups prior to the intervention ? (*1- Yes, 2- No, 3- Can't tell*), Question 3 = If yes, indicate the percentage of relevant

confounders that were controlled (*1- 80-100%, 2- 60-79%, 3- < 60%, 4- can't tell*), Question 4 = Was the outcome assessor aware of the intervention or exposure status of participants? (*1- Yes, 2- No, 3- Can't tell*), Question 5 = Were the study participants aware of the research question? (*1- Yes, 2- No, 3- Can't tell*), Question 6 = Were data collections tools shown to be valid? (*1-Yes, 2- No, 3- Can't tell*), Question 7 = Were data collection tools shown to be reliable? (*1-Yes, 2- No, 3- Can't tell*).

For question 3, 6 relevant confounders were defined for studies conducted in public settings: gender, age, ethnicity, weight status, presence of bags and pedestrian traffic volume. For studies conducted in worksites, 4 confounders were added: time of day (when continuous measures or at different times of day, i.e. morning and afternoon, were realized), height of the building, number of lifts and distance between the entrance to the elevator and the stairs (when more than one building were available for the analyses).

**Supplementary Table 2 - Percentages of stair use and stair climbing during the baseline period, the first and second intervention phases and the follow-up period (for each of 84 study arms)**

| | Baseline | Intervention phase 1 | | | Intervention phase 2 | | | | Follow-up | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Stair use (%) | Strategy | Stair use (%) | | OR (95% CI) Vs. baseline | Strategy | Stair use (%) | | OR (95% CI) vs. baseline *vs. phase 1* | Stair use (%) | | OR (95% CI) |
| **Studies conducted in worksites** | | | | | | | | | | | | |
| **Outcome = stair use** | | | | | | | | | | | | |
| Adams and White, 2002 | 20.1 | MP + SE | 20.6 | ns | / | / | / | | / | / | | / |
| Boutelle et al., 2001 | 11.1 | MP | 12.7 | ns | / | MP + SE | 15.5 | (+) | / | 13.8 | (+) | / |
| Bungum et al., 2007 | 22.8 | MP | 38.4 | (+) | / | MP | 30.8 | (+) | / | NA | ns | / |
| Cooley et al., 2008 | NA | MP | NA | ns | 0.60 (0.30-1.10) | MP | NA | ns | 1.00 (0.50-1.90) | NA | ns | 1.10 (0.50-2.10) |
| Grimstvedt et al., 2010 | 35.5 | MDP | 47.5 | (+) | 1.65 (1.47-1.85) | / | / | | / | 48.9 | (+) | 1.75 (1.51-2.03) |
| Kwak et al., 2007 (study arm 1) | 45.6 | MP | 48.2 | (+) | / | / | / | | / | 49.2 | (+) | / |
| Kwak et al., 2007 (study arm 2) | 24.0 | MP | 28.4 | (+) | / | / | / | | / | 24.5 | ns | / |
| Lee et al., 2012 (study 2) | 25.1 | MP | 33.8 | (+) | / | / | / | | / | / | | / |
| Lee et al., 2012 (study 3) | 13.0 | MP | 17.4 | (+) | / | MP + Se | 21.8 | (+) | / | / | | / |
| Russel et al., 1999 | 37.9 | MP | 41.9 | (+) | / | / | / | | / | / | | / |
| Swenson and Siegel, 2013 | 31.5 | MP + SE | 66.2 | (+) | / | / | / | | / | / | | / |
| Vanden Auweele et al., 2005 | 69.0 | MP | 77.0 | (+) | / | Se | 85.0 | (++) | / | 67.0 | ns | / |
| **Outcome = stair climbing** | | | | | | | | | | | | |
| Coleman and Gonzalez, 2001 (study arm 1) | 35.7 | MP | 36.1 | (+) | / | / | / | | / | 35.8 | (+) | / |
| Coleman and Gonzalez, 2001 (study arm 2) | 33.2 | MP | 30.7 | (-) | / | / | / | | / | 34.0 | (+) | / |
| Eves et al., 2006 | NA | MDP | NA | (+) | 1.12 (1.02-1.23) | / | / | | / | / | | / |
| Eves et al., 2012b (study 1) | 33.8 | MDP | 41.0 | (+) | 1.24 (1.15-1.34) | / | / | | / | / | | / |
| Eves et al., 2012b (study 2) | 50.0 | MDP | 62.3 | (+) | 1.52 (1.40-1.66) | / | / | | / | / | | / |
| Eves et al., 2012a | 22.9 | MDP | 21.3 | ns | 0.96 (0.92-1.00) | / | / | | / | / | | / |
| Ford and Torok, 2008 | 23.6 | MP | 28.0 | (+) | / | / | / | | / | 28.6 | (+) | / |
| Howie and Young, 2011 | 24.9 | MP + Se | 33.2 | (+) | / | / | / | | / | 25.4 | ns | / |
| Kerr et al., 2001a (study arm 1) | 20.7 | MP | 21.5 | ns | 1.04 (0.92-1.18) | / | / | | / | / | | / |
| Kerr et al., 2001a (study arm 2) | 19.0 | MP | 23.2 | ns | 1.22 (0.96-1.55) | / | / | | / | / | | / |
| Lee et al., 2012 (study 1) | 56.0 | MP | 67.3 | (+) | / | / | / | | / | / | | / |
| Lewis and Eves, 2012a | 59.4 | MP | 55.1 | ns | 0.93 (0.85-1.02) | MDP | 60.1 | (++) | 1.23 (1.14-1.32) *1.30 (1.20-1.42)* | / | | / |
| Marshall et al., 2002 | NA | MDP | NA | (+) | 1.05 (1.01-1.10) | MDP | NA | ns | 0.97 (0.93-1.01) | / | | / |
| Olander and Eves, 2011a | 47.9 | Se | 48.8 | ns | 1.02 (0.88-1.19) | MP | 52.6 | (++) | 1.20 (1.06-1.37) *1.19 (1.02-1.39)* | / | | / |
| Pillay et al., 2009 | 43.0 | MDP | 52.0 | (+) | / | / | / | | / | 50.0 | (+) | / |
| van Nieuw-Amerongen et al., 2011 | 51.8 | MP + SE | 60.0 | (+) | / | / | / | | / | / | | / |
| **Studies conducted in public settings** | | | | | | | | | | | | |
| **Outcome = stair use** | | | | | | | | | | | | |
| Nomura et al., 2009 | 3.6 | MP + Se | 5.8 | (+) | / | / | / | | / | NA | Ns | / |
| **Outcome = stair climbing** | | | | | | | | | | | | |
| Andersen et al., 1998 | 4.8 | MP | 6.9 | (+) | / | / | / | | / | / | | / |
| Andersen et al., 2006 | 15.8 | MP | 21.5 | (+) | / | / | / | | / | / | | / |
| Andersen et al., 2008 | 21.9 | MP | 29.3 | (+) | / | / | / | | / | 26.8 | (+) | / |
| Blamey et al., 1995 | 8.0 | MP | 16.0 | (+) | / | / | / | | / | NA | (+) | / |
| Boen et al., 2010 (study 1) | 1.7 | MP | 11.7 | (+) | / | / | / | | / | / | | / |
| Boen et al., 2010 (study 2) | 35.2 | MP | 43.8 | (+) | / | MP | 47.8 | (+) | / | / | | / |
| Brownell et al., 1980 (study 1) | 5.3 | MP | 13.7 | (+) | / | MP | 15.0 | (+) | / | / | | / |
| Brownell et al., 1980 (study 2) | 11.6 | MP | 18.3 | (+) | / | / | / | | / | 11.9 | ns | / |
| Coleman and Gonzalez, 2001 (study arm 3) | 1.7 | MP | 4.6 | (+) | / | / | / | | / | 2.9 | (+) | / |
| Coleman and Gonzalez, 2001 (study arm 4) | 3.8 | MP | 6.1 | (+) | / | / | / | | / | 4.3 | (+) | / |
| Eves et al., 2008a | 1.7 | MP | 1.8 | ns | 1.02 (0.74-1.41) | / | / | | / | / | | / |
| Eves et al., 2008b | NA | MP | NA | ns | / | / | / | | / | / | | / |
| Eves et al., 2009 (study arm 1) | 39.7 | MP | 40.8 | (+) | 1.10 (1.02-1.19) | / | / | | / | / | | / |
| Eves et al., 2009 (study arm 2) | 41.7 | MP | 40.5 | ns | 0.98 (0.91-1.06) | / | / | | / | / | | / |
| Eves et al., 2009 (study arm 3) | 40.6 | MP | 41.0 | ns | 1.00 (0.95-1.06) | | / | | / | / | | / |
| Iversen et al., 2007 (study arm 1) | 23.0 | MP | 31.0 | (+) | 1.50 | / | / | | / | 25.0 | ns | / |
| Iversen et al., 2007 (study arm 2) | 12.0 | MP | 16.0 | (+) | 1.50 | / | / | | / | / | | / |
| Kerr et al., 2000 | NA | MP | NA | (+) | / | / | / | | / | NA | ns | / |
| Kerr et al., 2001b (study 1) | 2.2 | MP | 4.5 | (+) | / | / | / | | / | / | | / |
| Kerr et al., 2001b (study 2) | 2.4 | MP | 4.0 | (+) | / | / | / | | / | / | | / |
| Kerr et al., 2001c | NA | MP | NA | (+) | / | / | / | | / | NA | (+) | 1.29 (1.14-1.47) |
| Kerr et al., 2001d | 8.1 | MP | 18.4 | (+) | 2.27 (2.05-2.51) | / | / | | / | / | | / |
| Kerr et al., 2001e (study 1) | 8.0 | MP | 7.3 | ns | 0.91 (0.79-1.05) | / | / | | / | / | | / |
| Kerr et al., 2001e (study 2) | 3.0 | MP | 2.9 | ns | 0.95 (0.71-1.27) | / | / | | / | / | | / |
| Kerr et al., 2001e (study 3) | 38.1 | MP | 41.9 | (+) | 1.12 (1.05-1.20) | MP | 45.7 | (++) | 1.22 (1.15-1.31) *1.09 (1.02-1.15)* | / | | / |
| Kerr et al., 2001e (study 4) | 7.4 | MP | 11.0 | (+) | 1.49 (1.26-1.76) | / | / | | / | / | | / |
| Lewis and Eves, 2011 | NA | MP | NA | ns | 1.30 (0.94-1.80) | MP | NA | ns | / | / | | / |
| Lewis and Eves, 2012b (study arm 1) | 39.5 | MP | 41.4 | (+) | 1.07 (1.01-1.13) | / | / | | / | NA | ns | 0.97 (0.93-1.02) |
| Lewis and Eves, 2012b (study arm 2) | 41.9 | MP | 42.4 | ns | 0.99 (0.94-1.04) | / | / | | / | NA | ns | 1.00 (0.94-1.06) |
| Lewis and Eves, 2012c | NA | MP | NA | ns | 0.99 (0.87-1.13) | MP | NA | (++) | 1.20 (1.08-1.33) *1.15 (1.02-1.29)* | / | | / |
| Muller-Riemenschneider et al., 2010 | 23.7 | MP | 29.0 | (+) | / | / | / | | / | 30.0 | (+) | / |
| Olander et al., 2008 | 40.6 | MP | 40.9 | ns | 1.00 (0.95-1.05) | MP | 44.3 | (+) | 1.36 (1.16-1.60) | / | | / |
| Puig-Ribera and Eves, 2010 | NA | MP | NA | (+) | 1.50 (1.27-1.78) | MP | NA | (+) | 1.35 (1.13-1.60) | NA | (+) | 1.22 (1.01-1.48) |
| Russel and Hutchinson, 2000 | 8.2 | MP | 14.9 | (+) | / | / | / | | / | / | | / |
| Ryan et al., 2011 (study arm 1) | 12.2 | MP | 16.9 | (+) | / | / | / | | / | 17.4 | ns | / |
| Ryan et al., 2011 (study arm 2) | 7.1 | MP | 11.6 | (+) | / | / | / | | / | 8.7 | ns | / |
| Webb and Eves, 2005 | 7.0 | MP | 14.2 | (+) | / | / | / | | / | / | | / |
| Webb and Eves, 2007a | NA | MP | NA | ns | 0.88 (0.77-1.01) | MP | NA | (+) | 2.90 (2.55-3.29) | / | / | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Webb and Eves, 2007b | 5.3 | MP | 14.6 | (+) | 2.76 (2.44-3.12) | / | / | / | NA | (+) | 1.67 (1.44-1.94) |
| Webb and Cheng, 2010 | NA | MP | NA | (+) | 1.28 (1.08-1.53) | / | / | / | / | | / |

OR = Odds ratio, CI = confidence interval, MP = motivational prompts, MDP = motivational and directional prompts, SE = stairwell enhancement, Se = Social environment, / = not measured, NA = not available, ns = non significant, (+) = increase in stair use or stair climbing from baseline ($p<0.05$), (++) = increase in stair use or stair climbing from baseline and from phase 1 ($p<0.05$), (-) decrease in stair use or stair climbing from baseline ($p<0.05$).